Environmental Impact Assessment for STC Limestone Quarry in Mandalay Region, Myanmar

Shwe Taung Cement Company Ltd

Environmental Impact Assessment Report

February 2024

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Summary: This document presents the Environmental Impact Assessment Report for STC Limestone Quarry in Mandalay Region, Myanmar.	Date: 28 November 2022 Approved by: Piers Touzel *Partner*

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Ministry of Natural Resources and Environmental Conservation

Office No. (53), Nay Pyi Taw, Myanmar

Attn: Director General

Environmental Conservation Department

Re: Environmental Impact Assessment (EIA) Report for Limestone Quarry in Mandalay Region

Dear Sir,

We refer to the EIA, which was prepared by Environmental Resources Management (ERM) during 2019-2022 in accordance with the Environmental Conservation Law, Rules and Procedure under the instruction of Ministry of Natural Resources and Environmental Conservation and formally submitted by Ministry of Natural Resources and Environmental Conservation to Environmental Conservation Department under letter dated on 24/04/2018.

Intending to be legally bound hereby and financially liable to the Ministry of Natural Resources and Environmental Conservation hereunder, we:

Endorse and confirm to Ministry of Natural Resources and Environmental Conservation

a. The accuracy and completeness of the EIA,
b. Confirm and undertake to Ministry of Natural Resources and Environmental Conservation that the EIA has been prepared in strict compliance with applicable Environmental Conservation Law, Rules and Procedures and
c. Confirm and undertake to Ministry of Natural Resources and Environmental Conservation that the project company established by Shwe Taung Mining Co., Ltd in respect of the Limestone Quarry shall at all time comply fully with: (i) any and all commitments and obligations as set forth in the EIA, and (ii) any and all plans and the various components thereof, including without limitation, impact avoidance, mitigation, and remediation measures and with respect to both (i) and (ii), including but not limited to such commitments, obligations, plans and measures as related to the development, construction, commissioning, operation and maintenance of the project, and any circumstance in which work done or to be done, or services performed or to be performed, in connection with the project's development, construction, commissioning, operation and maintenance is carried out or intended or required to be carried out by any contractor, subcontractor or other party.

By .....

Kyaw Naing Soe

Deputy Managing Director

Shwe Taung Mining Co., Ltd.

၁ အကျဉ်းချုပ် အစီရင်ခံစာ

၁.၁ နိဒါန်း

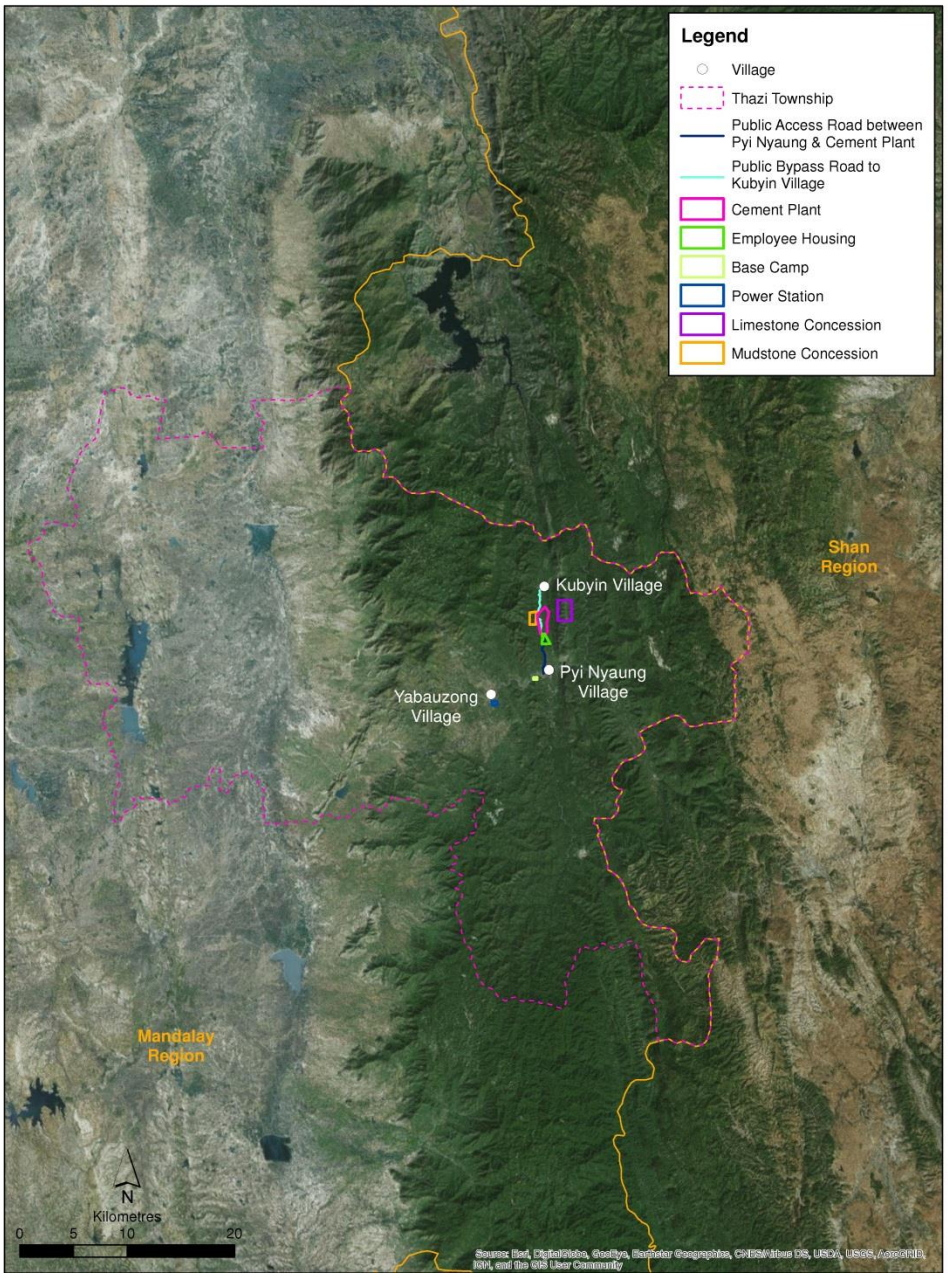
Shwe Taung Cement Company Ltd. (STC) သည် မြန်မာနိုင်ငံ၌ ကက္ကာမျိုးစုံတွင် စီးပွားရေးလုပ်ငန်းအမျိုးမျိုးတို့ကို ပိုင်ဆိုင်လုပ်ကိုင်လည်ပတ်နေသော **Shwe Taung Group** (STG) ၏ အစိတ်အပိုင်းတစ်ရပ်အနေဖြင့် မြန်မာနိုင်ငံ၊ မွန္တလေးတိုင်းဒေသကြီး၊ သာစည်မြို့နယ်၊ ပြည်ညောင်ကျေးရွာတွင် ၎င်း၏တည်ရှိနေပြီးသော ထုံးကျောက်ကျင်၌ ထုံးကျောက်တိုးချဲ့ထုတ်လုပ်မှု တစ်ရပ်ကို ဆောင်ရွက်ရန် စီစဉ်လျက် ရှိပါသည် (စီမံကိန်း)။ စီမံကိန်းသည် ထုံးကျောက်ထုတ်လုပ်မှုကို နှစ်စဉ် တန် ၇၁၅,၀၀၀ မှ တန် ၂,၃၁၅,၀၀၀ ထိ တိုးချဲ့ထုတ်ယူရန် ရည်ရွယ်ပါသည်။ စီမံကိန်းတည်နေရာ ကို *ပုံ ၁.၁* တွင် ဖော်ပြထားပါသည်။

STC သည် ထုံးကျောက်ကျင်းစီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း (EIA) ကို ဆောင်ရွက်ရန် **Environmental Resources Management (ERM)-Hong Kong, Limited** ထံသို့ တာဝန်လွှဲအပ်ပြီး ဖြစ်ပါသည်။

ထုံးကျောက်ကျင်းသည် STC ဘိလပ်မြေစက်ရုံ၏ အရှေ့ဘက် ၅ ကီလိုမီတာခန့် တွင် တည်ရှိပါသည် (*ပုံ ၁.၁* တွင်ကြည့်ပါ)။ ထုံးကျောက်ကျင်း နှင့် STC ဘိလပ်မြေစက်ရုံ အနောက်ဘက်ရှိ ရွှံ့ကျောက်ကျင်း နှင့် စစ်ကိုင်းတိုင်းဒေသကြီး၊ ကလေးဝမြို့နယ်ရှိ ကျောက်မီးသွေးသတ္တုတွင်းတို့ သည် ကုန်ကြမ်းများကို ထောက်ပံ့ပေးလျက် STC ဘိလပ်မြေစက်ရုံ တိုးချဲ့မှုကို အထောက်အပံ့ ပြုသွားမည် ဖြစ်ပါသည်။ STC ဘိလပ်မြေစက်ရုံတိုးချဲ့မှု၊ ရွှံ့ကျောက်ကျင်း နှင့် ကျောက်မီးသွေး သတ္တုတွင်းတို့ကို သီးခြား ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း အစီရင်ခံစာသုံးစောင်ဖြင့် ဆန်းစစ်ထား ပါသည်။ သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန၏ ၁၉-၁၀-၂၀၁၇ ရက်စွဲပါ စာအမှတ် (သစ်တော) ၃(၂)/၁၆(ဃ)(၃၃၅၉/၂၀၁၇) ဖြင့် ပြန်လည်ပေးပို့လာသော သုံးသပ်အကြံပြုချက်များအရ STM သည် ယခင်တင်ပြခဲ့သော ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာမှ လုပ်ငန်း တစ်ခုချင်းစီအတွက် သီးခြားအစီရင်ခံစာ (၄) အုပ်ကို ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာနသို့ ၂၀၁၈ ခုနှစ်တွင် ထပ်မံတင်သွင်းခဲ့ပါသည်။ ERM သည် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း စိစစ်သုံးသပ်ရေးအဖွဲ့၏ အစည်းအဝေးမှတ်ချက်များအပြီးတွင် ၂၀၁၉ ခုနှစ် မှ ၂၀၂၂ ခုနှစ်အတွင်း ရရှိထားသော မှတ်ချက်များနှင့်အညီ ထုံးကျောက်လုပ်ကွက်အတွက် ပတ်ဝန်းကျင်ထိ ခိုက်မှု ဆန်းစစ်ခြင်း အစီရင်ခံစာကို မွမ်းမံပြင်ဆင်ထားပြီး ပြင်ဆင်ထားသောအချက်များကို နောက်ဆက်တွဲ-V တွင် ဖော်ပြအပ်ပါသည်။ ၂၀၂၂ ခုနှစ် ဒီဇင်ဘာလတွင် ERM မှ STM အတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း အကြံပေးဝန်ဆောင်မှုကို ရပ်ဆိုင်းခဲ့ပြီး ၎င်းတို့ ပြင်ဆင် ဆောင်ရွက်ထားရှိသည့် EIA အစီရင်ခံစာကို STM သို့ လွှဲပြောင်းပေးခဲ့ပါသည်။ ယခုအခါ STM သည် အမှတ်(၁) သတ္တုတွင်းလုပ်ငန်း၏ ၂၀-၀၂-၂၀၂၄ ရက်စွဲပါ စာအမှတ် ၆/၂ (ECD)/၁/၂၀၂၄(၂၄၄၅) အရ ပြန်လည်ပြင်ဆင်ထားသော ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းအစီရင်ခံစာကို အမှတ် (၁) သတ္တုတွင်းလုပ်ငန်းသို့ ပေးပို့တင်ပြခြင်းဖြစ်ပါသည်။

ယခုစာတမ်းမှာ အဆိုပြုထုံးကျောက်ကျင်းတိုးချဲ့မှုဆိုင်ရာစီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းအစီရင်ခံစာ ဖြစ်ပါသည်။

ပုံ ၁.၁ STC ထုံးကျောက် ကျင်း တည်နေရာပြပုံ



၁.၂ *မူဝါဒ နှင့် ကြီးကြပ်ရေးဆိုင်ရာမူဘောင်*

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံ *ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဥပဒေ* ၏ *ပုဒ်မ ၇* နှင့် *ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးနည်းဥပဒေ* ၏ *ပုဒ်မ ၅၂* နှင့် *၅၃* တို့အရ၊ STC သည် အဆိုပြု ရှာဖွေရေး လုပ်ငန်းများအတွက် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဆိုင်ရာ လိုက်နာဆောင်ရွက်မှု သက်သေခံ လက်မှတ် (ECC) ကို ရရှိရန် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း (EIA) ကို ပြုလုပ်ဆောင်ရွက်ရန် လိုအပ်ပါသည်။

စီမံကိန်းကို အမျိုးသားအဆင့် စည်းမျဉ်းစည်းကမ်းများနှင့် နိုင်ငံတကာ စံနှုန်းများ နှင့်အညီ ဆောင်ရွက်သွား မည် ဖြစ်ပါသည်။ EIA နှင့်စပ်လျဉ်းသည့် ဒေသဥပဒေများတွင် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဥပဒေ (၂၀၁၂)၊ ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးနည်းဥပဒေများ (၂၀၁၄)၊ အမျိုးသား ပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန်ချက်များ (၂၀၁၅)၊ နှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆိုင်ရာ လုပ်ထုံး လုပ်နည်း (၂၀၁၅) တို့ပါဝင်ကြပါသည်။

အပြီးသတ် မြန်မာ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ထုံးလုပ်နည်း ကို ၂၀၁၅ ဒီဇင်ဘာ လ တွင် ထုတ်ပြန်ခဲ့ခြင်းနှင့်အတူ၊ အမျိုးသားပတ်ဝန်းကျင်အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန် ချက်များကိုလည်း ထုတ်ပြန်ခဲ့ပါသည်။ ညစ်ညမ်းမှုကို တားဆီးရန် နှင့် ပတ်ဝန်းကျင်နှင့် အများပြည် သူကျန်းမာရေးကို ကာကွယ်ရန် စီမံကိန်းများမှ ထွက်ရှိလာသည့် စွန့်ပစ်ရည်များ၊ အသံ နှင့် အခိုးအငွေ့ ထုတ်လွှတ်မှုတို့ကို ထိန်းချုပ်ရန် စည်းကမ်းချက်များအတွက် အခြေခံအချက်အလက် များကို ဤလမ်းညွှန်ချက်များမှ ပြဋ္ဌာန်းပေးပါသည်။ ဤစံနှုန်းများသည် ကမ္ဘာ့ဘဏ်အုပ်စု (WBG) ၏ အထွေထွေ သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ၊ ကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံရေး (EHS)ဆိုင်ရာ လမ်း ညွှန်ချက်များ (၂၀၀၇) နှင့် တူညီပါသည်။

၁.၃ *စီမံကိန်း အကြောင်းအရာဖော်ပြချက် နှင့် အခြားနည်းလမ်းရွေးချယ်မှုများ*

ထုံးကျောက်ကျင်းသည် မန္တလေးတိုင်းဒေသကြီးအတွင်းရှိ သာစည်မြို့နယ် ပြည်ညောင် ကျေးရွာ နှင့် ကူပြင်ဇရိယာ၏ သာပြည့် (Tha Pyae) တောင်တန်း၏ တောင်ကြောပေါ်ရှိ သစ်တောဇရိယာ အ တွင်း တည်ရှိပါသည် (*ပုံ ၁.၁* တွင် ကြည့်ပါ)။ ၂၀၁၁ မတ်လ ၃၁ ရက် ကတည်းက နှစ်စဉ် အသစ်ပြု လုပ်သည့် သစ်တောဦးစီးဌာနမှ မြေငှားသဘောတူစာချုပ်နှင့် ထုံးကျောက်ထုတ်လုပ်မှုအတွက် STC သို့ အရွယ်အစား ဇက ၆၀၀ ပိုင်ခွင့်ကို လျာထားပေးခဲ့ပြီး၊ ၂၀၁၀ ဒီဇင်ဘာလ ၂၂ ရက်မှ စတင်၍ ၂၅ နှစ်ကြာအတွက် သတ္တုတွင်းဝန်ကြီးဌာနမှ ထုတ်လုပ်မှုဝေမျှရေးစနစ်ဖြင့် ထုံးကျောက်အကြီးစား ထုတ်လုပ်မှုအတွက် လည်ပတ်ဆောင်ရွက်ရေးသဘောတူ စာချုပ်များကို ချုပ်ဆိုခဲ့ပါသည်။

ထုံးကျောက်ထုတ်လုပ်ရာတွင် တူးယူမှု နှင့် ဖောက်ခွဲမှုနည်းလမ်းကိုအသုံးပြု၍ ဆောင်ရွက်ပါသည်။ ထုတ်ယူပြီးသော ထုံးကျောက်များကို ထရပ်ကားဖြင့် ထုံးကျောက်ကြိတ်ခြေရေးနေရာသို့ သယ်ယူပို့ဆောင်ပါသည်။ ၎င်းနေရာတွင် ကြိတ်ခြေပြီး၊ အသုံးမပြုမီ သိုလှောင်ထားပါသည်။ STC ဘိလပ်မြေ စက်ရုံရှိ လက်ရှိထုတ်လုပ်မှုအတွက် တစ်နှစ်လျှင် ထုံးကျောက် ၇၁၅,၀၀၀ တန်ခန့် လိုအပ်ပါသည်။

စီမံကိန်းတိုးချဲ့မှုအတွက် ကျောက်ကျင်းမှ ထုံးကျောက်များကို ထရပ်ကားများနေရာရှိ ထုံးကျောက် ကြိတ်ခြေသည့် ကိရိယာထံသို့ သယ်ယူရန် သယ်ပို့ပေးသည့်စက်ကို တည်ဆောက်သွားမည် ဖြစ်ပါ

သည်။ လုပ်ပိုင်ခွင့်ရှိသည့်နေရာ ကို နောက်ထပ် လိုအပ်သော သစ်တောများကို ရှင်းလင်းလျှက် ပင်လယ်ရေမျက်နှာပြင်အမြင့် ~ ၇၅၀ မီတာ မှ ၅၅၀ မီတာ သို့ လျော့ချထုတ်ယူသွားမည်ဟု ခန့်မှန်း ထားပါသည်။ ကျန်ရှိသော ထုံးကျောက်ကျင်းသက်တမ်းမှာ ၂၀၁၂ ဖွန်လ မှစ၍ ၂၀၁၇ အောက်တို ဘာလ ထိ ထုံးကျောက်ထုတ်လုပ်မှုကိုပါထည့်တွက်ပြီး၊ STC ဘိလပ်မြေစက်ရုံတိုးချဲ့ဆောက်လုပ်မှု လည်ပတ်သည်နှင့်တစ်ပြိုင်နက် တစ်နှစ်လျှင် တန် ၂.၃၁၅ သန်းရှိ မြင့်မားသည့် တူးဖော်မှုနှုန်းအပေါ် အခြေခံလျှက် ၃၇ နှစ်ခန့်ရှိမည် ဖြစ်ပါသည်။

စီမံကိန်းသည် လက်ရှိဆောင်ရွက်နေသော ကျောက်ကျင်းနေရာကို တိုးချဲ့ဆောင်ရွက်မှုဖြစ်သဖြင့်၊ စီမံကိန်းနေရာအတွက် ဖြစ်နိုင်ခြေရှိသော အခြားနေရာ ရွေးချယ်ဆောင်ရွက်နိုင်မှု မရှိပါ။ ကြိတ်ခြေမှု ကိရိယာကို တပ်ဆင်မှုသည် တူးဖော်ထားသော ကျောက်များကို သယ်ယူရန် ယာဉ်အသုံးပြုမှုကို လျော့ကျစေသောကြောင့် လောင်စာအသုံးပြုမှုအရ ပိုမိုအကျိုးရှိမည် ဖြစ်ပါသည်။

၁.၄ *အခြေခံအချက်အလက်များ*

ရွေးချယ်ထားသော မျိုးခွဲအုပ်စုများအတွက် အခြေခံမျိုးကွဲများနားလည်မှုကို ရရှိနိုင်ရန် ထုံးကျောက် ကျင်းနေရာရှိ အခြေခံ ဇီဝမျိုးစုံမျိုးကွဲ ကွင်းဆင်းစစ်တမ်းကောက်ယူမှုကို ဆောင်ရွက်ခဲ့ပါသည်။ *ဇယား ၁.၁* တွင် ၂၀၁၄ က ကောက်ယူခဲ့သော စစ်တမ်းများ နှင့် ၂၀၁၇ က ကောက်ယူခဲ့သော စစ်တမ်းများ၊ ၎င်းတို့၏ ပစ်မှတ် မျိုးခွဲများ နှင့် ဆောင်ရွက်ခဲ့သည့် နေ့စွဲတို့ကို ဖော်ပြထားပါသည်။

ဇယား ၁.၁ ထုံးကျောက်ကျင်းဌ ဆောင်ရွက်ခဲ့သည့် စစ်တမ်းများ

ပစ်မှတ်ထားသည့် ဇီဝအုပ်စု	ကောက်ယူမှုနည်းလမ်း အကျဉ်း	တိုင်းတာသည့် နေ့စွဲ	စစ်တမ်းကောက်သူ
ထုံးကျောက်ကျင်း			
ငှက်၊ ကုန်းနေရေနေသတ္တဝါများ၊ နို့တိုက်သတ္တဝါ နှင့် ဒေသရင်းအပင်များ	ကန့်လန့်ဖြတ်လျှောက် တိုင်းတာမှု အင်တာဗျူးများ	၂၀၁၄ မတ်လ မှ ဖေဖြော်လ ထိ	National Engineering & Planning Services Co., Ltd, Myanmar
ငှက်၊ ကုန်းနေရေနေသတ္တဝါများ၊ သစ်ပင်နေ နို့တိုက်သတ္တဝါ /ပရိုင်းမိတ် နှင့် မြေပေါ်နေ နို့တိုက်သတ္တဝါများ	ကန့်လန့်ဖြတ်လျှောက် တိုင်းတာမှု အင်တာဗျူးများ	၂၀၁၇ ဇန်နဝါရီလ ၂၇ မှ ၃၁ ရက်နေ့ ထိ	Dr Christian Matauschek (FFI မှ ကန်ထရိုက်ချုပ်သည်)
ဒေသရင်းအပင်များ	ကန့်လန့်ဖြတ်လျှောက် တိုင်းတာမှု	၂၀၁၇* ဇန်နဝါရီလ ၃၁ ရက် မှ ဖေဖော်ဝါရီလ ၇ ရက် ထိ	Dr Win Myint (FFI မှ ကန်ထရိုက်ချုပ်သည်)
ခရုများ	မြေဆီလွှာ နမူနာကောက်ခြင်း ခရုခွံများ ကောက်ယူ လေ့လာခြင်း	၂၀၁၇ ဖေဖော်ဝါရီလ ၁၃ ရက် မှ ဖေဖော်ဝါရီလ ၁၉ ရက်နေ့ထိ	Dr Jaap Vermeulin (ERM မှ ကန်ထရိုက်ချုပ်သည်)
တွားသွားသတ္တဝါများ	ရွေးချယ်ထားသော နေရာများတွင် ပစ်မှတ်ထားသော စစ်တမ်းကောက်ယူခြင်း	၂၀၁၇ မတ်လ ၈ ရက် မှ မတ်လ ၁၀ ရက်နေ့ ထိ ၂၀၁၇ အောက်တိုဘာလ ၁၁ ရက် မှ အောက်တိုဘာလ ၁၂ ရက်နေ့ ထိ	Dr Lee Grismer (FFI မှ ကန်ထရိုက်ချုပ်သည်)
ထုံးကျောက်အပိုင်းအခြား ဒေသရင်းအပင်များ	ရွေးချယ်ထားသော နေရာများတွင် ပစ်မှတ်ထားသော စစ်တမ်းကောက်ယူခြင်း	၂၀၁၇ ဖေဖော်ဝါရီလ ၁၃ ရက် မှ ၁၉ ရက်နေ့ ထိ ၂၀၁၇ ဩဂုတ်လ ၁၆ ရက် မှ ၂၀ ရက်နေ့ ထိ	Dr Jaap Vermeulin (ERM မှ ကန်ထရိုက်ချုပ်သည်)

မြေနေရာအမျိုးအစားအလိုက်အတွင်း မျိုးစိတ်အစုအဝေးများအပေါ်နှားလည်မှုဖြင့်၊ ၎င်းမြေနေရာများ၏ ယေဘုယျအရည်အသွေး ကွင်းဆင်းလေ့လာမှုများနှင့် ဖြည့်စွက်လျက် သဘာဝ-ပြုပြင်မြေနေရာအမျိုးအစားများကို IFC PS6 (IFC, 2012a, IFC 2012b) အရ သတ်မှတ်ခဲ့ပါသည်။ ထုံးကျောက်ကျင်းသည် သဘာဝမြေနေရာ ၂၃၅.၅၈ ဟက်တာ နှင့် ပြုပြင်မြေနေရာ ၁၁၈.၇၉ ဟက်တာ တို့ဖြင့် ဖုံးလွှမ်းနေပါသည်။ နောက်ထပ် အထူးအရေးပါသောမြေနေရာ (CH) စီစစ်မှုဆန်းစစ်ခြင်းမှ ဖော်ထုတ်သတ်မှတ်ထားသည့် ထုံးကျောက်ကျင်းအတွက် မျိုးစိတ် (၇) မျိုးမှာ CH မျိုးစိတ်များဖြစ်ကြပါသည်(*ဇယား ၁.၂* တွင်ကြည့်ပါ)။ ၎င်းအထူးအရေးပါမြေနေရာများကို ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ၏ ထိခိုက်မှုလေ့လာချက်တစ်ရပ်အဖြစ် ထည့်သွင်းစဉ်းစားခဲ့ပါသည်။ IFC လုပ်ဆောင်မှုစံသတ်မှတ်ချက်များ ၆တွင် သတ်မှတ်ထားသည့်အတိုင်း ထုံးကျောက်ကျင်း နေရာတွင် အထူးအရေးပါသော မြေနေရာတို့ပါဝင်သည်ဟု ထည့်သွင်းစဉ်းစားပါသည်။

အပြီးသတ်ကျက်စားရာနေရာများဆန်းစစ်ခြင်း၏ စံသတ်မှတ်ချက် (၁) မှ (၅) ကို နောက်ဆက်တွဲ "ယ-၂" တွင် ဖော်ပြထားပါသည်။

ဇယား ၁.၂ ဒေအထူးအရေးပါသော ကျက်စားရာနေရာများ ဆန်းစစ်ခြင်းအကျဉ်းချုပ်ဖော်ပြချက်

စဉ်	သိပ္ပံအမည် (မျိုးစိတ်)	မြန်မာအမည်	အပြည်ပြည်ဆိုင်ရာ သဘာဝထိန်းသိမ်းရေး အဖွဲ့စာရင်းဝင်
ထုံးကျောက်ကျင်း			
၁	*Manis pentadactyla*	တရုတ်သင်းခွေချပ်	CR
၂	*Trachypithecus phayrei shanicus*	ရှမ်းမျောက်ညို	
၃	*Dalbergia oliveri*	နံသာနီ	EN
၄	*Trachypithecus phayrei* spp. *shanicus*	ရှမ်းပြည်နယ် မျောက်ညို	EN

လူမှုစီးပွားရေး ရှုထောင့်အရ၊ ထုံးကျောက်ကျင်းဇရိယာသည် ယခင်တည်းကဝင်ခွင့်မပြုသောနေရာဖြစ် ပါသည်။ ထိုကြောင့် ထုံးကျောက်ကျင်းသည် ဒေသခံလူထု၏ အသက်မွေးဝမ်းကျောင်းလုပ်ငန်းများ အပေါ် သက်ရောက်မှု မရှိခဲ့ပါ။

ထိခိုက်မှုဆန်းစစ်ခြင်း နှင့် အဆိုပြုလျော့ချရေးအစီအမံများ

ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းတွင် လက်ရှိလည်ပတ်နေသော စီမံကိန်းတိုးချဲ့ခြင်းမှ သက်ရောက်မှုများကို လျော့ချနိုင်ရန် ဖြစ်ပေါ်လာနိုင်သော သက်ရောက်မှုများနှင့် အဆိုပြုလျော့ချရေး အစီအမံတို့ကို ဆန်းစစ်ခဲ့ပြီးဖြစ်ပါသည်။ အကြံပြုထားသော လျော့ချရေးအစီအမံများကို စနစ်တကျ အကောင်အထည်ဖော် ဆောင်ရွက်ခြင်းဖြင့် အထူးအရေးပါပြီး ထိခိုက်ဆုံးရှုံးသွားသော ဇီဝမျိုးစုံမျိုးကွဲများအား ပြန်လည်အစားထိုး စောင့်ရှောက်မှု အစီအစဉ် အရ ပြန်လည်အစားထိုးမှု ဆောင်ရွက်ရန်လိုအပ်သည့် ထုံးကျောက်ကျင်း လည်ပတ်မှုကြောင့် မြေနေရာများ ဆုံးရှုံးခြင်း မှလွဲ၍ စီမံကိန်း၏ လည်ပတ်မှုမှ ဖြစ်ပေါ်လာနိုင်သည့် ကြွင်းကျန်ပတ်ဝန်းကျင် နှင့် လူမှုဘဝ အပေါ် သက်ရောက်မှုများသည် အတန်အသင့် အရေးပါမှု အဆင့်ထက်

ကြီးမားမည် မဟုတ်ကြောင်း ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းတွင် နိဂုံးချုပ် ထားပါသည်(*ဇယား ၁.၃* တွင်ကြည့်ပါ)။

ဇယား ၁.၃ ထုံးကျောက်ကျင်း တည်ဆောက်ရေး နှင့် လည်ပတ်ရေး ကာလ တို့အတွက် ထိခိုက်မှုဆန်းစစ်ခြင်း ဆိုင်ရာ အကျဉ်းဖော်ပြချက်

အကြောင်းအရာ	သက်ရောက်မှုအကျဉ်း	သက်ရောက်မှု၏ အရေးပါမှု *(လျော့ချရေး နှင့် စီမံခန့်ခွဲရေး အစီအမံများ အကောင်အထည်ဖော် မဆောင်ရွက်မီ)*	ကြွင်းကျန်သက်ရောက်မှု၏ အရေးပါမှု *(နောက်ထပ်လျော့ချရေး နှင့် စီမံခန့်ခွဲရေး အစီအမံများ အကောင်အထည်ဖော် ဆောင်ရွက်ပြီးနောက်)*
လေထုအရည်အသွေး	စီမံကိန်းမှထုတ်လွှတ်သော $PM_{2.5}$ နှင့် PM_{10} တို့မှသက်ရောက်မှုများ	အရေးပါသော (အလုပ်သမားများနေထိုင်ရာ နေရာ) သာမည မှ မပြောပလောက်သော (ကျပြင် နှင့်ပြည်ဘောင်ရွာများ)	သာမည မှ မပြောပလောက်သော
မြေပေါ်ရေ အရည်အသွေး	လုပ်ငန်းလည်ပတ်ရေးကာလ တွင် စွန့်ပစ်ရေ နှင့် စီးဆင်းရေ တို့ကြောင့် မြေပေါ်ရေ အရည်အသွေးအပေါ် သက်ရောက်မှုများ	အရေးပါသော	သာမည မှ အတန်အသင့်ဖြစ်သော အဆင့်
စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲမှု	လုပ်ငန်းလည်ပတ်ရေးကာလ တွင် စွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှုမှ သက်ရောက်မှုများ	အတန်အသင့်ဖြစ်သော	သာမည်ဖြစ်သော
ဇီဝမျိုးစုံမျိုးကွဲ	လုပ်ငန်းလည်ပတ်မှုကြောင့် နေရင်းဒေသများ အရည်အသွေးကျဆင်းမှု	အတန်အသင့်ဖြစ်သော	မပြောပလောက်သော
	လုပ်ငန်းလည်ပတ်မှုကြောင့် မျိုးစိတ်များ အပေါ် သက်ရောက်မှုများ	အတန်အသင့်ဖြစ်သော	မပြောပလောက်သော
	လုပ်ငန်းလည်ပတ်မှုကြောင့် စားကျက်မြေများ အမြဲတမ်း နှင့် ယာယီ ဆုံးရှုံးခြင်း	အထူးအရေးပါသော	အထူးအရေးပါသော
	လုပ်ငန်းလည်ပတ်မှုကြောင့်သဘာဝအပင်နှင့်ေ တာရိုင်းတိရိစ္ဆာန်များ အစိတ်စိတ် အမြွှာမြွှာဖြစ်ခြင်း နှင့် ပြန့်ကျဲခြင်း (fragmentation and edge effects)	အတန်အသင့် မှ အရေးပါသော အဆင့်	သာမည်ဖြစ်သော
လုပ်ငန်းခွင် ကျန်းမာ ရေးနှင့် ဘေးကင်း လုံခြုံရေး	လုပ်ငန်း လည်ပတ်မှုကြောင့် လုပ်သားများကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံရေးအပေါ် သက်ရောက်မှုများ	အတန်အသင့်ဖြစ်သော	သာမည်ဖြစ်သော
ရှုခင်း နှင့် အမြင်သာယာမှု အပေါ် သက်ရောက်မှုများ	စီမံကိန်း၏ ရှုခင်း နှင့် အမြင်သာယာမှု အပေါ် သက်ရောက်မှုများ	အတန်အသင့်ဖြစ်သော	မပြောပလောက်သော မှ အတန်အသင့်ဖြစ်သော
မြေဆီလွှာ	အမှုန်များလွင့်ပါးခြင်းမှ မြေဆီလွှာအပေါ် သက်ရောက်မှု	မပြောပလောက်သော	မပြောပလောက်သော

၁.၆ *အများပြည်သူများနှင့် တိုင်ပင်ဆွေးနွေးခြင်း နှင့် ထုတ်ဖော်တင်ပြခြင်း*

၂၀၁၆ နိုဝင်ဘာလ မှ ၂၀၁၇ ဇူလိုင်လ အတွင်း သက်ဆိုင်သူများနှင့် တိုင်ပင်ဆွေးနွေးမှုကို ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း၏ အစိတ်အပိုင်းတစ်ရပ်အဖြစ် ဆောင်ရွက်ခဲ့ပါသည်။

စီမံကိန်းအတွက် အချက်အလက်ကွာဟချက်များကို ဖြည့်သွင်းနိုင်ရေး နှင့် ထိခိုက်ခံစားရနိုင်သည့် အုပ်စုများ နှင့် တစ်ဦးချင်းပုဂ္ဂိုလ်များ၏ အမြင်များ၊ စိုးရိမ်မှုများ နှင့် သဘောထားများကို နားလည်ပြီး ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအတွက် ထည့်သွင်းအသုံးပြုရန် ၎င်းတိုင်ပင်ဆွေးနွေးမှုများမှ အထောက်အကူ ဖြစ်စေနိုင်ပါသည်။

အတိုချုပ်ဆိုရလျှင်၊ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းမူကြမ်းအတွက် အောက်ပါ တိုင်ပင်ဆွေးနွေးမှုတို့ကို ဆောင်ရွက်ခဲ့ပါသည် (*ဇယား ၁.၄* တွင်ကြည့်ပါ)။

- ၂၀၁၆ နိုဝင်ဘာလ နယ်ပယ်အတိုင်းအတာသတ်မှတ်မှုကာလအတွင်း ပြည်ညောင် နှင့် ကူပြင် ကျေးရွာတို့ရှိ ကျေးရွာခေါင်းဆောင်များနှင့် တိုင်ပင်ဆွေးနွေးခြင်း။
- ၂၀၁၇ ဇန်နဝါရီလတွင် ပြည်ညောင် နှင့် ကူပြင်ကျေးရွာတို့တွင် ရပ်ရွာအစည်းအဝေးများ။
- ၂၀၁၇ ဇန်နဝါရီလတွင် ပြည်ညောင် နှင့် ကူပြင်ကျေးရွာတို့တွင် အိမ်ထောင်စု ၁၀၀ ကို စစ်တမ်းကောက်ယူခြင်း။
- ၂၀၁၇ ဇန်နဝါရီလတွင် ပြည်ညောင် နှင့် ကူပြင်ကျေးရွာတို့တွင် အမျိုးသမီးများ နှင့် လယ်သမားများနှင့် အဖွဲ့လိုက်ဆွေးနွေးခြင်း။
- ၂၀၁၇ ဇန်နဝါရီလတွင် ထိခိုက်ဆုံးရှုံးသွားသော ဇီဝမျိုးစုံမျိုးကွဲများ ပြန်လည်အစားထိုးစောင့်ရှောက်နိုင်သော နေရာ တည်ဆောက်မှုနှင့်စပ်လျဉ်း၍ Flora and Fauna International နှင့် သားငှက်ထိန်းသိမ်းရေးအဖွဲ့ (WCS) တို့နှင့် တိုင်ပင်ဆွေးနွေးခြင်း။
- ၂၀၁၇ ခုနှစ်၊ ဩဂုတ်လတွင် အပြည်ပြည်ဆိုင်ရာသဘာဝထိန်းသိမ်းရေးအဖွဲ့(ICUN) ၊ မြန်မာ့စီးပွားရေးကဏ္ဍ တာဝန်ယူမှုရှိရေး အထောက်အကူပြုဌာန (MCRB) နှင့် သားငှက်ထိန်းသိမ်းရေးအဖွဲ့ (WCS) တို့နှင့်ဆွေးနွေးခြင်း။
- ရွေးချယ်ထားသော ထိခိုက်ဆုံးရှုံးသွားသည့် ဇီဝမျိုးစုံမျိုးကွဲများ ပြန်လည်အစားထိုးစောင့်ရှောက်နိုင်သော နေရာနှစ်ခုကို စီမံခန့်ခွဲမှုအတွက် သစ်တော ဦးစီးဌာနက ကိုယ်စားလှယ်များ နှင့် MONREC တို့နှင့် တိုင်ပင်ဆွေးနွေးခြင်း။

ဇယား ၁.၄ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းမူကြမ်း ပြင်ဆင်ရေးသားရေးအတွက် ဆောင်ရွက်ခဲ့သည့် ဆွေးနွေးတိုင်ပင်မှုများ

နေ့စွဲ	ကျေးရွာအမည်	ကျေးရွာအုပ်စု	ကျေးရွာအုပ်စုတွင် တိုင်ပင်ဆွေးနွေးခဲ့သည့် အိမ်ထောင်စု အရေအတွက်
၁၇-၁-၁၇	ကူပြင် နှင့် ပြည်ညောင်	ပြည်ညောင်	ကျေးရွာခေါင်းဆောင်များ နှင့် အစည်းအဝေးပြု လုပ်ခြင်း နှင့် လူမှုစီးပွား စစ်တမ်း ၂ ခု ကောက်ယူခြင်း

နေ့စွဲ	ကျေးရွာအမည်	ကျေးရွာအုပ်စု	ကျေးရွာအုပ်စုတွင် တိုင်ပင်ဆွေးနွေးခဲ့သည့် အိမ်ထောင်စု အရေအတွက်
၁၈-၁-၁၇	ကူပြင်	ပြည်ညောင်	အိမ်ထောင်စု စစ်တမ်း ၂၅ ခု
၁၉-၁-၁၇	ပြည်ညောင်	ပြည်ညောင်	အိမ်ထောင်စု စစ်တမ်း ၂၅ ခု
၂၀-၁-၁၇	ကူပြင် နှင့် ပြည်ညောင်	ပြည်ညောင်	မြို့နယ်ခန်းမအစည်းအဝေး၂ခု၊ အဖွဲ့လိုက်ဆွေးနွေးပွဲ ၆ခု

တိုင်ပင်ဆွေးနွေးမှုရလဒ်များကို စီမံကိန်းအတွက် လျော့ချရေးအစီအမံများဆိုင်ရာ ဒီဇိုင်းတွင် ထည့်သွင်းခဲ့ပြီး ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာ မူကြမ်းတွင် ထည့်သွင်းခဲ့ပါသည်။ ၎င်းတွင် အောက်ပါတို့ ပါဝင်ပါသည် -

- စက်ရုံ နှင့် လူနေဆောင်ဇရိယာများမှ မိလ္လာစနစ် နှင့် စွန့်ပစ်ရေ စုဆောင်းမှု နှင့် သန့်စင်မှု တိုးတက်ကောင်းမွန်ခြင်း၊
- စီမံကိန်းလည်ပတ်ရေးအဆင့်တွင် ဝင်ရောက်လာမည့် အလုပ်သမားများအတွက် လုပ်ငန်း ဆိုင်ရာကျင့်ဝတ်စည်းကမ်းကို ရေးဆွဲသွားမည် ဖြစ်ပါသည်၊ ထို့ပြင်
- ဒေသရှိနေထိုင်သူများအသုံးပြုနိုင်ရန်အတွက် တရားဝင်အကြံပြုတိုင်ကြားရေးဆိုင်ရာ လုပ်ထုံး လုပ်နည်းစနစ်တစ်ခုကို ရေးဆွဲသွားမည် ဖြစ်ပါသည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းမူကြမ်း တွေ့ရှိချက်များအပေါ် သက်ဆိုင်သူများမှာထံမှ အမြင်များကို ရယူနိုင်ရန် နောက်ပိုင်းတွင် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာမူကြမ်း ထုတ်ဖော်တင်ပြချက်ကို ဆောင်ရွက်ခဲ့ပါသည်။ ၎င်းထုတ်ဖော်တင်ပြချက်တွင် STC ဝက်ဘ်ဆိုက် နှင့် IFC ထုတ်ဖော်ခြင်းဆိုင်ရာနေရာ တို့တွင် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းမူကြမ်းကို ၂၀၁၇ ဇူလိုင်တွင် တင်ပြခြင်းတို့ ပါဝင်ပါသည်။ ထို့ပြင် အများပြည်သူနှင့်သက်ဆိုင်သည့် ဖိုရမ် နှင့် ရပ်ရွာအစည်းအဝေးများကို ၂၀၁၇ ဇူလိုင်လ ၌ ကျင်းပခဲ့ပါသည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းမူကြမ်းအပေါ် အဓိကတုံ့ပြန်မှုများ၊ မေးခွန်းများ နှင့် STC တုံ့ပြန်ဖြေကြားမှုတို့မှာ အောက်ပါအတိုင်းဖြစ်ပါသည် -

- စွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှု - STC သည် စွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှုအစီအစဉ် / လုပ်ထုံးလုပ်နည်းစနစ်ကို ကျင့်သုံးသွားမည် ဖြစ်ပါသည်။
- ဒေသအလုပ်အကိုင်အခွင့်အလမ်း - ဖြစ်နိုင်ခြေရှိသောနေရာများတွင် ဒေသမှလူများကို ဦးစားပေးသွားမည် ဖြစ်ကာ၊ CSR စီမံကိန်း၏ အစိတ်အပိုင်းတစ်ရပ်အနေဖြင့် ဒေသခံရပ်ရွာများထံ အဆင့်မြင့်ပညာရေးထောက်ပံ့မှုများကို ဆောင်ရွက်သွားမည် ဖြစ်ပါသည်။
- ဇီဝမျိုးစုံမျိုးကွဲအပေါ် သက်ရောက်မှု - သစ်ပင်များပြန်လည်စိုက်ပျိုးခြင်းအစီအစဉ်အပါအဝင် ဇီဝမျိုးစုံမျိုးကွဲဆောင်ရွက်မှုအစီအစဉ် (BAP) ကိုအကောင်အထည်ဖော်ဆောင်ရွက်ခြင်း။
- ကျန်းမာရေးကိစ္စများ (ဒေသတွင်းရေအရည်အသွေးပြဿနာများကြောင့် ဒေသခံများအကြား အရေပြားရောဂါများဖြစ်ပွားသည်ဟု ပြောဆိုခြင်း) – STC သည် CSR အစီအစဉ် အစိတ်အပိုင်းတစ်ရပ်အဖြစ် သန့်ရှင်းသောရေကို ထောက်ပံ့ပေးသွားမည်။

- စီစဉ်ထားသော CSR လုပ်ငန်းများကို ရှင်းလင်းခြင်း - ယခုအပြီးသတ် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းတွင် ပါဝင်ပါသည်။

- အကြံပြုတိုင်ကြားရေးဆိုင်ရာ ယန္တရား / အလုပ်သမားဘဝဖူလုံရေး - အလုပ်သမား အကြံပြုတိုင်ကြားရေးဆိုင်ရာ ယန္တရား နှင့် သက်ဆိုင်သူများ အကြံပြုတိုင်ကြားရေးဆိုင်ရာ ယန္တရားအား ရေးဆွဲပြီး အကောင်ထည်ဖော်ဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။

- သက်ဆိုင်သူများနှင့်တိုင်ပင်ဆွေးနွေးပွဲများကို ကြေညာရန် လမ်းကြောင်းအရေအတွက်များ တိုးပွားလာခြင်း - အသိပေးချက်များကို စာသင်ကျောင်းများ၊ ဘုန်းကြီးကျောင်းများ၊ သောက်သုံး ရေသန့်စင်ရေးရေတွင်းများ၊ အထွေထွေအုပ်ချုပ်ရေးရုံးများ၊ STC သတင်း ဖြန့်ဝေရေးစင်တာများ စသည့် အဓိက နေရာများတွင် ကြိုတင်၍ ကောင်းမွန်စွာ ဆက်သွယ်မည် ဖြစ်ပါသည်။ ESIA နယ်ပယ်အတိုင်းအတာသတ်မှတ်မှုအဆင့်တွင် သဘောထားတုံ့ပြန်ချက်များကိုလည်း ပေးခဲ့ပါသည်။ ရရှိခဲ့သော အမြင်များကို စေ့စေ့စပ်စပ်ဆောင်ရွက်လျက် ကျေးရွာခေါင်းဆောင်များကိုသာ အင်တာဗျူးဆောင်ရွက်ခဲ့ပါသည်။

- ပေါက်ကွဲလွယ်သောပစ္စည်းများသိုလှောင်ခြင်း - STC စံနှုန်းအလေ့အကျင့်များဆိုင်ရာ ရှင်းလင်းမှုကို ယခုအပြီးသတ် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းတွင် ထည့်သွင်းထားပါသည်။

- ဒေသငှက်ဖျားရောဂါကိစ္စရပ်များ - မြောက်များစွာသော ကိစ္စရပ်များသည် လွန်ခဲ့သော နှစ်အနည်းငယ်အတွင်း လျော့ပါးသွားခဲ့ပါသည်။ STC သည် ငှက်ဖျားကာကွယ်ရေးအစီအစဉ်ကို ၎င်း၏ စီစဉ်ထားသည့် CSR လုပ်ငန်းများတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။ ထို့ပြင်၊

- အချက်အလက်ဖြန့်ဝေရေးစင်တာ - အချက်အလက်ဖြန့်ဝေရေးစင်တာသစ်တစ်ခုကို ပြည်ညောင်ကျေးရွာ၌ ၂၀၁၇ ဒီဇင်ဘာလတွင် ဖွင့်လှစ်ခဲ့ပါသည်။

- လေထုအရည်အသွေးအပေါ် သက်ရောက်မှုများ - လေထုအရည်အသွေးအပေါ် သက်ရောက်မှုများ - NGO များ နှင့် ECD တို့သည် နောက်ထပ် အခြေခံလေထုနမူနာကို တောင်းခံခဲ့ပြီး၊ အပြီးသတ် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း မပြုလုပ်မီ၊ ၎င်းကို ကူပြင် နှင့် ပြည်ညောင်ကျေးရွာတို့တွင် ဆောင်ရွက်ခဲ့ပါသည်။ နောက်ထပ် အခြေခံလေ့လာချက်များမှ ရလဒ်များကို ယခု အပြီးသတ်ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းတွင် ထည့်သွင်းထားပါသည်။ ထုံးကျောက်ကျင်း (သို့မဟုတ် ၌ဂေကျာက်ကျင်း နှင့် ဘိလပ်မြေစက်ရုံ) လုပ်ငန်းလည်ပတ်မှုကြောင့် ကူပြင် နှင့် ပြည်ညောင်ကျေးရွာတို့ရှိ လေထုအရည်အသွေးအပေါ် ဆိုးကျိုးသက်ရောက်မှုများ မရှိနိုင်ကြောင်း NGO မှတ်ချက်များကို တုံ့ပြန်သောအားဖြင့် ဆောင်ရွက်ခဲ့သည့် နောက်ထပ်ဆန်းစစ်မှုမှ အတည်ပြုပါသည်။ ၎င်းမှာ အဓိကအားဖြင့် ပင်ရင်းနေရာ နှင့် လက်ခံရာနေရာ အကြားရှိ အကွာအဝေး နှင့် တိုက်နေမြဲလေ၏ တည်ဦးရာလမ်းကြောင်းကြောင့် ဖြစ်ပါသည်။

- ဇီဝမျိုးစုံမျိုးကွဲအတွက် ထိခိုက်မှုဆန်းစစ်ခြင်း နှင့် လျော့ချရေး အစီအမံများကို ခေတ်နှင့်အညီ ဆောင်ရွက်ရန် နောက်ထပ် ဇီဝမျိုးစုံမျိုးကွဲ စစ်တမ်းကောက်ယူမှုများကို ဆောင်ရွက်ရန် လိုအပ်ပါသည် - ထုံးကျောက်ကျင်းအတွက် တွားသွားသတ္တဝါများ နှင့် ကတ်မြေသားဒေသရင်းအပင်များ စစ်တမ်းကောက်ယူမှုအပါအဝင် နောက်ထပ် စစ်တမ်းအမျိုးမျိုးကို ဆောင်ရွက်ခဲ့ပြီး ယခု အပြီးသတ် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းတွင် ထည့်သွင်းခဲ့ပါသည်။ အကြံပြုထားသော လျော့ချရေးအစီအမံများကို စနစ်တကျအကောင် အထည်ဖော်ဆောင်ရွက်ခြင်းဖြင့် အထူး

အရေးပါပြီး ထိခိုက်ဆုံးရှုံးသွားသည့် ဇီဝမျိုးစုံမျိုးကွဲများ ပြန်လည်အစားထိုး စောင့်ရှောက်ရန် လိုအပ်သည့် ထုံးကျောက်ကျင်း လည်ပတ်မှုကြောင့် မြေနေရာများဆုံးရှုံးခြင်း မှလွဲ၍ စီမံကိန်းလည်ပတ်ခြင်းမှ ဖြစ်ပေါ်လာ နိုင်သည့် ကြွင်းကျန် ဇီဝမျိုးစုံမျိုးကွဲအပေါ် သက်ရောက်မှုများသည် အတန် အသင့် အရေးပါမှု အဆင့်ထက် ကြီးမားမည် မဟုတ် ကြောင်း အတည်ပြုပါသည်။ ပြန်လည်အစားထိုး စောင့်ရှောက်ရေးဆိုင်ရာသတ်မှတ်ချက်များ အသေးစိတ် ဇီဝမျိုးစုံမျိုးကွဲဆောင်ရွက်မှုအစီအစဉ်ကို ရေးဆွဲထားပါသည်။

၁.၇ *နိဂုံး နှင့် အကြံပြုချက်များ*

မန္တလေးတိုင်းဒေသကြီး၊ သာစည်မြို့နယ်ရှိ အဆိုပြု STC ထုံးကျောက်ကျင်းတိုးချဲ့မှုလုပ်ငန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းမှ STC သည် ၎င်းတို့ လုပ်ငန်းလည်ပတ် ဆောင်ရွက်မည့် နေရာ ၏ ပတ်ဝန်းကျင်နှင့် လူမှုအနေအထားများကို နားလည်သဘောပေါက်ထားပြီး စီမံကိန်းကြောင့် အဓိကဖြစ်ပေါ် လာနိုင်သည့် ပတ်ဝန်းကျင် နှင့် လူမှု သက်ရောက်မှုများကို စနစ်တကျ ဆန်းစစ်ထား ကြောင်း ထင်ရှားစေပါသည်။သာစည်မြို့နယ်ရှိ ဘိလပ်မြေစက်ရုံတိုးချဲ့ဆောင်ရွက်မှု လုပ်ငန်း စီမံကိန်းကာလ အတွင်း စီမံကိန်းနှင့်ဆက်နွယ်သက်ရောက်မှုများကို စီမံခန့်ခွဲရန်နှင့် စံနှုန်းနှင့် အလေ့ အကျင့်ကောင်း များနှင့်အညီ ဆောင်ရွက်ရန် စီမံကိန်းဆိုင်ရာအသေးစိတ် EMP ကို ပြင်ဆင်ရေးသား ပြီးဖြစ်ပါသည်။ အကြံပြုထားသောလျော့ချရေးအစီအမံများကို လိုက်နာ ဆောင်ရွက် ခြင်းဖြင့်၊ အဆိုပြုစီမံကိန်း၏ ပတ်ဝန်းကျင်နှင့် လူမှုဘဝဆိုင်ရာသက်ရောက်မှုများကို STC မှ လက်ခံ နိုင်ဖွယ် ရှိသောနည်းလမ်းများ ဖြင့် ဆောင်ရွက်သွားနိုင်မည် ဖြစ်ပါသည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းတွင် စီမံကိန်းလည်ပတ်မှုမှ ဖြစ်ပေါ်လာနိုင်သည့် ကြွင်းကျန် ပတ်ဝန်းကျင် နှင့် လူမှုဘဝ အပေါ် သက်ရောက်မှုများသည် **အတန်အသင့်အရေးပါမှု အဆင့်ထက် ကြီးမားမည် မဟုတ်ကြောင်း** သုံးသပ်ထားပါသည်။ သို့သော် ထုံးကျောက်ကျင်းလုပ်ငန်း လည်ပတ်မှုကြောင့် ဖြစ်ပေါ်လာသည့် သဘာဝနေရင်ဒေသများဆုံးရှုံးမှုမှာ အလွန်အရေးပါ သောကြောင့် ထိခိုက်ဆုံးရှုံးသွားသောဇီဝမျိုးစုံမျိုးကွဲများအား ပြန်လည်အစားထိုး စောင့်ရှောက်မှု အစီအစဉ်ကို အကောင်အထည်ဖော်ဆောင်ရွက်ရမည်ဖြစ်ပါသည်။

ဖော်ပြပါ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာအကျဉ်းချုပ်ကို မြန်မာဘာသာ နှင့် အင်္ဂလိပ်ဘာသာ ဖြင့် STC ဝက်ဘ်ဆိုက်တွင် ထုတ်ပြန်သွားမည် ဖြစ်ပါသည်။ ပတ်ဝန်းကျင်ထိခိုက်မှု အစီရင်ခံစာ စာတမ်းကို ရန်ကုန်ရှိ STC ရုံးနှင့် သာစည် GAD ရုံး နှင့် ပြည်ညောင်ကျေးရွာရှိ STC သတင်းအချက် အလက်ဖြန့်ဝေရေးစင်တာတို့တွင် ထားရှိသွားမည် ဖြစ်ပါသည်။

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

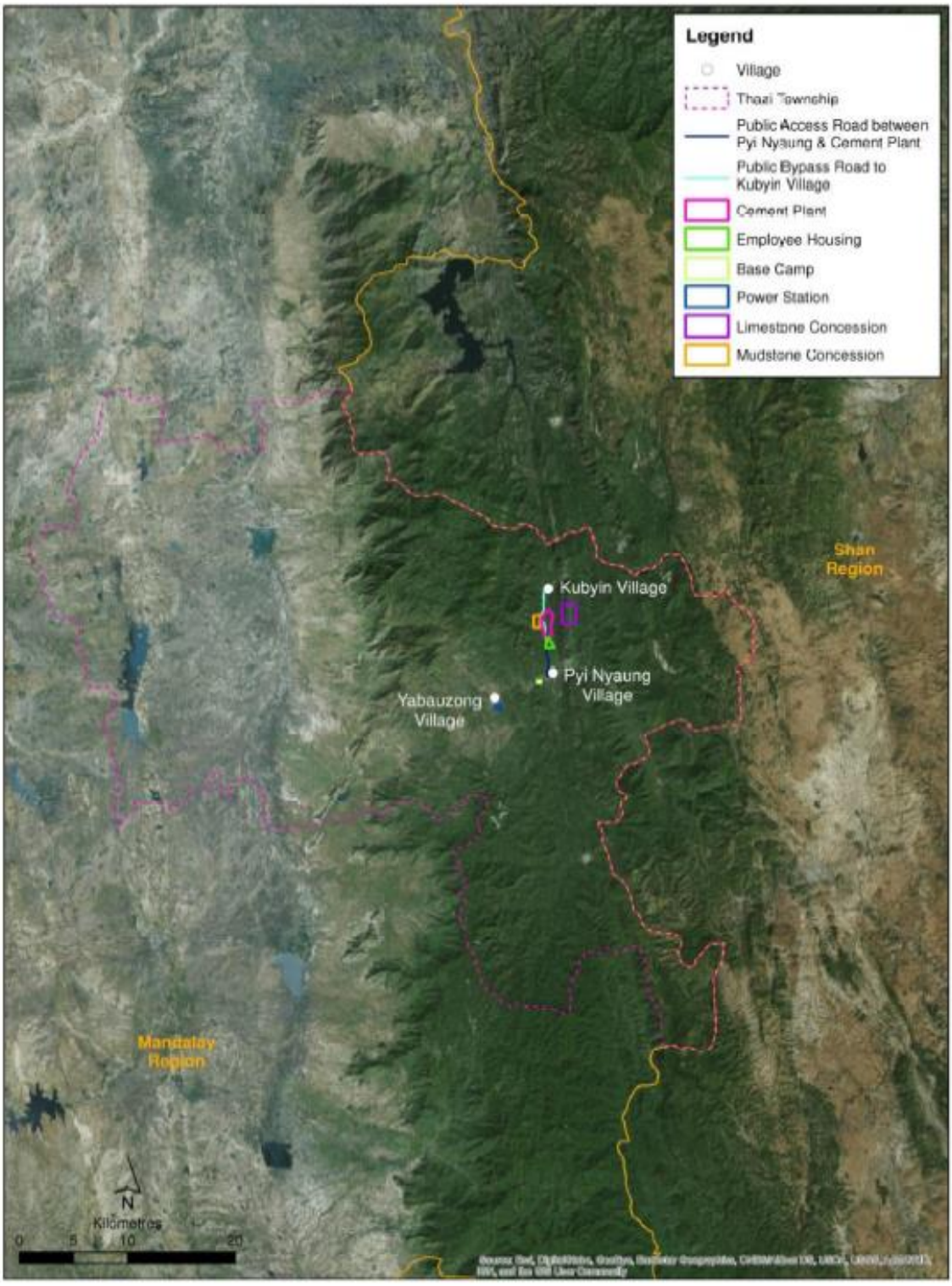
Shwe Taung Cement Company Ltd. (STC), is planning an expansion of the limestone production at its existing limestone quarry in Pyi Nyaung Village, Thazi Township in the Mandalay region of Myanmar (the Project). The Project aims to expand extraction of limestone from 715,000 tons to 2,934,965 tons every year. The location of the Project is shown in *Figure 1.1.*

STC has commissioned **Environmental Resources Management (ERM)-Hong Kong, Limited** to undertake the Environmental Impact Assessment (EIA) for the limestone quarry Project.

The limestone quarry is located approximately 5 km (haul distance) to the east of the STC cement plant (*Figure 1.1*). The limestone and mudstone quarries as well as a coal mine in Kalaywa township of Sagaing region are operated by **Shwe Taung Mining** (STM), subsidiary of **Shwe Taung Cement (STC)** which supply raw materials exclusively to the STC cement plant. The limestone quarry, mudstone quarry and coal mine of STM are thus considered as associated facilities of the STC cement plant and ERM has already prepared the STC's EIA for the cement plant, limestone quarry, mudstone quarry and coal mine. Regarding to the comments of MONREC - Office Letter No. (Forest) 3(2)/16(D)(3359/2017) (19/10/2017), STC again submitted the four EIA reports which are separated from the previous EIA report in 2018. Based on the review team meeting comments, ERM has updated this Limestone Quarry EIA report are addressed accordingly in the comment response table in Annex: V during 2019 – 2022. ERM terminated the EIA consultancy service for STM on December 2022 and ERM handovered this progress EIA report to STC. As per MONREC – Office Letter No. 6/2 (ECD) / 1 / 2024 (2445) (20/02/2024), STC submits this progress EIA report to Mining 1 Enterprise.

This document is the EIA Report for the proposed limestone quarry expansion Project.

Figure 1.1 Location of the STC Limestone Quarry



1.2 POLICY AND REGULATORY FRAMEWORK

Under *Section 7* of the *Environmental Conservation Law* and *Articles 52* and *53* of the *Environmental Conservation Rules* of the Republic of the Union of Myanmar, STC is required to undertake an EIA to obtain an Environmental Compliance Certificate (ECC) for the proposed limestone quarry expansion Project.

The Project will be undertaken in line with national regulation and international standards. Local laws relating to EIA include: Environmental Conservation Law (2012); Environmental Conservation Rules (2014); National Environmental Quality (Emission) Guidelines (2015); and the Environmental Impact Assessment (EIA) Procedure (2015).

With the release of the final Myanmar EIA Procedure in December 2015, the National Environmental Quality (Emissions) Guidelines were also released. These Guidelines provide the basis for regulation and control of noise and air emissions and effluent discharges from projects in order to prevent pollution and protect the environment and public health. These standards are equivalent to the World Bank Group (WBG) General Environmental Health & Safety (EHS) Guidelines (2007).

1.3 PROJECT DESCRIPTION AND ALTERNATIVES

The limestone quarry is located within the forest area on the ridge of the Tha Pyae mountain range of Thazi Township, Pyi Nyaung Village and Kubyin Area within the Mandalay Region (*Figure 1.1*). A concession of 600 acres in size has been allocated to STC for limestone extraction, with lease agreement from the Forest Department renewed annually since 31 March 2011 and operating agreements for large scale production of limestone in a production sharing system from the Ministry of Mines for 25 years starting 22 December 2010.

Limestone extraction is undertaken using a drill and blast method. The extracted limestone is transported by truck to the limestone crusher where it is crushed and stored prior to use. Approximately 715,000 tonnes of limestone per year is required for the current production of the STC cement plant.

For the Project expansion, a conveyor will be built to transport the limestone from the quarry to the limestone crusher in place of trucks. The concession, which has estimated limestone reserves of 110 million tonnes, is expected to be mined down from ~750 m to 550 m above sea level with further clearance of forest required. The remaining quarry lifetime is expected to be around 37 years, accounting for the limestone mined as of October 2017 and since June 2012, and based on a higher predicted mining rate of of ~2.9 million tonnes per year once the STC cement plant expansion becomes operational. While it is understood that the STC cement plant area is leased under a 50-year agreement from the Forest Department of Ministry of Environmental Conservation and Forestry on 31 March 2016, the current expected lifespan of the STC cement plant is 30 years and the supply from the limestone quarry

should thus be sufficient. If the lifespan of the STC cement plant is expanded beyond 37 years, STC will study the supply of limestone and ensure that all necessary permits will be obtained before further limestone extraction.

Given that the Project is a brownfield extension of an existing quarry, there are no feasible alternatives for Project siting. Installation of a conveyor will reduce the use of vehicles to transport quarried material and will therefore be more efficient in terms of fuel consumption.

1.4 BASELINE CONDITIONS

Baseline biodiversity field surveys of the limestone quarry site were conducted to obtain an understanding of baseline diversities for a selection of taxa groups. *Table 1.1* lists the surveys that were undertaken during the 2014 and 2017 surveys including their targeted taxa and dates conducted.

Table 1.1 Surveys Conducted at Limestone Quarry

Target Organism Group	Method Summary	Survey Dates	Surveyor
Limestone Quarry			
Bird, herpetofauna, mammals and flora	Transect Survey Interviews	March – April 2014	National Engineering & Planning Services (NEPS) Co., Ltd, Myanmar
Bird, herpetofauna, arboreal mammal/primate and ground dwelling mammals	Transect Survey Interviews	27th January – 31st January 2017	Dr Christian Matauschek (Contracted by FFI)
Flora	Transect Survey	31st January – 7th February 2017*	Dr Win Myint (Contracted by FFI)
Snails	Soil sampling Handpicking of snail shells	13th February – 19th February 2017	Dr Jaap Vermeulin (contracted by ERM)
Reptiles	Targeted Surveys at selected locations	8th March – 10th March 2017 11th October – 12th October 2017	Dr Lee Grismer (Contracted by FFI)
Limestone range flora	Targeted Surveys at selected locations	13th February –19th February 2017 16th August – 20th August 2017	Dr Jaap Vermeulin (Contracted by ERM)

Given an understanding of the species assemblages within each habitat/land class, and supplemented with field observations of the general quality of these habitats, natural-modified habitat classifications have been assigned according to IFC PS6 (IFC, 2012a, IFC 2012b). The limestone quarry covered 235.58 ha of natural habitat and 118.79 ha of modified habitat. Further Critical Habitat (CH) Screening Assessment identified seven (7) species for the Limestone Quarry that are CH species (*Table 1.2*). These Critical Habitat candidates were considered as part of the impact analysis of the EIA. The limestone quarry itself is considered to comprise Critical Habitat, as defined by IFC Performance Standard 6.

The complete Critical Habitat Screening Assessment for Criterion 1-5 is contained in *Annex D2*.

Table 1.2 Candidate Critical Habitat Assessment Summary

SN	Species	Common Name	IUCN Listing
Limestone Quarry			
1	*Manis pentadactyla*	Chinese Pangolin	CR
2	*Trachypithecus phayrei shanicus*	Shan Langur	
3	*Dalbergia oliveri*	Burma Rosewood	EN
4	*Trachypithecus phayrei* spp. *shanicus*	Shan State Langur	EN
5	Karst Snails	-	New-to-science
6	Karst Flora	-	New-to-science
7	Karst Reptiles	-	New-to-science

From a socio-economic perspective, the limestone quarry area itself was previously inaccessible and hence operations of the limestone quarry did not result in impacts to the livelihoods of local residents.

1.5 IMPACT ASSESSMENT AND PROPOSED MITIGATION

The EIA has assessed the potential impacts and proposed mitigation to reduce the level of the impact resulting from the expansion of existing operations. It is concluded in the EIA that with proper implementation of the recommended mitigation measures, the residual environmental and social impacts caused by the operation of the Project would be of no larger than moderate significance, except for the loss of habitat due to operation of the limestone quarry which are of critical significance and required to be offset as per the Biodiversity Offset Plan (*Table 1.3*).

Table 1.3 Summary of Impact Assessment for the Operation of the Limestone Quarry Expansion

Issue	Impact Summary	Impact Significance *(prior to implementation of Mitigation and Management Measures)*	Residual Impact Significance *(after implementation of Additional Mitigation and Management Measures)*
Air Quality	$PM_{2.5}$ and PM_{10} due to Project emission	Major (Worker Acommodation) Minor to Negligible (Kubyin and Pyi Nyuang Villages)	Minor to Negligible
Surface Water Quality	Impacts to surface water quality due to wastewater and runoff during operation.	Major	Minor to Moderate
Waste Management	Impacts from waste management during operation	Moderate	Minor

Issue	Impact Summary	Impact Significance *(prior to implementation of Mitigation and Management Measures)*	Residual Impact Significance *(after implementation of Additional Mitigation and Management Measures)*
Biodiversity	Degradation of habitats due to operation.	Moderate	Negligible
	Impacts to species during operation	Moderate	Negligible
	Permanent and Temporary loss of habitat due to operation.	Critical	Critical
	Fragmentation and edge effects due to operation.	Moderate to Major	Minor
Occputional Health and Safety	Impacts to health and safety of workers due to operation of the Project.	Moderate	Minor
Landscape and Visual Impacts	Impacts to landscape and visual amenity of Project area	Moderate	Negligible to Minor
Soil	Impacts to soil from dust deposition and runoff.	Negligible	Negligible

1.6 PUBLIC CONSULTATION AND DISCLOSURE

Engagement has been conducted with a range of relevant stakeholders from November 2016 to July 2017 as part of the EIA.

This engagement helped the Project to gather information to fill in data gaps and to understand the views, concerns and perceptions of potentially affected groups and individuals in order to inform the EIA.

In summary, the following consultation was undertaken for the Draft EIA (*Table 1.4*):

- Consultation with village leaders in Pyi Nyaung and Kubyin villages during Scoping in November 2016.
- Community briefings in Pyi Nyaung and Kubyin villages in January 2017.
- 100 Household surveys in Pyi Nyaung and Kubyin villages in January 2017.
- Focus Group Discussions with women and farmers in Pyi Nyaung and Kubyin villages in January 2017.
- Consultation with Flora and Fauna International and Wildlife Conservation Society concerning the establishment of biodiversity offsets in January 2017.

- Discussion with International Union for the Conservation of Nature (IUCN), Myanmar Centre for Responsible Business (MCRB) and Wildlife Conservation Society (WCS) in August 2017

- Consultation with MONREC and representatives of the Forest Department responsible for management of the two candidate Biodiversity Offset Sites.

Table 1.4 Consultation Conducted for the Preparation of the Draft EIA

Date	Village	Village Tract	No. of HH Consulted by Village Tract
17-1-17	Kubyin & Pyi Nyaung	Pyi Nyaung	Meeting with Village leaders and 2 Socio-economic Surveys
18-1-17	Kubyin	Pyi Nyaung	25 HH Survey
19-1-17	Pyi Nyaung	Pyi Nyaung	25 HH Survey
20-1-17	Kubyin & Pyi Nyaung	Pyi Nyaung	2 Townhall Meetings, 6 Groups Discussion

Consultation outcomes were incorporated into the design of mitigation measures for Project and are contained in the Draft EIA Report. These include:

- Improved drainage interception from the quarry and associated access road;

- A code of conduct will be developed for incoming workers during the operation phase of the project; and

- Development of a formal grievance procedure for use by local residents.

Disclosure of the Draft EIA Report was subsequently undertaken to obtain stakeholder views on finding of the Draft EIA. This disclosure included posting on the Draft EIA on STC website and IFC's disclosure portal in April 2017. In addition, a public forum and two community meetings were held in July 2017.

Key feedback, questions, and STC's responses on the Draft EIA were as follows:

- Waste management: STC will adopt a Waste Management Plan / Procedure;

- Local employment: priority will be given to hiring locally where feasible, and with higher education support to local communities as part of a CSR project;

- Biodiversity impact: implementation of a Biodiversity Action Plan (BAP), including a replantation programme;

- Health issues (alleged skin diseases among local residents due to local water quality issues): STC to provide clean water supply as part of its community (CSR) program;

- Clarification of planned CSR activities: included in this Final EIA;

- Grievance mechanism / employee welfare: a Worker Grievance Mechanism and a Stakeholder Grievance Mechanism is drafted and included in this Final EIA;

- Increasing the number of channels to announce stakeholder consultation meetings: notices will be communicated well in advance and at key locations such as schools, monasteries, drinking water treatment wells, GAD offices, STC information centres, etc. Feedback was also provided that during the EIA's scoping phase, only village leaders were interviewed, narrowing the range of viewpoints received;

- Storage of blasting materials: clarification of STC standard practices is included in this Final EIA;

- Local malaria cases: the number of cases have been reducing in the past few years. STC will include a malaria prevention programme in its planned CSR activities;

- Information centre: a new information centre has been opened at Pyi Nyaung Village;

- Air quality impacts: NGOs and ECD requested additional baseline air sampling and this was undertaken at Kubyin and Pyi Nyuang Villages prior to finalising the EIA. Results from further baseline studies are included in this Final EIA. Additional assessment undertaken in response to NGO comments confirms that there are not expected to be adverse air quality impacts at either Kubyin and Pyi Nyuang Villages as a result of the operation of the limestone quarry (or mudstone quarry and cement plant). This is principally due to the distance between source and receptor and the prevailing wind direction; and

- Further biodiversity surveys need to be conducted to update impact assessment and mitigation measures to biodiversity: various further surveys, including reptile survey and karst flora survey for the limestone quarry, were conducted and included in this Final EIA. It is confirmed that with proper implementation of the recommended mitigation measures, the residual biodiversity impacts causing by the operation of the Project would be of no larger than moderate significance, except for the loss of habitat due to operation of the limestone quarry which are of critical significance and required to be offset. The Biodiversity Action Plan is developed detailing the offset requirements.

1.7 CONCLUSIONS AND RECOMMENDATIONS

The EIA for the proposed expansion of the STC limestone quarry in Thazi Township of Mandalay Region demonstrates that STC understands the environment and social setting in which they are operating and has properly assessed the key potential environmental and social impacts associated with

the proposed Project. A Project-specific, dedicated Environmental Management Plan (EMP) has been developed to manage impacts associated with the Project and ensure legislative compliance and standards of good practice during the limestone quarry expansion Project in Thazi Township. Provided that the recommended mitigation measures are properly implemented, it is expected that the environmental and social impacts of the proposed Project would be managed by STC in an acceptable manner.

The EIA concludes that the residual environmental and social impacts caused by the operation of the Project would be of no larger than M**oderate** significance, except for the loss of habitat due to operation of the limestone quarry which are of **Critical** significance and required to be offset as per the Biodiversity Offset Plan

This EIA Report with the executive summary in Myanmar and English will be disclosed on STC's website. Hard copies of the EIA Report will be provided at STC's offices in Yangon as well as in Thazi GAD office and at the STC information centre at Pyi Nyaung Village.

2 INTRODUCTION

2.1 PROJECT OVERVIEW

Shwe Taung Cement Company Ltd. (STC) expanding limestone production at its existing limestone quarry in Pyi Nyaung Village, Thazi Township in the Mandalay region of Myanmar (the Project). The Project aims to expand extraction of limestone from 715,000 tons to 2,934,965 tons every year.

STC is part of the **Shwe Taung Group** (STG) which owns and operates a variety of businesses across various sectors in Myanmar. The limestone quarry is located approximately 5 km (haul distance) to the east of the STC cement plant (*Figure 1.1*). The limestone quarry, together with the mudstone quarry to the west of the STC cement plant and a coal mine in Kalaywa township of Sagaing region, supply raw materials exclusively to the STC cement plant and will all be expanded to support the expansion of the STC cement plant. Expansion of the STC cement plant, mudstone quarry and coal mine are assessed under three separate EIA Reports.

This document is the EIA Report for the proposed limestone quarry expansion Project.

2.2 BACKGROUND TO THE EIA

To date three local Environmental Impact Assessment (EIA) Studies related to the Project have been prepared and submitted to regulatory authorities in Myanmar, which are as follows (hereafter referred to as previous Local EIAs):

- EIA for the 1,500 tpd Apache Cement Plant, Thazi Township, Mandalay Region, NEPS, 2014;
- EIA on 3,500 tpd Shwe Taung Cement Factory, at Kubyin Village, Pyi Nyaung Area, Tharzi Township, Mandalay Region, Myanmar Environment Sustainable Conservation (MESC), 2016; and
- EIA on the 100,000 tpa Shwe Taung Coal Mine, at Chaung Sone Village (Paluzawa area), Kalaywa Township, Sagaing Region, MESC, 2016.

The previous Local EIAs do not fulfil the requirements of the International Finance Corporation's Performance Standards on Environmental and Social Sustainability, 2012 (IFC PSs). As such, **Environmental Resources Management** (ERM) has been commissioned by STC to undertake an EIA to address gaps with respect to the IFC PSs and other relevant international requirements. The Draft EIA was completed on 6 April 2017 and subsequently disclosed on STC's and IFC's websites and presented to stakeholders in the following months. It was submitted to the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) for review in July 2017.

This EIA for the limestone quarry expansion Project has been updated in response to inputs and comments received by various stakeholders, including the ECD, conservation groups and other civil society organisations (CSOs). This final EIA is being submitted to ECD for approval. ECD has requested four separate final EIA reports, namely:

a. Final EIA for the cement plant expansion;

b. Final EIA for the limestone quarry;

c. Final EIA for the mudstone quarry; and

d. Final EIA for the coal mine.

This EIA report is prepared for the limestone quarry expansion Project.

2.3 BACKGROUND TO THE PROJECT PROPONENT

The **Shwe Taung Group** (STG) is a Myanmar conglomerate that owns and operates businesses active throughout Myanmar and across five areas:

- Real estate management, such as cinemas, hotels, shopping centres, condominiums or industrial zone development;
- Construction of buildings that may then be managed by the real estate branch of the group;
- Infrastructure construction of roads, bridges, dams or factories through the subsidiary High Tech Concrete Technology (HTCT);
- Building materials that include STC, STM as well as High Tech Concrete Co. Ltd (HTC); and
- Distribution of light vehicles, heavy-vehicles, machineries, etc.

The Project Proponent, Shwe Taung Cement (STC), can be reached at its head office, as below:

Contact Person: Mr Kyaw Naing Soe
Deputy Managing Director
Shwe Taung Mining Co.Ltd.,

No.108, Corner of Min Ye Kyaw Swar Road & Hnin Si Gone Street,
Saw Yan Paing (East) Ward
Ahlone Township
Yangon, Myanmar
Tel.: 95-9-255112777
Website: www.apachecement.com
Email: kyawnsoe@shwetaungbm.com

2.4 *BACKGROUND TO THE EIA CONSULTANT*

Environmental Resources Management (ERM) is a leading global provider of environmental, health, safety, risk, social consulting services and sustainability related services. ERM has more than 160 offices in over 40 countries and territories employing more than 4,500 people who work on projects around the world.

ERM has been supporting clients in Myanmar since 1996, establishing a permanent office in February 2015 to ensure that ERM provides its clients in Myanmar with world class environmental and social expertise based on strong local knowledge and experience.

ERM's staff are comprised of both national and expatriate consultants, and use knowledge of the local regulatory process as a means of promoting sustainable development, enhancing reputation, securing permits and achieving economic objectives in an environmentally and socially responsible manner within Myanmar. ERM has worked across a variety of sectors including; oil and gas, power, mining, construction, infrastructure and manufacturing.

ERM is one of several international companies that has been recognized and approved by the ECD of MONREC to conduct and submit Environmental Impact Assessments, Social Impact Assessments and Environmental Management Plans for regulatory approval under the Myanmar EIA Procedure (2015). Key staff within the Myanmar office are also registered as EIA Experts under ECD of MONREC to deliver and apply for Environmental Compliance Certificates (ECCs) on behalf of our clients.

Contact person: Mr. Craig Reid, Country Managing Partner
(ECD Registration Number 0053)

ERM address in Yangon:
Suite 628, Arcc Offices 6/F
611 Hledan Centre
Corner of Pyay Road and Hledan Road
Yangon, Kamayut Township
Myanmar 11181
T: +95 (0) 1 230 4405

The following key ERM staff were involved in the Project:

Table 2.1 EIA Consultants - Individual Profiles

Name	Organisation	Academic Experience	Years' Experience	Area of Expertise	Registration Status
Piers Touzel	ERM	MBA, BSc, BA	18	Facilitation of meeting, Socio-Economy, Land use	Registered Under ERM Hong Kong (Certificate No. 0016)
Tam Man Cheong (Jovy Tam)	ERM	Mphil	>10	Ecology and Biodiversity, Socio-Economy	Registered Under ERM Hong Kong (Certificate No. 0016)
Myat Mon Swe	ERM	M.Eng.	>10	Socio-economic Facilitation of Meeting	Registered Individually (Certificate No. 0069) Registration Application to be submitted to ECD under ERM Hong Kong
Stuart Mackenzie	ERM	BSc	10	Waste Management	Registered Under ERM Hong Kong (Certificate No. 0016)
Edmund Taylor	ERM	MSc	5	Air Pollution Control, Modelling for Air Quality	Registered Under ERM Hong Kong (Certificate No. 0016)
Man Ping To (Mandy To)	ERM	MSc	20	Noise and Vibration	Registered Under ERM Hong Kong (Certificate No. 0016)
Laurence Genee	ERM	MSc	20	Risk Assessment and Hazard Management, Legal Analysis	Registered Under ERM Hong Kong (Certificate No. 0016)

In undertaking the EIA, ERM was supported by:

1) **Flora & Fauna International (FFI).** FFI is an international wildlife conservation organisation set up in 1903 in Cambridge, England. Its approach to conserving biodiversity is science-based, with a the view to build local capacity for conservation, integrating biodiversity and human needs, protecting species and habitats, securing land for conservation, providing emergency response to conservation needs, influencing policy and the practice of conservation and bridging the gap between business and biodiversity.

   FFI supported ERM on biodiversity aspects of the EIA, including baseline terrestrial ecology studies and inputs to the Biodiversity Action Plan (*Annex E*).

2) **Resources and Environment Myanmar (REM):** REM is a Yangon-based environmental consulting firm and is licensed to conduct EIAs by the Myanmar ECD. REM supported ERM on baseline environmental surveys of air quality and soil quality.

3 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This section sets out the relevant local policy, legal and institutional framework that the Project will follow, and that includes the following local regulations and international standards:

- EIA Legislation including EIA Procedure (2015) and National Environmental Quality (Emission) Guidelines in Myanmar;
- IFC Performance Standards (IFC PS) (2012);
- World Bank Group (WBG) Environmental Health and Safety (EHS) General Guidelines (2007); and
- WBG EHS Guidelines for Construction Materials Extraction (2007).

The local Myanmar requirements on emissions from the Project (for mining) are specified in the National Environmental Quality (Emissions) Guidelines which are noted to be the same as those recommended by the relevant WBG EHS Guidelines.

This section further presents the Project's contractual and other commitments, as well the Project's environmental and social standards that include the Project's policies, plans and procedures.

3.1 LOCAL POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

The following table summarises the local policy, legal and institutional framework applicable to the Project.

Laws and Regulations	Description
Constitution of the Republic of the Union of Myanmar, 2008	
The Constitution of the Union of Myanmar is the supreme law of the country and has provisions regarding the protection of the environment in Myanmar. Articles in the Constitution relevant to environmental protection are Articles 37, 45 and 390. They are quoted below:	
Article 37	The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water and in the atmosphere in the Union;

Laws and Regulations	Description
	The Union shall enact necessary law to supervise extraction and utilization of State owned natural resources by economics forces;
Article 45	The Union shall protect and conserve natural environment.
Article 390	Every citizen has the duty to assist the Union in carrying out the following matters: preservation and safeguarding of cultural heritage; environmental conservation; striving for development of human resources; protection and preservation of public property. These three Articles in the Constitution provide a basis for legalizing and institutionalizing environmental health impact assessment and social impact assessment.
The Environmental Conservation Law, 2012	
Section 7:	The duties and powers relating to the environmental conservation of the Ministry are as follows: (a) implementing the environmental conservation policies; (b) planning and laying down national or regional work plans relating to environmental management; (c) laying down, carrying out and monitoring programmes for conservation and enhancement of the environment, and for conservation, control and abatement not to cause environmental pollution; (d) prescribing environmental quality standards including standards on emissions, effluents, solid wastes, production procedures, processes and products for conservation and enhancement of environmental quality;

Laws and Regulations	Description
	(e) submitting proposals to the Committee for economic incentive mechanisms and terms and conditions which may not affect the environment or cause least environmental affect for sustainable development in addition to legal affairs and guidelines relating to environment; (f) facilitating for the settlement of environmental disputes and, if necessary, forming bodies to negotiate such disputes; (g) specifying categories and classes of hazardous wastes generated from the production and use of chemicals or other hazardous substances in carrying out industry, agriculture, mineral production, sanitation and other activities; (h) prescribing categories of hazardous substances that may affect significantly at present or in the long run on the environment; (i) promoting and carrying out the establishment of necessary factories and stations for the treatment of solid wastes, effluents and emissions which contain toxic and hazardous substances; (j) prescribing the terms and conditions relating to effluent treatment in industrial estates and other necessary places and buildings and emissions of machines, vehicles and mechanisms; (k) negotiating, cooperating and implementing in respect of international, regional and bilateral agreements, instruments and programmes relating to matters of environment; (l) implementing the international, regional and bilateral agreements accepted by Myanmar for environmental conservation and enhancement of environmental quality in accord with the guidance adopted by the Union Government or the Committee; (m) causing to lay down and carry out a system of environmental impact assessment and social impact assessment as to whether or not a project or activity to be undertaken by any Government department,

Laws and Regulations	Description
	organization or person may cause a significant impact on the environment; (n) laying down guidances relating to the management, conservation and enhancement of environment for the matters of protection of ozone layer, conservation of biological diversity, conservation of coastal environment, mitigation and adaptation of global warming and climate change, combating desertification and management of non-depleting substances and management of other environmental matters; (o) managing to cause the polluter to compensate for environmental impact, cause to contribute fund by the organizations which obtain benefit from the natural environmental service system, cause to contribute a part of the benefit from the businesses which explore, trade and use the natural resources in environmental conservation works; (p) carrying out other functions and duties assigned by the Union Government relating to environmental conservation.
Section 14:	A person causing a point source of pollution shall treat, emit, discharge and deposit the substances which cause pollution in the environment in accord with stipulated environmental quality standards.
Section 15:	The owner or occupier of any business, material or place which causes a point source of pollution shall install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If it is impracticable, it shall be arranged to dispose the wastes in accord with environmentally sound methods.
Section 24:	The Ministry may, in issuing the prior permission, stipulate terms and conditions relating to environmental conservation. It may conduct inspection whether or not it is performed in conformity with such terms and conditions or inform the relevant Government departments, Government organizations to carry out inspections.

Laws and Regulations	Description
Section 25:	The Ministry may, if it is found that a holder of the prior permission fails to comply with any of the terms and conditions relating to environmental conservation contained in the prior permission, pass any of the following administrative penalties: (a) causing to comply with in accord with the terms and conditions after warning, causing to sign the bond; (b) causing to comply with in accord with the terms and conditions after paying a fine.
Section 29:	No one shall violate any prohibition contained in the rules, notifications, orders, directives and procedures issued under this Law.

The Environmental Conservation Rules, 2014

The Ministry of Natural Resources and Environmental Conservation, in exercise of power conferred under sub-section (a) of section 42 of the Environmental Conservation Law, issues this rules by No. 50 of 2014 on the date of 5 June, 2014.

Act 68	For improvement of environmental management, the small scaled private enterprise, factory and workshop which are not included in the categories stipulated in sections 52 and 53 and 62 shall obtain a comment from the Department concerning the environment impacts before applying a permission and a license to the Ministry concerned to construct or operate the business.
Act 69	Any person shall not emit, ask to emit, dispose, ask to dispose, pile and ask to pile, by any means, hazardous waste or hazardous substances stipulated by notification according to any rules in this rules at any place which may affect the public directly or indirectly. Nobody shall carry out any activity which can damage the ecosystem and the natural environment which is affected due to such system, except for the permission of the Ministry for the interests of the people

EIA Procedure (2015)

Laws and Regulations	Description
The EIA Procedure sets out the procedures for completing an IEE, EIA and/or EMP in Myanmar. This includes information on project categorisation, responsibilities of project developers and ministries, EIA review, monitoring and auditing, among other issues.	
Section 102	The Project Proponent shall bear full legal and financial responsibility for: a) all of the Project Proponent's actions and omissions and those of its contractors, subcontractors, officers, employees, agents, representatives, and consultants employed, hired, or authorized by the Project acting for or on behalf of the Project, in carrying out work on the Project; and b) PAPs until they have achieved socio-economic stability at a level not lower than that in effect prior to the commencement of the Project, and shall support programs for livelihood restoration and resettlement in consultation with the PAPs, related government agencies, and organizations and other concerned persons for all Adverse Impacts.
Section 103	The Project Proponent shall fully implement the EMP, all Project commitments, and conditions, and is liable to ensure that all contractors and subcontractors of the Project comply fully with all applicable Laws, the Rules, this Procedure, the EMP, Project commitments and conditions when providing services to the Project.
Section 104	The Project Proponent shall be responsible for, and shall fully and effectively implement, all requirements set forth in the ECC, applicable Laws, the Rules, this Procedure and standards.
Section 105	The Project Proponent shall timely notify and identify in writing to the Ministry, providing detailed information as to the proposed Project's potential Adverse Impacts.
Section 106	The Project Proponent shall, during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure), engage in continuous, proactive and comprehensive self-

Laws and Regulations	Description
	monitoring of the Project and activities related thereto, all Adverse Impacts, and compliance with applicable laws, the Rules, this Procedure, standards, the ECC, and the EMP.
Section 107	The Project Proponent shall notify and identify in writing to the Ministry any breaches of its obligations or other performance failures or violations of the ECC and the EMP as soon as reasonably possible and in any event, in respect of any breach which would have a serious impact or where the urgent attention of the Ministry is or may be required, within not later than twenty-four (24) hours, and in all other cases within seven (7) days of the Project Proponent becoming aware of such incident.
Section 108	The Project Proponent shall submit monitoring reports to the Ministry not less frequently than every six (6) months, as provided in a schedule in the EMP, or periodically as prescribed by the Ministry.
Section 109	The monitoring reports shall include: a) documentation of compliance with all conditions; b) progress made to date on implementation of the EMP against the submitted implementation schedule; c) difficulties encountered in implementing the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties; d) number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation; e) accidents or incidents relating to the occupational and community health and safety, and the environment; and f) monitoring data of environmental parameters and conditions as committed in the EMP or otherwise required.
Section 110	Within ten (10) days of completing a monitoring report as contemplated in Article 108 and Article 109 in

Laws and Regulations	Description
	accordance with the EMP schedule, the Project Proponent shall make such report (except as may relate to National Security concerns) publicly available on the Project's website, at public meeting places (e.g. libraries, community halls) and at the Project offices. Any organization or person may request a digital copy of a monitoring report and the Project shall, within ten (10) days of receiving such request, submit a digital copy via email or as may otherwise be agreed upon with the requestor.
Section 113	For purposes of monitoring and inspection, the Project Proponent: a) shall grant to the Ministry and/or its representatives, at any time during normal working hours, access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed; and b) from time to time as and when the Ministry may reasonably require, shall grant the Ministry access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed.
Section 115	In the event of an emergency, or where, in the opinion of the Ministry, there is or may exist a violation or risk of violation of the compliance by the Project with all applicable environmental and social requirements, the Project shall grant full and immediate access to the Ministry at any time as may be required by the Ministry.
Section 117	The Project Proponent shall further ensure that the Ministry's rights of access hereunder shall extend to access by the Ministry to the Project's contractors and subcontractors.

National Environmental Quality (Emission) Guidelines (2015)

The NEQ sets out emission standards for air, noise and effluent discharges for oil and gas operations. The project shall consider emissions standards in its environment impact assessment and environmental management plan.

Laws and Regulations	Description
The Prevention and Control of Communicable Diseases Law 1995	
Section 3	In order to prevent the outbreak of Communicable Diseases, the Department of Health shall implement the following project activities: (a) immunization of children by injection or orally; (b) immunization of those who have attained majority, by injection or orally, when necessary; (c) carrying out health educative activities relating to Communicable Disease.
Section 4	When a Principal Epidemic Disease or a Notifiable Disease occurs: (a) immunization and other necessary measures shall be undertaken by the Department of Health, in order to control the spread thereof: (b) the public shall abide by the measures undertaken by the Department of Health under subsection (a).
Section 8	For prevention of the outbreak of Communicable Disease and effective control of Communicable Disease when it occurs, the public shall, under the supervision an guidance of the Health Officer of the relevant area, undertake the responsibility carrying out the following environmental sanitation measures: (a) in-door, out-door sanitation or inside the fence, outside the fence sanitation; (b) well, ponds and drainage sanitation; (c) proper disposal of refuse and destruction there of by fire: (d) construction and use of sanitary latrines; (e) Other necessary environmenta1 sanitation measures.
Section 9	The head of the household or any member of the household shall report immediately to the nearest health department or hospital when any of the following events occurs:

Laws and Regulations	Description
	(a) rat fall (b) outbreak of a Principal Epidemic Disease; (c) outbreak of a Notifiable Disease
Section 11	In order to prevent and control the spread of a Principal Epidemic Disease, the Health Officer may undertake the following measures: (a) investigation of a patient or any other person required: (b) medical examination; (c) causing laboratory investigation of stool, urine, sputum and blood samples to he carried out: (d) causing investigation by injection to he carried out; (e) carrying out other necessary investigations.
The Protection and Prevention of Antique Object Law, 2015	
Section 3	The objectives of this law are as follows: (a) to implement the policy of protection and preservation for the perpetuation of antique objects; (b) to protect and preserve antique objects so as not to deteriorate due to natural disaster or man-made destruction; (c) to uplift hereditary pride and to cause dynamism of patriotic spirit by protection and preservation of antique objects; (d) to have public awareness of the high value of antique objects; (e) to carry out in respect of protection and preservation of antique objects in conformity with the International Convention and Regional Agreement ratified by the State.
Section 12	The person who finds any object which has no owner or custodian, he shall promptly inform the relevant

Laws and Regulations	Description
	Ward or Village-Tract Administrator if he knows or it seems reasonable to assume that the said object is an antique object.

The Factories Act , 1951 (Amended in 1953, 1954, 1962, 2016)

	This act contains the provisions for chemicals management and storage. Some chemicals are likely to require permits. It also requires all factories to have proper pollution control measures such as air pollution, sewage and wastewater treatment system. The Project Proponent must surely acknowledge all the prescriptions and ensure to be free from any hazards and take necessary care regarding for occupational health and safety.

The Occupational Health and Safety Law (Pyidaungsu Hluttaw Law no.8/2019)

8 (a), 9(a,b)	• Anyone who wishes to begin establishing a business in any of the industries to which this Law applies shall apply for Permission, for the purposes of safety and health, to the Department in accordance with the prescribed requirements. • Anyone who wishes to construct a new building, extend or demolish an existing building, in accordance with the process therein, arrange machines according to the layout, to install, extend, or modify any machines in any industries to which this Law applies, shall apply to the Department for prior approval with respect to occupational safety and health.

The Conservation of Water Resources and Rivers Law, 2006

No. 8	No person shall: (a) carry out any act or channel shifting with the aim to ruin the water resources and rivers and creeks. (b) cause the wastage of water resources wilfully.
9	No person shall destroy, cause damage or cause collision of vessel with the river training structure either wholly or partly.

Laws and Regulations	Description
11	dispose of engine oil, chemical, poisonous material and other materials which may cause environmental damage, or dispose of explosives from the bank or from a vessel which is plying, vessel which has berthed, anchored, stranded or sunk. catch aquatic creatures within river-creek boundary, bank boundary or waterfront boundary with poisonous materials or explosives.
12	No person shall carry out growing of garden, digging, filling, silt trapping, closing pond, dyke building or erecting spur in the river-creek boundary, bank boundary and waterfront boundary without the permission of the relevant government department and organization.
13	No person shall carry out sand suction, sand dredging, sand excavating, river shingle suction, panning for gold, gold mineral dredging or resource production for commercial purpose in the river-creek boundary, bank boundary and waterfront boundary without the recommendation of the Directorate.
19	No one shall dispose of any substance into the river-creek that may cause damage to waterway or change of watercourse from the bank or vessel which is plying, vessel which has berthed, anchored, stranded or sunk.
21	No one shall: build lavatories unsuitable to the urban and rural community lifestyle in the bank area and watercourse area. drill well or pond or dig earth without the permission of the Directorate.
22	No one shall, without the permission of the Directorate, pile sand, shingle and other heavy materials for business purposes in the bank area and waterfront area.

Laws and Regulations	Description
24(b)	No one shall: (b) violate the conditions prescribed by the Directorate so as not to cause water pollution and change of watercourse in rivers and creeks.
30	Any government department and organization or any person desirous of constructing drainage, utilizing river water intake, constructing bridges spanning rivers, connecting underground pipe, connecting underground electric power cable, connecting underground telecom cable or digging in rivers and creeks, bank boundary and waterfront boundary, under the requirement of work, shall in order not to adversely affect the water resources and rivers and creeks, carry out only after obtaining the approval of the Ministry of Transport.

The Forest Law (2018)

The Forest Law is enacted by Pyihtaungsu Hluttaw in September, 2018. It empowers, to declare for the reserved forest for the maintaining a sustained yield of the forest produce, to manage the forest land.

Section 12	(a) mentioned that it needs prior approval from the Ministry if desirous to implement the development work or economic project within a forest land and forest covered land. (c) Whoever desirous to undertake as in sub-section (a), has to comply the Environmental Conservation Law and the stipulations from respective Laws.

The Protection of Biodiversity and Protected Area Law (2018)

Section 3	There it described its objectives as: (a) To implement the National Biodiversity Strategy and policy; (d)To control the trade of production of wildlife and wildplants; (e)To protect the areas which are significant in geological conditions, the habits of endangered wildlifes and wildplants.

Laws and Regulations	Description
Section 40	There it is mentioned the penalties up to five years imprisoment and fines three hundred thousands kyats in any or both for finding guilty in breaching the undermentioned prohibitions. (a)Hunting or selling the partially protected wildlifes, storing, carriage or transferring part of its without permission; (b)Collecting, Extracting and Destroying in any ways the protected wildplants without permission (d)The altering, transferring, destroying or deforming in any ways to the marks for Protected Areas, Zoological Gardens or Botanical being involved in financing by Government without permission.
Section 41	There it mentioned the penalties to three years and up to ten years imprisonment for finding guilty in breaching (a) Hunting or selling the fully protected wildlifes, storing, carriage or transferring part of its without permission; (c) The exporting, sub-exporting, importing the animals and plants which are protected and control in international trade without recommendation issued according to section 23, sub-section (a) and (b)

National Sustainable Development Strategy (2009)

Sustainable management of natural resources in Myanmar, from environmental perspective comprises 11 areas, in which mining sector development concerned are as follow:

Sustainable forest resources management;

Biodiversity conservation;

Sustainable fresh water resources management;

Environmental quality management and enhancement;

Sustainable management of land resources;

Sustainable management for mineral resources utilization;

Laws and Regulations	Description
	Sustainable energy production and consumption; and Sustainable industrial, transport and communication development.
National Environmental Policy (1994)	
	Under this policy, the main environmental body was the NCEA. Prior to the establishment of MONREC, environmental conservation was undertaken by various ministries and departments. In 1990, the NCEA was established to advise the government on environmental policy, to act as a focal point and as a coordinating body for environmental affairs and to promote environmentally sound and sustainable development. The NCEA's main mission is to ensure sustainable use of environmental resources and to promote environmentally sound practices in industry and other economic activities, objectives and mandates.
Public Health Law, 1972	
	Purpose: to ensure the public health include not only employees but also resident people and cooperation with the authorized person or organization of health department. It is concerned with the protection of peoples' health by controlling the quality and cleanliness of food, drugs, environmental sanitation, epidemic diseases and regulation of private clinics. The project owner will cooperate with the authorized person or organization in line with the section 3(1), 4 and 5 of said law. Section 3: There mentioned that the Government can undertake advising, inspection, maintaining, prohibiting the activities including the environmental health for the purpose of protection of public health, for better improvement of public health no matter what had been prescribed in any act and rules. The clause (1) of section (3) specifies for the activities of environmental health as: The collection and disposing wastes, rubbishes from the public area. The protection of drinking water quality for the public in accordance with the international standard. The protection of air pollution around public area from hazardous emissions, odors, particulates, noise and radiation. The undertaking for healthy and cleanness for the buildings or places where public utilize and for the purposes of civils development, housing.

Laws and Regulations	Description
	The project owner will abide by any instruction or stipulation for public health. Section 4: Prescribed as that the Government has the right to organize and empowered to any department, organization under Government to undertake any activity in accordance with this law. Section 5: There mentioned to inspect in any time at the factories, business, shops, premises, places, buildings for the purposes of public health.
Myanmar Investment Law, 2016	
Act 50(d)	The investor shall register the land lease contract at the Office of Registry of Deeds in accordance with the Registration Act.
Act 51	The investor: (a) may appoint of any citizen who is a qualified person as senior manager, technical and operational expert, and advisor in his investment within the Union in accordance with the Laws; (b) shall appoint them to replace, after providing for capacity building programs in order to be able to appoint citizens to different level positions of management, technical and operational experts, and advisors; (c) shall appoint only citizens for works which does not require skill; (d) shall appoint skilled citizen and foreign workers, technicians, and staff by signing an employment contract between employer and employee in accordance with the labor laws and rules; (e) shall ensure to obtain the entitlements and rights in the labor laws and rules, including minimum wages and salary, leave, holiday, overtime fee, damages, compensation of the workman, social welfare, and other insurance relating to workers in stipulating the rights and duties of employers and employees and occupational terms and conditions in the employment contract;

Laws and Regulations	Description
	(f) shall settle disputes arising among employers, among workers, between employers and workers, and technicians or staff in the investment in accordance with the applicable laws.
Act65	It is prescribed that the investor: (e) shall immediately inform to the Commission if it is found that natural mineral resources or antique objects and treasure trove are not related to the investment permitted above and under the land on which the investor is entitled to lease or use and not included in the original contracts. If the Commission allows, the investor shall continue to carry out the investment in such land, and if not allowed, the investor shall transfer and carry out, by obtaining the permission, at the substituted place which is selected and submitted by him; (f) shall not make any significant alteration of topography or elevation of the land on which he is entitled to lease or to use, without the approval of the Commission; (g) shall abide by applicable laws, rules, procedures and best standards practiced internationally for this investment so as not to cause damage, pollution, and loss to the natural and social environment and not to cause damage to cultural heritage; (h) shall list and keep proper records of books of account and annual financial statement, and necessary financial matters relating to the investments performed by permit or endorsement in accordance with internationally and locally recognized accounting standards; (i) shall close and discontinue the investment only after payment of compensation to employees in accordance with applicable laws for any breach of employment contracts, closure of investment, sale and transfer of investment,

Laws and Regulations	Description
	discontinuation of investment, or reduction of workforce; (j) shall pay wages and salaries to employees in accordance with applicable laws, rules, procedures, directives and so forth during the period of suspension of investment for a credible reason; (k) shall pay compensation and indemnification in accordance with applicable laws to the relevant employee or his successor for injury, disability, disease and death due to the work; (l) shall supervise foreign experts, supervisors and their families, who employ in their investment, to abide by the applicable laws, rules, orders and directives, and the culture and traditions of Myanmar; (m) shall respect and comply with the labor laws; (o) shall pay effective compensation for loss incurred to the victim, if there are damage to the natural environment and socioeconomic losses caused by logging or extraction of natural resources which are not related to the scope of the permissible investment, except from carrying out the activities required to conduct investment in a permit or an endorsement. (p) shall allow the Commission to inspect in any places, when the Commission informs the prior notice to inspect the investment; (q) shall take in advance permit or endorsement of the Commission for the investments which need to obtain prior approval under the Environmental Conservation Law and the procedures of environmental impact assessment, before undertaking the assessment, and shall submit the situation of environmental and social impact assessment to the Commission along the period of

Laws and Regulations	Description
	activities of the investments which obtained permit or endorsement of the Commission.
Act 73	The investor shall insure the types of insurance stipulated in the provision of the rules at any insurance enterprise which is entitled to carry out insurance businesses within the Union.
The Labour Organization Law 2011	
Section 17 to 22	17. The labour organizations shall have the right to carry out freely in drawing up their constitution and rules, in electing their representatives, in organizing their administration and activities or in formulating their programmes. The Labour Organizations have the right to negotiate and settle with the employer if the workers are unable to obtain and enjoy the rights of the workers contained in the labour laws and to submit demands to the employer and claim in accord with the relevant law if the agreement cannot be reached. 18. The labour organization has the right to demand the relevant employer to re-appoint a worker if such worker is dismissed by the employer and if there is cause to believe that the reasons of such dismissal were based on labour organization membership or activities, or were not in conformity with the labour laws. 19. The labour organizations have the right to send representatives to the Conciliation Body in settling a dispute between the employer and the worker. Similarly, they have the right to send representatives to the Conciliation Tribunals formed with the representatives from the various levels of labour organizations. 20. In discussing with the Government, the employer and the complaining workers in respect of worker's rights or interests contained in the labour laws, the representatives of the labour organization also have the right to participate and discuss. 21. The labour organizations have the right to participate in solving the collective bargains of the workers in accord with the labour laws.

Laws and Regulations	Description
	22. The labour organizations shall carry out peacefully in carrying out holding of meetings, going on strike and carrying out other collective activities in accord with their procedure, regulations, by-laws and any directives prescribed by the relevant Labour Federation.
Myanmar Investment Rules, Notification No. 35 / 2017 by Ministry of Planning and Finance	
Section 202	The Investor must comply with the conditions of the Permit and other applicable laws when making an Investment.
Section 203	The Investor shall fully assist while negotiating with the Authority for settling the grievances of the local community that have been effected due to Investments.
Section 206	If the Investor is desirous to appoint a foreigner as senior management, technician expert or consultant according to section 51 (a) of the Law, it shall submit such foreigner's passport, expertise evidence or degree and profile to the Commission Office for approval.
The Settlement of Labour Dispute Law 2012	
Section 38	No employer shall fail to negotiate and coordinate in respect of the complaint within the prescribed period without sufficient cause.
Section 39	No employer shall alter the conditions of service relating to workers concerned in such dispute at the consecutive period before commencing the dispute within the period under investigation of the dispute before the Arbitration Body or Tribunal, to affect the interest of such workers immediately.
Section 40	No party shall proceed to lock-out or strike without accepting negotiation, conciliation and arbitration by Arbitration Body in accord with this law in respect of a dispute.

Laws and Regulations	Description
Section 51	If any employer, in the course of settlement of dispute, commits any act or omission, without sufficient cause, which by causing a reduction in production resulting so as to reduce the workers' benefits shall be liable to pay full compensation in the amount determined by the Arbitration Body or Tribunal. Such money shall be recovered as the arrear of land revenue.

The Leaves and Holidays Act 1951

Under the Leave and Holidays Act (1951), every employee shall be granted paid public holidays as announced by the Government in the Myanmar Gazette. On average, Myanmar has 26 public holidays per year, depending on the date of the variable holidays. Myanmar law recognizes various types of leave. Leave is governed by the Leave and Holidays Act (1951), but additional rules may apply in accordance with other laws, such as the Social Security Law (2012) for employees contributing to the Social Security Fund.

Section 4	Every employee who has completed a period of twelve months continuous service shall be granted earned leave with average wages or average pay for a period of ten consecutive days by his employer during the subsequent period of twelve months.

The Minimum Wage Law, 2013

Section 12	The employer: (a) shall not pay wage to the worker less than the minimum wage stipulated under this Law; (b) may pay more than the minimum wage stipulated under this Law; (c) shall not have the right to deduct any other wage except the wage for which it has the right to deduct as stipulated in the notification issued under this Law; (d) shall pay the minimum wage to the workers working in the commercial, production and service business in cash. Moreover, if the specific benefits, interests or opportunities are to be paid, it may be paid in cash or partly in cash and partly in property, with prevailing regional price, jointly according to the desire of the worker;

Laws and Regulations	Description
	(e) in paying minimum wage to the workers working in the agricultural and livestock business, some cash and some property at prevailing regional price may be paid jointly according to local custom or desire of the majority of workers or collective agreement. Such payment shall be for any personal use and benefit of the worker and his family and the value shall also be considerable and fair.
Section 13(a) to (g)	The employer: (a) shall inform the workers the rates of minimum wage relating to the business among the rates of minimum wage stipulated under this Law and advertise it at the workplace to enable to be seen by the relevant workers; (b) shall prepare and maintain the lists, schedules, documents and wages of the workers correctly; (c) shall report the lists, schedules and documents prepared and maintained under subsection(b) to the relevant department in accord with the stipulations; (d) shall accept the inspection when summoned by the inspection officer. Moreover, he shall produce the said lists and documents upon asking to submit; (e) shall allow the entry and inspection of the inspection officer to the commercial, production and service businesses, agricultural and livestock breeding workplaces and give necessary assistances; (f) if the workers cannot work due to sickness, shall give them holiday for medical treatment in accord with the stipulations; (g) if the funeral matter of the member of the family of worker or his parent occurs, shall give holiday without deducting from the minimum wage, in accord with the stipulations.
The Payment of Wages Act 2016	
Section 3	The employer must…

Laws and Regulations	Description
	(a) Pay in local currency or foreign currency recognized by the Central Bank of Myanmar. This may be in cash, check or deposit into the bank account of Employee. (b) Moreover, pay can be in the means of… (1) Totally in cash OR half the cash and half in things set according to the local price to those employees working in trade, manufacturing and service sectors. (2) Totally in cash OR half the cash and half in things set as local price according to local traditions or common agreement to those working in agriculture and livestock sectors. But, this must be for the sake of the employees and their families. And, it also must be reasonable/fair. (3) An employee shall receive the payment for 60 days when he/she is in Alternative Civil Service.
Section 4	An employer must pay for… (a) Part-time, daily, weekly or other part-time job, temporary or piecework when the work is done OR at the agreed time. (b) According to the Article (a), the time frame shall not exceed one month. (c) Wages for the permanent work must pay per monthly basis. If so… (1) Must pay at the end of the payment period when there are not more than 100 workers. (2) If there are 100 workers and above, pay must not be administered later than 5 days after the end of the payment period. (d) Upon termination, wages must be paid within 2 days from the date of termination. (e) If a resignation letter is submitted, wages must be paid at the ending day of the payment period.

Laws and Regulations	Description
	(f) If an employee dies, wages must be paid to the legally recognized heir within 2 working days after the day he/she has died. (g) All wages must be paid during the working day.
Section 5	If the owner encounters difficulty to pay the wages according to Section 4 sub-section (c) because of significant happenings, including natural disaster, the employer must report to the Department with solid evidence that wages will be paid at the mentioned day upon the workers' agreement.
Section 7	The Employer… (a) Can deduct from wages for absences except when such absence is during a public holiday or entitled leave, according to the law. (b) Accommodation charges and transportation charges, meal allowances, charges for water and electricity, taxes and errors in payment shall be allowed for deduction. (c) Can deduct from pre-issued, expensed and saved (or) contributed amount according to the law upon the employee contract. (d) The Employer can deduct with the judgment of the Court of Arbitrator Jury Council.
Section 8	The Employer cannot deduct except the deduction in accordance with Section 7 and Section 11.
Section 9	The total amount of other deductions, except when the employee fails to perform their duties, shall not be more than 50% of the employee's wages.
Section 11	Employers shall fine for the following actions or performance failure by the employees… (a) Direct damage which is either intentional or due to negligence or due to the failure of the employee concerned with company property to take proper care.

Laws and Regulations	Description
	(b) A breach of the employment contract or breech of any rules for which a fine had been previously set.
Section 12	If a worker… (a) Encounters any one of the following situations, he/she shall ask directly or via a registered Labor Organization or by the in-house Workplace Coordination Committee to the Employer: (1) Any unreasonable deduction from wages (2) Payment which is not made by the due date. (b) If the Employer takes no action, although asked in accordance with Section 12 Sub-Section (a), the Employee can present this to the Inspector within 6 month from the date of the deduction or from the date of the failure to render payment.
Section 13	(a) The Inspector shall issue a decree after reviewing the case presented in accordance with Section 12 Sub-Section (b). (b) Not only the Employee, but also the Employer, has 30 days to appeal to the Chief of Inspector if they are not satisfied with the order. (c) The Chief of Inspector shall decree after reviewing the appeal applied in accordance with Sub-Section (b). (d) The Chief of Inspector's decision will be the final decision.
Section 14	If an Employee carries out overtime work, he/she must be allowed the presiding overtime rate as set by the Law.
Employment and skill Development Law 2013	
Section 5	This section described in detail for making contract of employment

Laws and Regulations	Description
Section 14	The skill development team to develop the skill relating to the employment for the workers who are proposed to appoint and working at present. The work requirement in line with the policy of the skill development team to develop the skill relating to the employment for the workers who are proposed to appoint and working at present.
Section 30(a)	The employer of the industry and service business shall put in to the fund monthly as put in fees without fail for the total wages of the subordinates and the supervisors' salary for not less than 0.5%;
Section 30(b)	Put in money paid under sub-section (a) shall not be deducted from the wage and salary of the employees.
The Social Security Law 2012	
Section 11 (a)	The following establishments shall be applied with the provisions for compulsory registration for social security system and benefits contained in this Law if they employ minimum number of workers and above determined by the Ministry of Labour in co-ordination with the Social Security Board: (i) industries which carry out business whether or not they utilize mechanical power or a certain kind of power, businesses of manufacturing, repairing and servicing, or engineering businesses, factories, warehouses and establishments; (ii) Government departments, Government organizations and regional administrative organizations which carry out business; (iii) development organizations; (iv) financial organizations; (v) companies, associations, organizations, and their subordinate departments and branch offices which carry out business; (vi) shops, commercial establishments, public entertaining establishments;

Laws and Regulations	Description
	(vii) Government departments and Government organizations which carry out business or transport businesses owned by regional administrative body, and transport businesses carried out with the permission of such department, body or in joint venture with such department or body; (viii) constructions carried out for a period of one year and above under employment agreement; (ix) businesses carried out with foreign investment or citizen investment or joint ventured businesses; (x) businesses relating to mining and gem contained in any existing law; (xi) businesses relating to petroleum and natural gas contained in any existing law; (xii) ports and out-ports contained in any existing law; (xiii) businesses and organizations carried out with freight handling workers; (xiv) Ministry of Labour and its subordinate departments and organizations; (xv) establishments determined by the Ministry of Labour, from time to time, that they shall be applied with the provisions of compulsory registration for Social Security System and benefits contained in this Law in co-ordination with the Social Security Board and with the approval of the Union Government;
Section 15 (a)	The following funds are included in the Social Security Fund: (i) health and social care fund; (ii) family assistance fund; (iii) invalidity benefit, superannuation benefit, and survivors' benefit fund; (iv) unemployment benefit fund;

Laws and Regulations	Description
	(v) other social security fund for social security system of compulsory registration and contribution stipulated by the Ministry of Labour, in co-ordination with the Social Security Board, under clause (ii) of sub-section (e) of section 13; (vi) other social security fund stipulated that contribution may be paid after voluntary registration under clause (ii) of sub-section (e) of section 13; (vii) Social Security Housing Plan fund;
Section 18 (b)	The employer shall deduct contributions to be paid by worker from his wages together with contribution to be paid by him and pay to the social security fund. The employer shall also incur the expense for such contribution;
Section 48	(a) The employer shall effect insurance by registering at the relevant township social security office in order to get employment injury benefit by the workers applied to provisions of compulsory registration for employment injury benefit insurance system contained in section 45 and by paying contribution to employment injury benefit fund in accord with the stipulations; (b) The employers may effect insurance by registering voluntarily for the workers who are not applied to provisions of compulsory registration for employment injury benefit insurance system and by paying stipulated contribution to employment injury benefit insurance fund; When registering to effect insurance for employment injury benefit under sub-sections (a) and (b), the worker shall submit medical certificate.
Section 49	The employers and insured of establishments where the employer had registered compulsorily under sub-section (a) of section 48 or where the employer had registered voluntarily under sub-section (b) of section 48 who have paid contribution to employment injury benefit fund shall not apply to the provisions contained in the Workmen's Compensation Act in respect of the

Laws and Regulations	Description
	employment injury benefit; (b) The insured who has effected insurance for employment injury benefit under sub-sections (a) and (b) of section 48 shall only be entitled to employment injury benefits contained in this Law.
Section 75	The employers of establishments applied by this Law: (a) shall prepare and keep the following records and lists correctly and submit to the relevant township social security office in accord with the stipulations: (i) records and lists of workers' daily attendance; (ii) records on appointment of new workers, employing worker by changing of work, termination, dismissal and resignation; (iii) records on promotion and paying remuneration ; (iv) records and lists of employer, manager, and administrator and records on change of them; (b) shall inform the relevant township social security office if the following matters arise: (i) changes in number of workers and address of establishment; (ii) change of employer, change of business, suspension of work, and close-down of work; (iii) employment injury, decease and contracting diseases; (c) shall submit records of work and lists if requested by inspectorate or official assigned by the Social Security Head Office and various levels of Regional Social Security Office under this Law.
Law protecting Ethnic Right, 2015	
	This is for the Equal right between the Ethnics living in Myanmar. It enacted that if an ethnic loose the right, he can complain to the Regional or State Government to get the equal chance and find the equal right. Clause 5 of Chapter IV provides that project matters shall be informed, coordinated and undertaken in

Laws and Regulations	Description
	consultation with ethnic groups if projects are in areas with ethnic groups. The Succeeding laws to protect the right of Myanmar national similar in nature to this are: ***Monogamy Law (2015):*** Concerning all those who are living in Myanmar, Myanmar Citizens who live outside of Myanmar, and foreigners who marry Myanmar citizens while living in Myanmar for preventing misconducting marriages. ***Buddhist Women Special Marriage Law (2015):*** Concerning the marriage between Buddhist Woman and other religious man. There prescribed the legal procedure, the conditions to be complied by non-Buddhist husband, the customs for dividing property when divorcing. ***Religious Conversion Law (2015):*** This is enacted for the freedom to convert from one religion to another, or a person without a religion has the freedom to convert to a religion. There prohibited to apply for a religious conversion with an intent to insult, disrespect, destroy, or abuse a religion. **Population Control Healthcare Law (2015);** This is for alleviate poverty, provide adequate quality healthcare, and ensure that family planning improves maternal and child health in the country. This Empowers region or state government that concerned with the special zone for healthcare to form region or state population control healthcare group to implementing the task as per the directives of the Ministry and region or state government and the Union Territory Governing body.
Control of smoking and consumption of Tobacco product law 2006	
Section 9	The person-in-charge shall: (a) Keep the caption and mark referring that it is a non-smoking area at the place mentioned in section 6 in accordance with the stipulations. (b) Arrange the specific place where smoking is allowed as mentioned in section 7, and keep the caption and mark also referring that it is a specific place where smoking is allowed, in accordance with the stipulations.

Laws and Regulations	Description
	(c) Supervise and carry out measures so that no one shall smoke at the non-smoking area. (d) Accept the inspection when the supervisory body comes to the place for which he is responsible.
The Protection and Preservation of Ancient Monuments Law 2015	
Section 12	If a person who finds an ancient monument of over one hundred years old and above or under the ground or above or under the water which has no owner or custodian knows or it seems reasonable to assume that the said monument is an ancient monument, he shall promptly inform the relevant Ward or Village-Tract Administrative Office.
Section 15	A person desirous of any of the followings within the specified area of an ancient monument shall apply to get prior permission to the Department: (a) extending towns, wards and villages; (b) constructing or extending or repairing new buildings including hotels, factories and residential buildings or fencing or extending a fence; (c) digging to search petroleum, natural gas, gem or mineral, piping petroleum and natural gas, constructing factories, connecting national grid, constructing communication tower, constructing or extending infrastructures such as road, bridge, airfield, irrigation and embankment; (d) connecting underground electric cable, communication cable and other underground works; (e) digging or extending wells, lakes, cannels and ponds; (f) gold sieving, digging, burning bricks, digging well, lake, creek, ditch, gully, pit digging, refilling, levelling, mining, quarry, gravel digging and unearth sand, removing the mounds and hills which can damage the physical feature of the land

Laws and Regulations	Description
	(g) placing and fencing ancient monuments in a private compound and area; (h) constructing a building which is not consistent with the terms and conditions stipulated according to the region by the Ministry near and at the surrounding of an ancient monument.
Section 20	No one shall carry out any of the following acts which is assumed to cause damage to an ancient monument within the specified area of an ancient monument or of a listed ancient monument without a written prior permission: (a) taking photo, video, film or copying and modeling an ancient monument stipulated as a listed ancient monument for commercial purposes; (b) using machines which causes vibration within the specified place of an ancient monument and running various types of vehicles (c) cultivating, gardening, breeding, fencing by blocking nearby an ancient monument or doing any other act which can affect an ancient monument; (d) emission of gas such as hot-air balloon which can affect an ancient monument; (e) landing and taking off and, flying aeroplane and helicopter which can directly or indirectly affect an ancient monument (f) discarding chemical substance and rubbish which can affect an ancient monument and the environment.

The Protection and Preservation of Cultural Heritage Regions Law, 1998

The State Peace and Development Council Law enacted this law by Law No. 9/ 98 on the date of 10 September, 1998. The Ministry of Culture may, with the approval of the Government issue notification for the protection of cultural heritage areas are categorized as following kinds of zones / region:

a) Ancient monumental zone;

Laws and Regulations	Description
b) Ancient site zone.	
Section 13	A person desirous of carrying out one of the following shall abide by the provisions of other existing laws and also apply to the Department in accordance with stipulations to obtain prior permission under this Law (a) within the ancient monumental zone or the ancient site zone:- (1) constructing or extending a building; (2) renovating the ancient monument or extending the boundary of its enclosure; (b) within the protected and preserved zone, constructing, extending, renovating a hotel, motel, guest house, lodging house or industrial building or extending the boundary of its enclosure; (c) within the cultural heritage region:- (1) carrying out the renovation and maintenance work of the ancient monument without altering the original ancient form and structure or original ancient workmanship; (2) carrying out archaeological excavations; (3) building road, constructing bridge, irrigation canal and embankment or extending the same.
Section 16	The Department of Archaeology:- (a) may, after scrutinizing in accordance with the stipulations the application submitted under section 15, grant or refuse permission; (b) shall, when permission is granted under section (a), issue the permit to the applicant together with the conditions to be observed.
Section 18	No person shall, without prior permission granted under this law, construct, extend, renovate a building or extend the boundary of its enclosure in the ancient monumental zone or ancient site zone.

Laws and Regulations	Description
Section 22	No person shall construct a building which is not in conformity with the conditions prescribed region wise by the Ministry of Culture in the cultural heritage region.
The Myanmar Insurance Law 1993	
Section 15	Owners of motor vehicles shall effect compulsory Third Party Liability Insurance with the Myanmar Insurance.
Section 16	An entrepreneur or an organization operating an enterprise which may cause loss to State-owned property or which may cause damage to the life and property of the public or which may cause pollution to the environment shall effect compulsory General Liability Insurance with the Myanmar Insurance.
Explosives Act (1887)	
The President of the Union make rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a licence granted as provided by those rules, the manufacture, possession, use, sale, transport and importation of explosives, or any specified class of explosives.	
Myanmar Engineering council 2013	
Section 20	If the holder of a technological degree or technological diploma, conferred by any engineering university, any technological university, any technological college or any technological institute within the country or abroad, wishes to obtain a registered graduate technologist certificate or a registered technician certificate, he shall apply to the council in accordance with the stipulations.
Section 24	(a) A registered technician certificate holder may apply to the council in accordance with the stipulations to obtain a registered graduate technologist certificate upon the specified period having elapsed;

Laws and Regulations	Description
	(b) The executive committee shall, on behalf of the council, issue a registered graduate technologist certificate to a registered technician who has passed the examination held by the council in the respective specialized engineering subject and who meets the specified qualifications of a registered graduate technologist, and fix the terms and conditions of the registration.
Section 25	(a) A registered graduate technologist certificate holder may apply to the council in accordance with the stipulations to obtain a registered engineer certificate upon the specified period having elapsed. (b) The executive committee shall, on behalf of the council, issue a registered engineer certificate to a registered graduate technologist who has passed the examination held by the council in the respective specialized engineering subject and who meets the specified qualifications of a registered engineer, and fix the terms and conditions of the registration.
Section 31(a)(b)	(a) If a foreign engineer who meets the requirements applies to the council for issuance of a registered limited engineer certificate, the executive committee shall, on behalf of the council, fix the permitted engineering subjects, the permitted status, the permitted region, the permitted time and other terms and conditions and issue, upon payment of the registration fee and the annual fees, the registered limited engineer certificate. (b) If a foreign registered professional engineer who meets the requirements in accordance with the ASEAN Mutual Recognition Arrangement on Engineering Services applies to the council for issuance of a registered limited professional engineer certificate, the executive committee shall, on behalf of the council, fix the permitted engineering subjects, the permitted status, the permitted region, the permitted time and other terms and conditions and issue, upon payment of the registration fee and the annual fees, a registered limited professional engineer certificate.

Laws and Regulations	Description
Section 37	No one shall perform any engineering work and technological work which are specified as being dangerous to the public by a rule enacted under this law without having received a registration certificate issued by the council, except for engineers appointed in a government department or an organization in the performance of their duties.
Myanmar Fire Service Law, 2015	
N0. 25	No person shall fail to abide by the directives in respect of fire precaution and prevention issued under section 17 by the Township Fire Services Department.
Prevention from Danger of Hazardous Chemical and Associated Material Law (Pyidaungsu Hluttaw Law No 28/2013)	
Section 8	The duty and powers of the central supervising team are as follows: (a) Supervising and directing whether the chemical and associated materials produced by the chemical and associated materials business are in compliance with the standard norm or not; (b) Forming and specifying the duty and responsibility of the supervising teams of the region, the state, the union territory, self-administered division, self-administered region, district or township, with the consent of central body; (c) Specifying safety rules and regulations in connection with the chemical and associated materials businesses; (d) Advising the central body the names of the chemical and associated materials which should be amended or supplemented or abolished from the list of the national level chemical and associated materials; (e) Carrying out the educating work in the permitted and used chemical and associated materials for transporting, keeping, buying, distributing, selling, storing, using and disposing systematically;

Laws and Regulations	Description
	(f) Attending local and foreign trainings for keeping and using the safety devices and personal protective equipment systemically, in order to prevent and alleviate occurring of accidents with respect to chemical and associated materials; (g) Specifying rules and regulations relating to the transporting, storing, using and disposing methods for the chemical and associated materials; (h) Prohibiting the importing and exporting of deterred chemical and associated materials or the equipment utilized for these materials, in accord with the international agreement; (i) Specifying regulations and inspecting whether the specified regulations are followed or not in connection with the vapor, liquid, oil and solid waste emitted from chemical and associated materials businesses, destroying, dumping, disposing of damaging or expired chemical and associated materials; (j) Issuing or refusing the recommendation for transit trading from the country, importing or exporting the chemical and associated materials; (k) Specifying danger level and danger types of the chemical and associated materials; (l) Specifying the regulation for license and registered certificate; (m) Performing the duty and responsibilities assigned by the central body.
Section 15	Before doing the business for the relevant chemical and associated materials, the license holder: (a) Shall be inspected by the relevant supervising team and inspecting team for the safety and endurance of the equipment; (b) The persons, who are discharging the duty shall be asked to attend the relevant foreign training or for the trainings for prevention from the danger of

Laws and Regulations	Description
	chemical and the associated materials conducted by the government department and organizations.
Section 16	The license holders: (a) Shall follow the principles contained in the license; (b) Shall follow the directives for safety in handling the chemical and associated materials and shall ask the workers to follow strictly ; (c) Shall keep the necessary safety equipment sufficiently in the chemical and associated materials business and shall issue personal protective equipment and clothing to the workers free of charge; (d) Shall give the course to use personal protective equipment and clothing systematically, to give the training and shall instruct as necessary the chemical and associated materials business; (e) In respect of whether affecting the danger to the health of man and animals, environment or not, shall be examined by the relevant supervising teams and inspection teams; (f) Shall give the medical check-up to the workers who shall do the chemical and associated material business and shall allow to working in the said business if they have the recommendation to fit for the health. Shall keep the records of the medical check-up of them systematically; (g) If the dangerous chemical and associated materials are allowed to store, shall give the copy of the permit to the relevant township general administration department; (h) If the business is prone to the fire hazard using inflammable materials or explosives, the prior consent, directive of the relevant fire service department must be taken; (i) Shall transport the allowed amount in accord with the stipulations upon transporting the chemical and the associated materials in the country;

Laws and Regulations	Description
	(j) Shall get the approval of the central supervising body if the chemical and the associated materials are transported from the permitted region to any other region; (k) Shall follow to abide by the law relating to the environment in order not to impact the environment in doing the chemical and the associated materials business.
Section 17	The license holder shall keep the insurance in accord with the stipulations to pay for the compensation if any loss occurred to man and animals or environment in respect of the chemical and associated materials business.
Section 20	License holder shall apply to the central supervising body in accord with the stipulation for the relevant chemicals and associated materials using for his chemicals and associated materials business.
Section 22	The registered certificate holder shall abide by the regulations contained in the registered certificate and shall follow the order and directives issued from time to time by the central supervising body.
Section 23	The registered certificate holder: (a) Shall apply again to the central supervising body to register if he wants to use the chemical in the associated materials which are not contained in the registered list; (b) Shall inform to the central supervising body if he does not want to use the chemical in the associated materials which are contained in the registered list.
Section 27	The license holders shall follow the stipulations of the following items to control, prevent and alleviate the danger relating to the chemical and associated materials: (a) To classify the danger level according to the properties of the chemical and associated materials so as to prevent the danger in advance;

Laws and Regulations	Description
	(b) To reveal the danger warning sign and safety level certificate; (c) To attend the training for keeping the personal protective equipment and using them systematically to prevent and elevate accident; (d) To carry out in accord with the stipulations in connection with transporting, keeping, storing, using and disposing the chemical and associated materials; (e) Importing or exporting the chemical and associated materials which are prohibited by the central supervising team, the equipment which are used inside the said materials.
The Private Industrial Enterprise Law 1990	
Section 4	(a) Any person desirous of conducting any private industrial enterprise; (b) Any person conducting any private industrial enterprise on the day this Law is enacted; by using any type of power which is three horsepower and above or manpower of ten wage-earning workers and above shall register under this Law.
Section 13	The duties of the entrepreneur are as follows:- (b) shall abide by the terms and conditions of the registration certificate; (c) shall conduct the enterprise by opening an account with the relevant bank in the name of its registered enterprise; (d) shall maintain systematically and fully as prescribed by the Directorate, the statement of accounts relating to the registered private industrial enterprise and shall submit the same to the relevant Government department, organization or Supervisory Body when required to do so;

Laws and Regulations	Description
	(g) shall abide by the orders and directives issued from time to time by the Ministry and the Directorate;
Section 15	The entrepreneur has the right to carry out the followings:- (a) appointing foreign exports and technicians with the approval of the Ministry; (b) carrying out change of the name of enterprise, transfer of ownership, temporary suspension or permanent closing down of the enterprise in the manner prescribed and with the approval of the Directorate.

Explosive Substances Act (1908)

Any person who unlawfully and maliciously causes, by any explosive substance, an explosion of a nature likely to endanger life or to cause serious injury to property shall, whether any injury to person or property has been actually caused or not, be punished with transportation for life or any shorter term, to which a fine may be added, or with imprisonment for a term which may extend ten years, to which a fine may be added.

Myanmar Agenda 21 (1997)

The Myanmar Agenda 21 makes recommendations for the drafting and promulgation of a framework law which can further promote the integration of environmental and developmental concerns in the decision-making processes of the country.

The Myanmar Agenda 21 contains guidelines to address the following issues:

increasing energy and material efficiency in production processes;

reducing wastes from production and promoting recycling;

promoting use of new and renewable sources of energy;

using environmentally sound technologies for sustainable production;

reducing wasteful consumption;

increasing awareness for sustainable consumption.

Laws and Regulations	Description
The Import and Export Law, 2012	
7. A person who obtained any license shall not violate the conditions contained in the license.	
The Workmen Compensation Act, 1923 (amended 2005)	
The Workmen's compensation act had been promulgated in 1923, amended in 2005, to provide for the payment by certain classes of employers to their workmen of compensation for injury by accident. There it clearly described for the liability for compensation of employer's, amount of compensation, compensation to be paid when due and penalty for default, method of calculating wages, review, commutation of half-monthly payments, payment of a lump sum amount, distribution of compensation, compensation not to be assigned, attached or charged, notice and claim, power to require from employers statements regarding fatal accidents, reports of fatal accidents and serious bodily injuries, medical examination, contracting, remedies of employer against stranger, compensation to be first charge on assets transferred by employer, special provisions relating to masters and seamen. The amendment law is for revising the monetary amount to update.	
Fresh Water Fisheries Law, 1991	
Section 36	No one shall erect, construct place, maintain or we any obstruction such as a dam, bank or weir in a freshwater fisheries waters without the permission of the Department.
Section 40	No one shall cause harassment of fish and other aquatic organisms or pollution of the water in a freshwater fisheries water.
Section 41	No one shall alter the quality of water, volume of water or the water -course in a leasable fishery, reserved fishery and creeks contiguous thereto or in water-courses.
Combating AIDS Act, 1995 , THE PREVENTION AND CONTROL OF HIV AND AIDS ACT, 2007	
Section .3	Integrate instructions on the causes, modes of transmission, prevention and protection against HIV

Laws and Regulations	Description
	and AIDS and other sexually transmitted infections in subjects taught in public and private schools at primary, secondary and tertiary levels, including formal and non-formal systems
Section 4	HIV and AIDS education and information dissemination shall form part of the delivery of healthcare services by healthcare providers.
Section 9	Consultation with the relevant registered professional associations of healthcare providers prescribe guidelines
Sectioin10	Any person or institution who, in the course of his professional practice, knowingly or negligently causes another person to be infected with HIV through unsafe or unsanitary practices or procedures contrary to this Act or any prescribed guidelines commits an offence.
The Motor Vehicles Law, 2015	
Chapter I, 2 (v)	Taking actions to conserve the green environment and the reduction in pollution of air, water, land and noises caused by motor vehicles.
The Myanmar Mines Law 1994	
Section 29	The Ministry may with the approval of the Government issue prohibitions In respect purchasing obtaining, storing, possessing, transporting, selling, transferring of any mineral obtained from mineral production.
Mandalay City Development Law, 2002	
Section 8	The Committee shall, in respect of the following functions and duties lay down policy, give guidance, supervise and implement within the City territory:- (h) carrying out environmental conservation works;
Section 24, 25, 26, 27	These section mentioned offences and penalties for violating any rules, regulations, orders and directives issued by Committee.

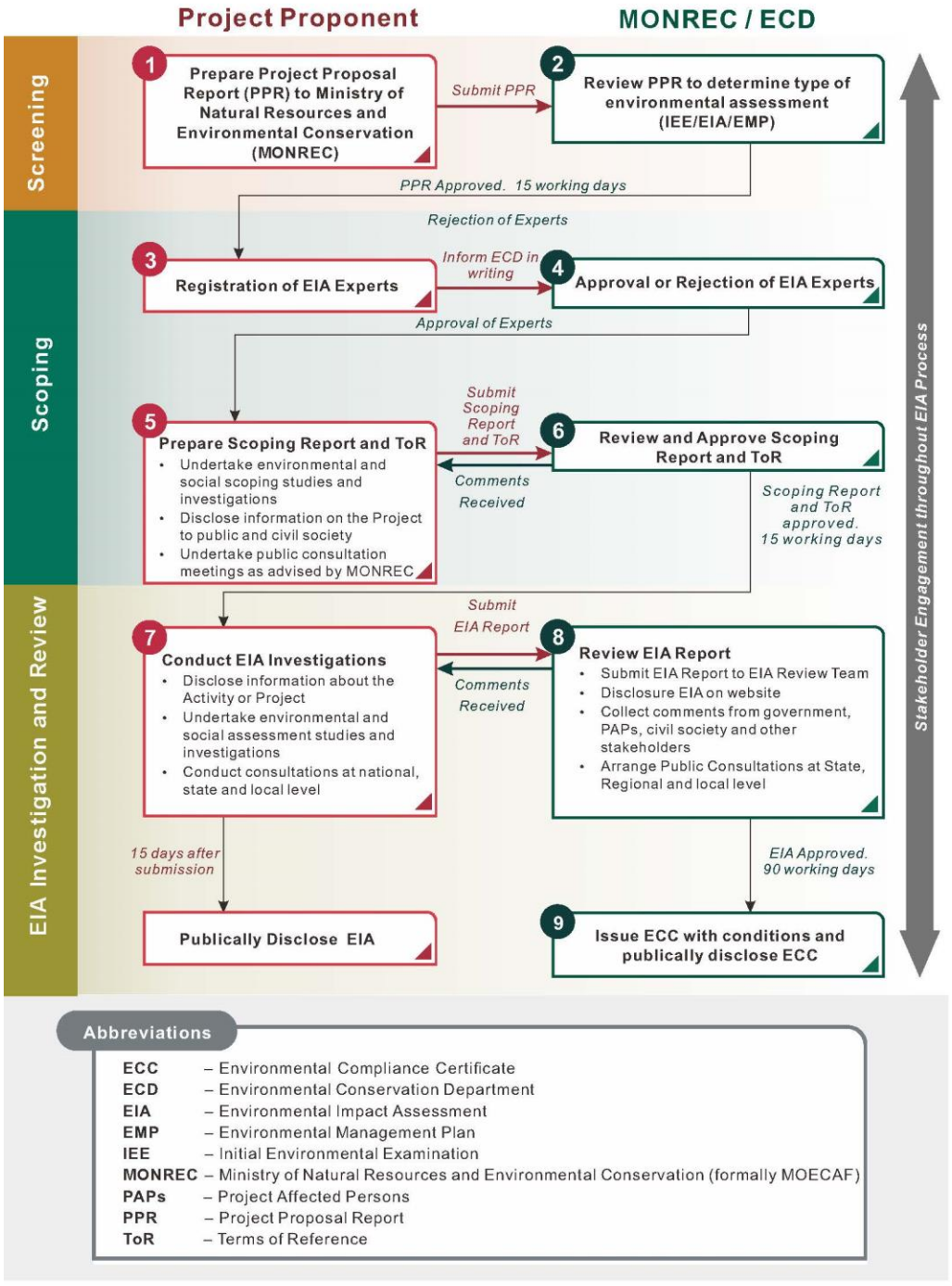
Laws and Regulations	Description
Mandalay Region Freshwater Fishery Law, 2012	
This is enacted in accordance with the power conferred in accordance with Constitution (2008), This is for purposes of Fishery sector, conserve Fish Species, protect the degrading of fresh water, to obtain taxes for the regional government, to manage and taking action for fishing sector in accordance with rules and regulations.	

3.1.1 EIA Procedure

The Myanmar EIA Procedure (dated 29 December 2015) set out the requirements for development, assessment and subsequent monitoring of an EIA. The requirements to conduct an EIA are outlined in the Environment Conservation Law (2012) and Environment Conservation Rules (2014). In addition, the EIA Procedures are supported by the draft Administrative Instruction which sets out a proposed format and content for reports.

The EIA Process is shown in *Figure 3.1*. This Project is currently in the EIA Investigation and Reporting Phase.

Figure 3.1 Myanmar EIA Procedures (2015)



3.1.2 *Environmental and Social Standards*

With the release of the Myanmar EIA Procedure in December 2015, the National Environmental Quality (Emissions) Guidelines (NEQEG) were also enacted. The NEQEG provide the basis for regulation and control of noise and air emissions and effluent discharges from projects in order to prevent pollution and protect the environment and public health. The NEQEG are noted to be equivalent to the WBG General EHS Guidelines (2007) and the WBG sector specific Environmental, Health, and Safety guidelines for Construction Materials Extraction (2007) which are summarised in *Table 3.1* to *Table 3.5* below.

Table 3.1 Noise Level Guidelines outside the Project Site Boundary

Receptor	One Hour LAeq (dBA)[a]	
	Daytime 07:00 – 2:00 (10:00 – 22:00 for Public holidays)	Nighttime 22:00 -07:00 (22:00 – 10:00 for Public holidays)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Note: [a] Equivalent continuous sound level in decibels

Table 3.2 Ambient Air Quality Guidelines

Parameter	Averaging Period	Guideline Value in µg/m³
Nitrogen dioxide	1-year	40
	1-hour	200
Ozone	8-hour daily maximum	100
Particulate matter PM_{10} (a)	1-year	20
	24-hour	50
Particulate matter $PM_{2.5}$ (b)	1-year	10
	24-hour	25
Sulphur dioxide	24-hour	20
	10-minute	500

a) $PM_{2.5}$ = Particulate matter 2.5 micrometers or less in diameter
b) PM_{10} = Particulate matter 10 micrometers or less in diameter

Table 3.3 Guideline Values for Construction Materials Extraction

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U.	6-9
Total coliform bacteria	MPN/100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

Table 3.4 Guideline Values for Parameters selected from Wastewater, Storm Water Runoff, Effluent and Sanitary Discharges (General Application)

Parameter	Unit	Maximum Concentration
5-day Biochemical oxygen demand	mg/l	50
Ammonia	mg/l	10
Arsenic	mg/l	0.1
Cadmium	mg/l	0.1
Chemical oxygen demand	mg/l	250
Chlorine (total residual)	mg/l	0.2
Chromium (hexavalent)	mg/l	0.1
Chromium (total)	mg/l	0.5
Copper	mg/l	0.5
Cyanide (free)	mg/l	0.1

Parameter	Unit	Maximum Concentration
Cyanide (total)	mg/l	1
Fluoride	mg/l	20
Heavy metals (total)	mg/l	10
Iron	mg/l	3.5
Lead	mg/l	0.1
Mercury	mg/l	0.01
Nickel	mg/l	0.5
Oil and grease	mg/l	10
pH	S.U.a	6-9
Phenols	mg/l	0.5
Selenium	mg/l	0.1
Silver	mg/l	0.5
Sulphide	mg/l	1
Temperature increase	°C	<3
Total coliform bacteria	100 ml	400
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50
Zinc	mg/l	2

Table 3.5 Guideline Values for Biosolids and Sludge Disposal

Parameter	Unit	Maximum Concentration
Arsenic	mg/kg	75
Cadmium	mg/kg	85
Chromium (total)	mg/kg	3,000
Copper	mg/kg	4,300
Lead	mg/kg	840
Mercury	mg/kg	57
Molybdenum	mg/kg	75
Nickel	mg/kg	420
Selenium	mg/kg	100
Total coliform bacteria	g	1,000
Zinc	mg/kg	7,500

3.2 INTERNATIONAL FINANCE CORPORATION PERFORMANCE STANDARDS

The IFC PS represent the 'policy framework' for the EIA and sustainable social and environmental management for the Project [1], whereas the World Bank Group's EHS Guidelines provide guidance on general and industry best practice as well as recommended numerical limits for emissions to the atmosphere, noise, liquid and solid wastes, hazardous wastes, health and safety, and other aspects of industrial facilities and other types of development projects. The IFC PS include:

- PS1 - Assessment and Management of Environmental and Social Risks and Impacts
- PS 2 - Labour and Working Conditions
- PS 3 - Resource Efficiency and Pollution Prevention

(1) IFC Performance Standards on Environmental and Social Sustainability, January 2012, International Finance Corporation, World Bank Group

- PS 4 - Community Health, Safety and Security
- PS 5 - Land Acquisition and Involuntary Resettlement
- PS 6 - Biodiversity Conservation and Sustainable Management of Natural Resources
- PS 7 - Indigenous Peoples
- P8 8 - Cultural Heritage

PS 1-6 are considered by ERM to be relevant to the Project, while PS 7[(1)] and PS8 are not considered relevant.

3.3 WORLD BANK GROUP EHS GUIDELINES

The WBG EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs and the contents.

Levels of noise, air emissions and effluent recommended by the relevant WBG Guidelines noted to be the same as those specified in Myanmar NEQEG as summarised in *Table 3.1* to *Table 3.3*. The Project should achieve compliance with these recommended levels.

3.4 OTHER RELEVANT AIR QUALITY GUIDELINES

3.4.1 Air Quality Criteria for Impact Assessment on Sensitive Ecological and Agricultural Receptors

The impacts relating directly to air quality (i.e. NO_x) are not habitat or species specific and are the same for all sites. NO_x is especially relevant in this context as it plays a role in the acidification of water and soil and contributes to eutrophication. Air quality critical levels for the protection of sensitive ecological areas and agriculture and presented below in *Table 3.6.*

Table 3.6 Air Quality Critical Levels used for the Assessment of Impacts on Sensitive Ecological and Agricultural Receptors

Pollutant	Averaging Period and Statistic	Assessment Criterion (μg/m³)
NO_x	24-hour mean	75
	Annual mean	30

Source: Air quality guidelines for Europe, 2nd ed. Copenhagen, WHO Regional Office for Europe, 2000 (WHO Regional Publications, European Series, No. 91).

(1) In April 2017, IFC publicly disclosed its conclusion (as well as the rationale for the conclusion), that PS7 was not considered applicable to the Project. As per IFC, a second external professional opinion is being sought in the form of an assessment, to confirm applicability of PS7.

3.4.2 Dust Deposition Nuisance Criteria

Dust emissions from the Project site may result in nuisance issues when depositing onto surfaces, for example, property, vehicles and washing. In addition, dust deposition can affect sensitive vegetation due to the soiling of leaves hindering photosynthesis and the blockage of leaf pores. There is very little information available on the sensitivity of specific plants to dust soiling, however, the information that is available suggests that the guidelines for identifying the deposition rate at which nuisance at human sensitive receptors may occur is also appropriate for use as a metric for assessing the point at which significant impacts on plants may arise (1).

Dust generally does not pose a specific risk to human health and as such the IFC and WHO guidelines (which are focussed on human health) do not include guidelines for nuisance dust. A number of organisations have set guidelines for dust deposition and these are set out in *Table 3.7.*

Table 3.7 Dust Deposition Nuisance Criteria

Criteria definition	Measure of soiling ($mg/m^2/day$)	Data source
National Guidelines		
Possible Nuisance	350 (monthly mean)	TA-Luft (Germany)
Very Likely Nuisance	650	TA-Luft (Germany)
First Loss of Amenity	133 (monthly mean)	West Australia Nuisance Standard
Unacceptable reduction in air quality	333	West Australia Nuisance Standard
Serious nuisance	200	UK recommended nuisance dust deposition rate
Nuisance dust deposition	133	Malaysia air quality standard
Evidence based guidelines		
Noticeable (urban)	95	Source 1
Possible complaint (rural)	119	Source 1
Objectionable	167	Source 1
Probable complaint	476	Source 1
Serious complaint	1191	Source 1

Note:
Source 1: Cites:
Hancock, R. P., Esmen, N. A., and Furber, C. P. (1976) "Visual Response to Dustiness", Journal of the Air Pollution Control Association, 26 (1), 1976, pp54 -57;
Beaman, A. L. and Kingsbury, R. W. S. M. (1981) "Assessment of Nuisance from Deposited Particles Using a Simple and Inexpensive Measuring System". Clean Air, 11, 1981;
Bate, K. J. and Coppin, N. J. (1991) "Dust impacts from mineral workings", Mine and Quarry, 20 (3), 1991, pp31 – 35;
Hofschreuder, P. and Vrins, E. L. M. (1992) "Nuisance from coarse dust", Journal of Aerosol Science, 23 (S1), 1992, pp691 - S694;
Quality of Urban Air Research Group. (1996) "Airborne Particulate Matter in the United Kingdom: Third Report of the Quality of Urban Air Review Group", prepared at the request of the Department of the Environment. University of Birmingham, Birmingham.

(1) Farmer, A, M. (1993). The Effects of Dust on Vegetation – A Review. Environmental Pollution. 79, 63-75.

There is no clear consensus as to the level of dust deposition that is likely to result in nuisance issues as nuisance is around perception rather than health based impacts. Dust deposition nuisance thresholds have been developed for the AQIA as presented in *Annex C1.*

3.5 RELEVANT BIODIVERSITY LEGISLATION, POLICIES AND PROGRAMS

National Biodiversity Strategy and Action Plan (NBSAP)

Myanmar has developed two NBSAPs to date, the first in 2011 and the second in 2015 to span 2015 to 2020. The 2015 NBSAP is structured around the 20 Aichi Biodiversity Targets, and was designed to be achieved realistically within the 5-year timeframe. The goal of the NBSAP is to 'establish a strategic planning framework, identify concrete actions, and ensure effective management and conservation of Myanmar's diverse ecosystems, species, and natural resources'.

One of the Aichi Targets outlined in the NBSAP states that 'by 2020, governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits'. Under this goal, Myanmar has enacted an Environmental Conservation Law and an EIA Procedure.

The NBSAP has highlighted limestone quarrying as a threat to karst ecosystems, and unregulated gold mining in the Sagaing Region as a major cause of forest loss and pollution of the Chindwin River. These concerns are relevant to the Project as the former is an activity undertaken at the Apache limestone quarry site.

Global Tiger Initiative

The Global Tiger Initiative (GTI) seeks to empower tiger range countries to manage the range of threats facing the species. The goal is to double the number of wild tigers globally by 2022 through a mix of conservation, education and enforcement initiatives. Myanmar is one of 13 countries that fall within the range of the wild tiger, and thus plays a role in the program. The GTI has placed tiger habitats in Myanmar as a global management priority as tiger populations have the highest probability of persistence in these areas.

The estimated numbers of adult tigers within Myanmar is 85. Priority initiatives identified by GTI for Myanmar are '(i) improved legal protection of critical tiger habitats and/or increasing penalties for wildlife crime, (ii) improved inter-sectoral coordination and establishment of best management practices for industry and infrastructure development in buffer zones, and (iii) providing support for front-line staff with equipment, infrastructure, training, incentives and insurance.'

The limestone quarry site is not within a Tiger Conservation Landscape.

Species and Habitat Management

There are several efforts by both government and non-governmental organisations (NGOs) to manage habitats and species within Myanmar. Conservation programmes are typically targeted at threatened species. Marine and bird habitat conservation and management initiatives are also being established. Legislation relevant to biodiversity conservation include the Elephant Preservation Act, the Wild Birds and Animals Protection Act, the Wildlife Protection Act, the Forest Law, Protection of Wildlife and Conservation of Natural Areas law, Forest Policy and Rules relating to the Protection of Wildlife and Conservation of Natural Areas.

MONREC has identified key threats to biodiversity and habitat conservation in Myanmar. These include the hunting and poaching of wildlife, conversion of natural habitats, shifting cultivation, water pollution, introduction of invasive species and weak law enforcement (1).

With the exception of shifting cultivation, the remainder of these priority threats are relevant to the Project.

3.6 PROJECT-RELATED CONTRACTUAL AND OTHER COMMITMENTS

The limestone concession is located within the forest area on the ridge of the Tha Pyae mountain range in Thazi Township, Pyi Nyaung Village and Kubyin Area within the Mandalay Region. A concession of 600 acres in size has been allocated to STC for limestone extraction, with lease agreement from the Forest Department of Forestry of Environmental Conservation renewed annually since 31 March 2011 and Forestry and operating agreements for large scale production of mineral and heavy production of limestone in product sharing system from the Ministry of Mines for 25 years starting 22 December 2010. It is located approximately 5 km (haul distance) to the east of the cement plant.

3.7 PROJECT PROPONENT POLICIES, PLANS AND PROCEDURES

STC is a subsidiary of the Shwe Taung Group which has been a member of the UN Global Compact since 2013. The Group is committed to the principles of the UN Global Compact and has integrated them into its business strategies and practices, in its Code of Conduct and its various policies, as follows:

- Conflict of Interest Policy;
- Intellectual Property Policy;
- Media Relations and Disclosure Policy;

(1) Nature and Wildlife Conservation Division, Forest Department (nd) Status of Biodiversity Conservation in Myanmar. Retrieved from https://www.cbd.int/doc/meetings/nbsap/nbsapcbw-seasi-01/other/nbsapcbw-seasi-01-mm-en.pdf

- Privacy and Confidentiality Policy;
- Sustainability Policy;
- Transparency Policy;
- Whistle Blowing Policy;
- Anti-Corruption Policy;
- Environmental Policy;
- Employees' and Human Rights Policy;
- Safety and Health Policy (and Safety and Health Plan in GTS, Safety and Health Activities in HTC and HTCT);
- Land Acquisition Policy [1]; and
- Grievance and Dispute Resolution.

The above policies are appended in *Annex K*. STC should follow these policies for this Project and in case of discrepancy between STG policies and STC policies / management plans, STG polies should be adopted.

Policies related to biodiversity issues of the Project are detailed in *Section 2* to *Section 4* of the Biodiversity Action Plan in *Annex E* of this report. These includes:

- STC Biodiversity and Ecosystem Services Policy;
- STC Zero Tolerance Policy on Possession of Wildlife and Forest Resources; and
- STC Anti-illegal Logging Policy.

STC commenced its cement plant project near the limestone quarry in Pyi Nyaung Village, Thazi Township, in 2010 and began commercial production in 2014, selling its end-product, namely Portland cement, under the brand name "APACHE". The company is committed to focusing on the development of environmentally-friendly technologies, consuming less energy, sustaining resources and reducing pollution. STC is also committed to maintaining a dedicated management team and providing opportunities to enhance technical skills and knowledge of all its employees through ongoing professional training.

STC's policy encompasses a commitment to protect the health and safety of all people working at or visiting STC's cement plant and the limestone quarry and to comply with all relevant legislation, code of practices and regulations

[1] No land acquisition is required for the Project.

while continuously improving performance and striving for excellence in occupational health, safety and environment.

STC's health and safety goals include:

- Maintaining completely safe and health work environments at the mines and the cement plant;
- Nurturing a positive health and safety culture that includes understanding, awareness and behavior at all staff levels of the company's employees and those of its contractors;
- Yielding zero accident and no injury;
- Committing to not discharge any employee because of occupational diseases.

STC's strategy to nurture a health and safety culture is based on people-oriented principles and evidenced by:

- Colleagues sharing in decision-making and problem solving processes;
- An atmosphere of trust where people feel comfortable questioning and challenging assumptions, being pro-active and reporting issues;
- Staff, employers and contractors conducting activities and behaving in such a manner that are conducive to good health and safety.

STC's health and safety culture for its workers and surrounding community is reflected in STC's various procedures that contribute to STC workers' Occupational Health and Safety as well as Community Health and Safety. The following procedures are of particular relevance, as they enable the implementation of mitigation measures against impacts that could adversely affect both on-site workers and visitors and neighbouring residents:

- Waste Management Procedure;
- Storage and Handling of Hazardous Material;
- Emergency Response Plan (which includes a Spill response Plan); and
- Contractor Management Procedure.

With regard to the community residing around STC's Project site, STC is committed to contributing to the community health and safety through the implementation of various corporate social responsibility (CSR) programs in education promotion, environment protection, infrastructure improvement, health, natural disaster relief and general social matters, with a financial focus on education facilities and medical support, as well as on the provision of water treatment systems and of electricity. STC has also been providing reconstruction support for post-emergency events such as fire or flooding.

Finally, STC is in the process of defining operational Stakeholder Engagement Activities and Grievance Mechanisms which will specify how STC will address community issues. STC's procedures, plans and mechanisms are based on the "plan-do-check-act" environmental management system philosophy and ensure answers and corrective actions are implemented.

Upon disclosure of the Draft EIA report, STC engaged an independent environmental and social consultant to monitor the implementation of the commitments made under the ESMP.

3.8 LIST OF COMMITMENTS

A consolidated summary list of environmental, social and community health and safety commitments that STC will implement in order to manage and mitigate potential impacts associated with the Project's development is provided below in ***Error! Reference source not found.***.

STC will implement and comply with the commitments in all Project phases, including construction, operation, closure and post-closure. Where relevant, the commitments are also documented in, and will be implemented through progression of the environmental and social management and monitoring plans.

Table 3.8 Project Key Commitments

Commitment Source	No.	Commitment	ESIA Reference
Laws, Procedures, Policy	1.1	SHWE TAUNG MINING COMPANY LTD. (STM) will comply with all Myanmar laws, rules and regulations.	Section 3.1
	1.2	SHWE TAUNG MINING COMPANY LTD. (STM) will operate the process with international standard and guidelines	Section 3.2, 3.3
Environmental and Social Monitoring Report	2.1	SHWE TAUNG MINING COMPANY LTD. (STM) will prepare an Environmental Monitoring Report and submit to the Ministry of Natural Resources and Environmental Conservation (MONREC) in every six months as per the EIA Procedure requirements.	Section 11.5.1
Emergency Response Plan including Spill Response Plan	3.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures stated in Emergency Response Plan	Section 8.5.2
Air Quality	4.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: Particulate matter associated with mining operations at the mudstone quarry should be	Section 8.1.3

Commitment Source	No.	Commitment	ESIA Reference
		controlled by the following good practice techniques: - Water suppression should be used on unpaved roads and work areas in dry and windy conditions; - Storage of dusty materials (i.e. stockpiles) should be enclosed or operated with efficient dust suppression measures; - Stockpile heights should be kept to a minimum; and - Drop heights during loading and transfer of materials should be minimized and shielded against the wind. STC has agreed to relocate all worker accommodation beyond a distance of 500 m from the plant in order to achieve satisfactory air quality. The permanent worker accommodation will be located to the south of the plant (upwind) at a distance of greater than 500 m from the plant boundary.	
	4.2	SHWE TAUNG MINNING COMPANY LTD. (STM) is committed to carry out air quality monitoring works in the following locations during operation phase: Dust deposition at Cement Plant, Kubyin and Pyi Nyaung Villages	
Noise	5.1	SHWE TAUNG MINNING COMPANY LTD. (STM) is committed to carry noise monitoring works in the following locations during operation phase: To conduct noise and vibration at Kubyin and Pyi Nyaung Village twice per year.	
Surface Water Quality Management	6.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: • Construction of a dedicated drainage network to intercept and divert runoff from the mudstone quarry to an appropriately sized and maintained sedimentation pond to allow adequate retention time for suspended solids to settle; • After passing through sedimentation ponds, runoff from mudstone quarry may be discharged to the wetland created by STC via a weir to remove	Section 8.2.2

Commitment Source	No.	Commitment	ESIA Reference
		suspended solids before entering the wetland; • Baffles or other measures to reduce the velocity of runoff downhill slopes should be installed to minimise scouring; and Exposed areas and overburden dumps should be revegetated as quickly as possible.	
	7.2	SHWE TAUNG MINNING COMPANY LTD. (STM) is committed to carry out water quality monitoring works in the following locations during operation phase: BOD, COD, TSS, oil and grease, pH, total coliform bacteria, total nitrogen, total phosphorus monthly measurement of discharge of treated wastewater and runoff at: 1. Kubyin River 2. Reservoir 3. Pyi Nyaung Village 4. Ye Shin Chaung creek 5. Mudstone runoff area	Table 11.2
Forest Resources	8.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: • Develop and implement a corporate policy to prohibit the extraction, purchase, use or trade of illegal timber by staff, contractors, and subcontractors; • Prevent access to the following Company managed roads to mechanised logging vehicles/equipment: • cement plant access road; and • existing and future revegetated/offset areas. *Note: This restriction is not intended to prevent collection of firewood and non-timber forest products by local residents.* • Recognising that the road between Pyi Nyaung Village and the cement plan is a public road, STC will discuss and agree with Forest Department how the Company can support the Forest Department's efforts to prevent access by illegal loggers. • Where appropriate to do so, STC will support efforts to assist local communities to transition from illegal logging to more sustainable livelihoods	Section 8.5.2

Commitment Source	No.	Commitment	ESIA Reference
		through job training, sustainable forest product harvesting programmes, or other means.	
Soil Management	9.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: **<u>Air</u>** Particulate matter associated with mining operations at the mudstone quarry should be controlled by the following good practice techniques: - Water suppression should be used on unpaved roads and work areas in dry and windy conditions; - Storage of dusty materials (i.e. stockpiles) should be enclosed or operated with efficient dust suppression measures; - Stockpile heights should be kept to a minimum; and - Drop heights during loading and transfer of materials should be minimized and shielded against the wind. STC has agreed to relocate all worker accommodation beyond a distance of 500 m from the plant in order to achieve satisfactory air quality. The permanent worker accommodation will be located to the south of the plant (upwind) at a distance of greater than 500 m from the plant boundary. **<u>Rrunoff</u>** • Construction of a dedicated drainage network to intercept and divert runoff from the mudstone quarry to an appropriately sized and maintained sedimentation pond to allow adequate retention time for suspended solids to settle; • After passing through sedimentation ponds, runoff from mudstone quarry may be discharged to the wetland created by STC via a weir to remove suspended solids before entering the wetland;	

Commitment Source	No.	Commitment	ESIA Reference
		• Baffles or other measures to reduce the velocity of runoff downhill slopes should be installed to minimise scouring; and Exposed areas and overburden dumps should be revegetated as quickly as possible.	
Waste Management	10.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: • A comprehensive waste management plan (WMP) for the Project has been developed (Annex F). The existing temporary solid waste storage area is not lined and should be only used for inert (non-reactive) and non-hazardous waste only.	Section 8.4
Occupational Health and Safety	11.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: Mitigation measures include the review and update of STC's existing procedures and the design and implementation of additional procedures, such as: • Incident Reporting Procedure; • Contract Health and Safety Procedure (including Occupational, Environmental Health and Safety with co-benefits for the community health and safety); • Emergency Response Procedure; • Storage and Handling of Hazardous Material Procedure; • Waste Management Procedure; and • Worker Grievance Mechanism. Such procedures should enable the Project Proponent to expand its own procedures to its Contractors. They should contribute to the Project's integration in its community by enabling dialogue (grievance lodging and communication). They should also reduce and prevent hazards and risks that may trigger occupational health and safety incidents on the Project's workforce and on the Project's communities. In addition, independent occupational health and safety (OHS) auditor and independent environmental and social specialist are engaged by STC to support the development, implementation, monitoring and review of the above procedures in order	Section 8.6.2

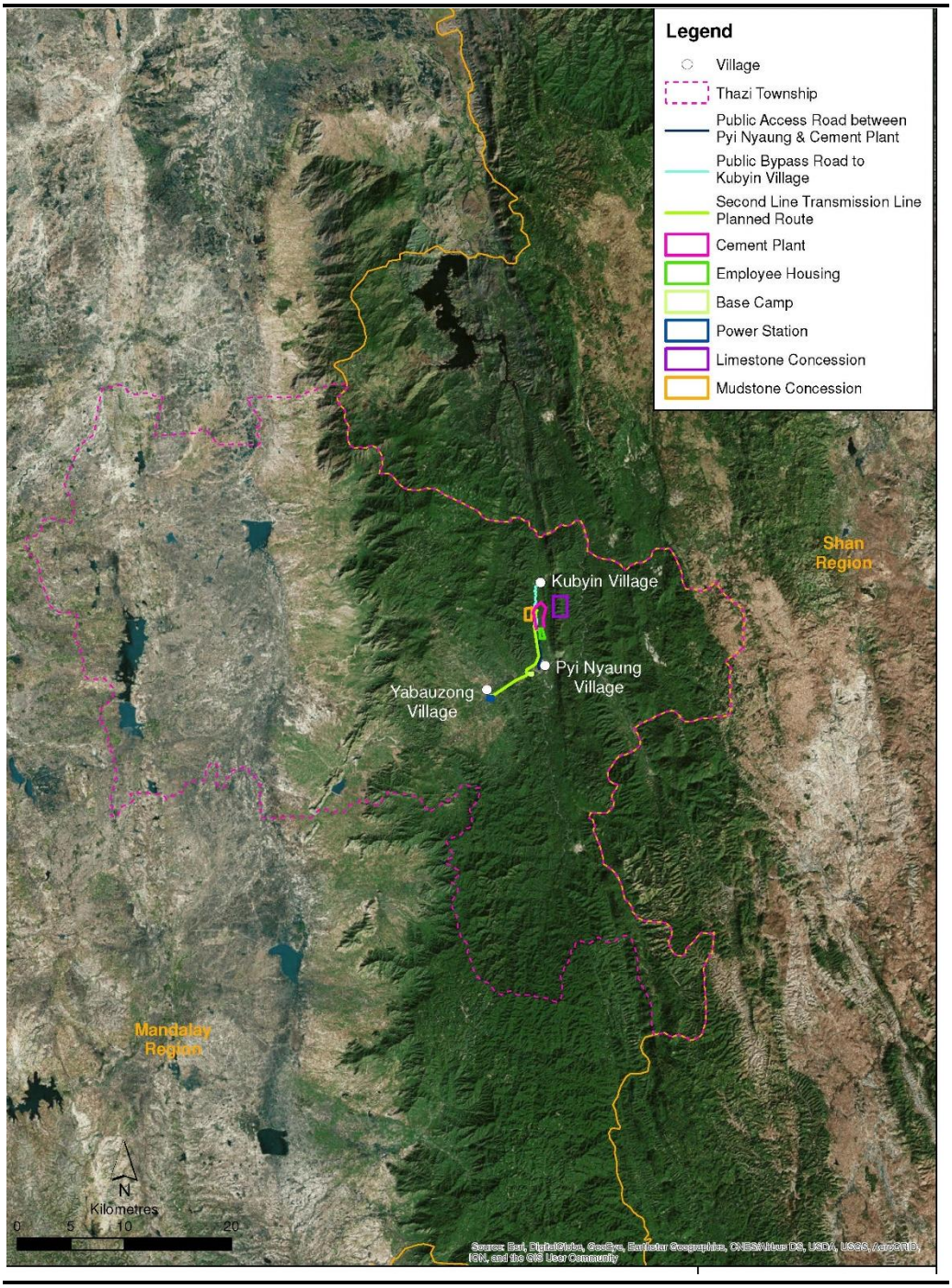
Commitment Source	No.	Commitment	ESIA Reference
		to improve STC performance on health, safety, social and environment. It is also recommended that use of temporary accommodation facilities to the west of the cement plant be discontinued as quickly as possible and workers housed at the new accommodation quarters to the south of the cement plant.	
Landscape and Visual	12.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: • The design for earthworks and cut and fill should ensure that it is blended with the landscape as much as possible; • Cut and fill slopes as well as areas disturbed by operation activity are to be suitably top soils and revegetated as soon as is possible after shaping; • All existing large trees, if any, that fall outside the earthworks areas must be retained; • Felled trees should be replaced where possible; • Laydown areas which will no longer be required for the operation stage are to be landscaped with suitable vegetation after the operation work is completed; • Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring; and All habitat clearance during quarrying/mining operations is to be clearly marked prior to excavation.	Section 8.7.4
Community Health and Safety	13.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures stated in Community Health Program.	Annex T
Stakeholder Engagement	14.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures stated in Community Health Program (CHP).	Annex N
Hazardous Material/	15.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the	Section 8.4

Commitment Source	No.	Commitment	ESIA Reference
Waste Management		mitigation measures which include: • A comprehensive waste management plan (WMP) for the Project has been developed (Annex F). The existing temporary solid waste storage area is not lined and should be only used for inert (non-reactive) and non-hazardous waste only.	
Land Acquisition in relation to second transmission line	16.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures which include: • Once operational, STC must pay the Forest Department to offset the loss of forest cover with an area equal to 20% of the concession that is to be planted with teak forest. • This area has been established on the west side of the road opposite the guardhouse. Note that this offset is considered as a forestry offset and is not for the purposes of biodiversity offsetting.	Section 9
Community Development	17.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures stated in Community Development Plan (CDP).	Annex P
Closure	18.1	SHWE TAUNG MINING COMPANY LTD. (STM) will ensure to undertake the mitigation measures stated in Conceptual Mine Closure and Rehabilitation Plan.	Annex K.
Cumulative Immpact Assessment	19.1	SHWE TAUNG CEMENT COMPANY LTD. (STC) is committed to undertake the cumulative impact assessment should information of nearby projects become publicly available.	Section 10

The Project consists an expansion of limestone quarry located in Thazi township of Mandalay region.

An overview of the Project location and its associated facilities' locations in Myanmar is shown in *Figure 4.1*. All the areas were leased from the Forest Department. The limestone quarry covers a leased area of 600 acres. Detailed descriptions of the Project are provided below. The lease agreement is appended in *Annex I*.

Figure 4.1 Project Location within the wider Mandalay Region



4.1 PROJECT DESCRIPTION

4.1.1 Limestone Quarry

The limestone quarry is located in within the forest area on the ridge of the Tha Pyae mountain range of Thazi Township, Pyi Nyaung Village and Kubyin Area within the Mandalay Region (*Figure 4.2*). A concession of 600 acres in size has been allocated to STC for limestone extraction, with lease agreement from the Forest Department renewed annually since 31 March 2011 and operating agreements for large scale production of mineral and heavy production of limestone in product sharing system from the Ministry of Mines for 25 years starting 22 December 2010 (*Annex I*).

The limestone quarry is located approximately 5 km (haul distance) to the east of the STC cement plant, to fully supply the limestone as raw material for cement production (*Figure 4.2*). The limestone quarry, together with the mudstone quarry to the west of the STC cement plant and a coal mine in Kalaywa township of Sagaing region, supply raw materials exclusively to the STC cement plant and will all be expanded to support the expansion of the STC cement plant. Expansion of the STC cement plant, mudstone quarry and coal mine are assessed under three separate EIA Reports.

Limestone extraction is undertaken using a drill and blast method. The extracted limestone is transported by truck to the limestone crusher where it is crushed and stored prior to use. Approximately 715,000 tonnes of limestone per year is required for the current production of the cement plant. In the final Project stage, the highest sea level of the limestone mountain will be +550 MSL (*Figure 4.9*).

Limestone is currently transported by truck to the plant. For the Project expansion, a conveyor will be built to transport the limestone from the quarry to the limestone crusher in place of trucks (*Figure 4.3)*. The new cement production line will require an additional ~1.6 million tonnes of limestone per year bringing the total to ~2.9 million tonnes of limestone per year. The concession, which has estimated limestone reserves of 110 million tonnes, is expected to be mined down from ~750 m to 550 m above sea level with further clearance of forest required. The remaining quarry lifetime is expected to be around 37 years, accounting for the limestone mined as of October 2017 and since June 2012, and based on a higher predicted consumption of ~2.9 million tonnes per year once the second line becomes operational. While it is understood that the STC cement plant area is leased under a 50-year agreement from the Forest Department of Ministry of Environmental Conservation and Forestry on 31 March 2016, the current expected lifespan of the STC cement plant is 30 years and the supply from the limestone quarry should thus be sufficient. If the lifespan of the STC cement plant is expanded beyond 37 years, STC will study the supply of limestone and ensure that all necessary permits will be obtained before further limestone extraction.

Table 4.1 summarizies the forecasted annual limestone requirement of the STC cement plan while *Table.4.11* shows corresponding yearly limestone production target, using 2019 as an example. The limestone quarry is

scheduled to operate everything, except for days with heavy rainfall. The mining plan is shown in *Table 4.3* with *Figure 4.4* to *Figure 4.9* demonstrate the detailed mining sequences in the limestone quarry area. Further mining is expected to be undertaken from Stage 2 to Stage 7 for the remaining 37 lifespan of the limestone quarry.

Figure 4.2 Locations of Limestone Quarry and Associated Facilities

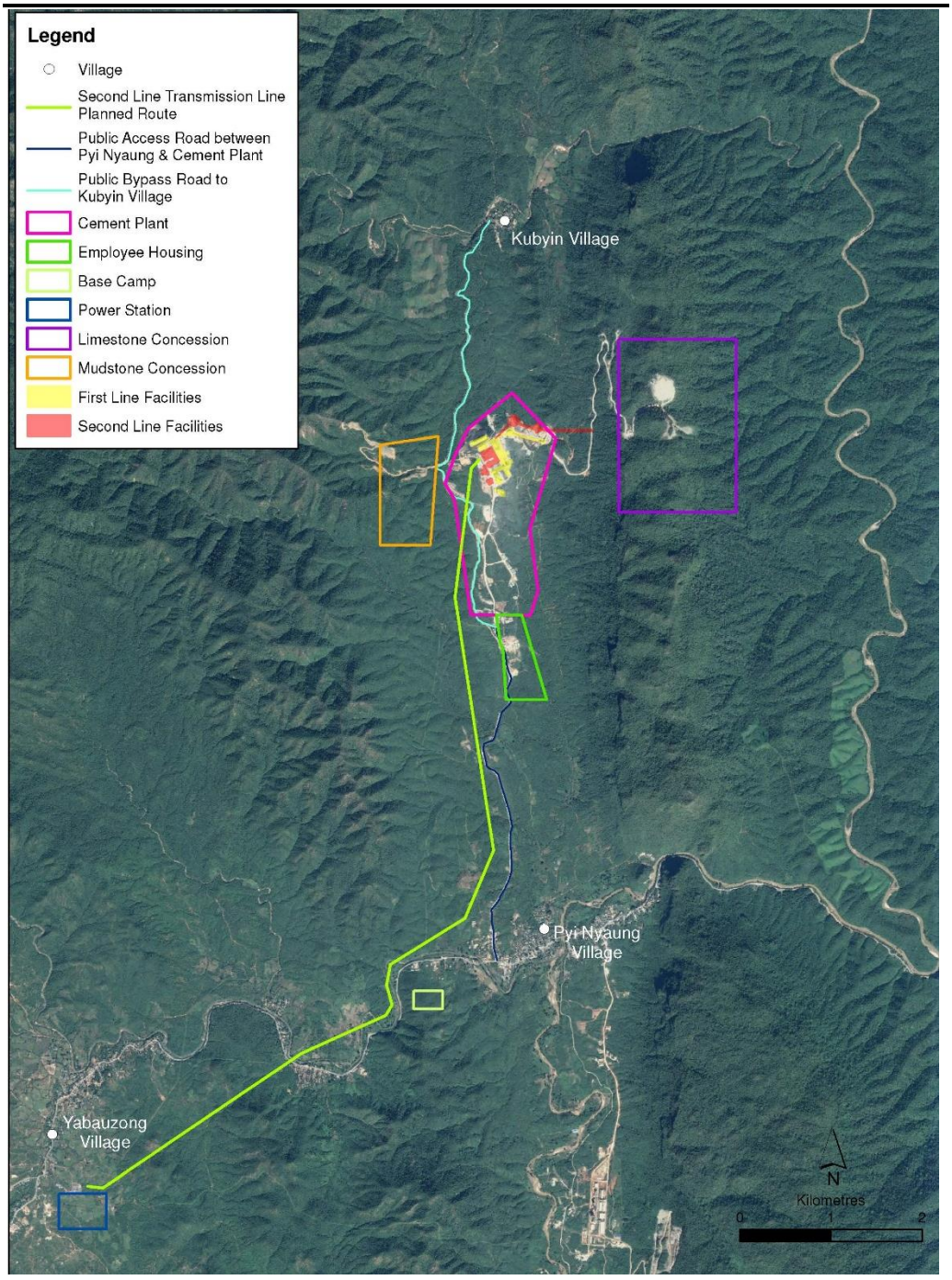


Figure 4.3 Layout of the Cement Plant showing the Crusher and Conveyor Belt from the Limestone Quarry to its eastern side

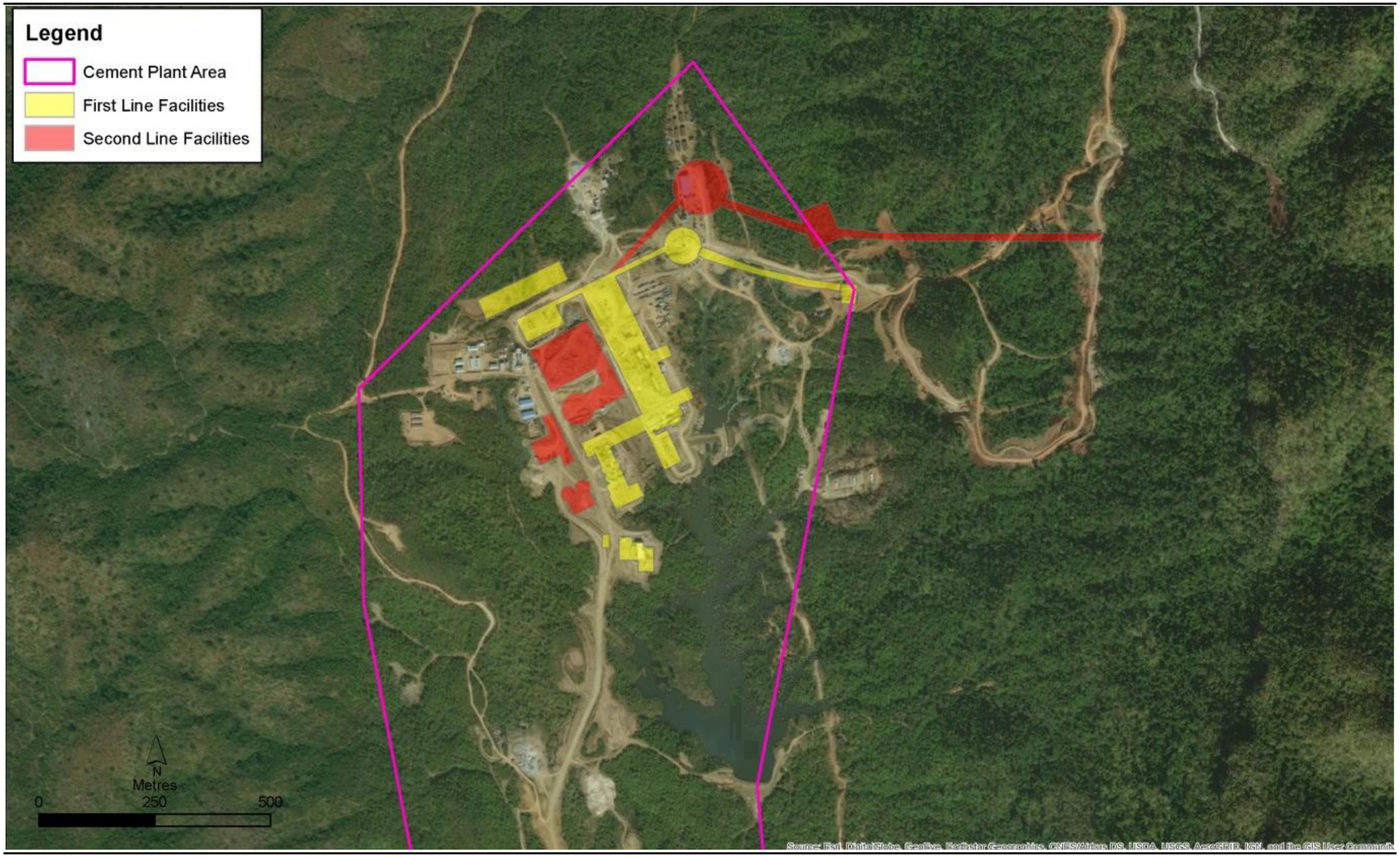


Table 4.1 Annual Limestone Requirements for the Cement Plant

Scheduled Forcast Parameters	Details
Tones Clinker per day	6,000
Clinker Factor	1.65%
Total Limestone Dry Ton	9,900
Moisture	5%
Total Limestone Wet	10,197
Total Requirements For Plant (Limestone)	85%
Total Requirements For Plant (Limestone)	8,836
Additive	1.6
Limestone Require Ton per Day	8,836
Estimate Mining Production per Day	8,836
Minimum Requirement Limestone per Day Wet ton	10,000
Minimum Requirement Limestone per Month Wet Ton	300,000
Minimum Requirement Limestone per Year Wet Ton	3,440,000

Source: STC, 2018

Table 4.2 Yearly Limestone Production Target (example for Year 2019)

Months	Days	Rainy Days	Net Working Days	Mine Production Tons Per Day	Mine Prodcution Tons Per Month
Jan	31	0	31	10,000	310,000
Feb	28	0	28	10,000	280,000
Mar	31	0	31	10,000	310,000
Apr	30	0	28	10,000	280,000
May	31	2	29	10,000	290,000
Jun	30	4	27	10,000	270,000
Jul	31	6	28	10,000	280,000
Aug	31	6	27	10,000	270,000
Sep	30	3	27	10,000	270,000
Oct	31	4	27	10,000	270,000
Nov	30	0	30	10,000	300,000
Dec	31	0	31	10,000	310,000
	365	25	344		3,440,000

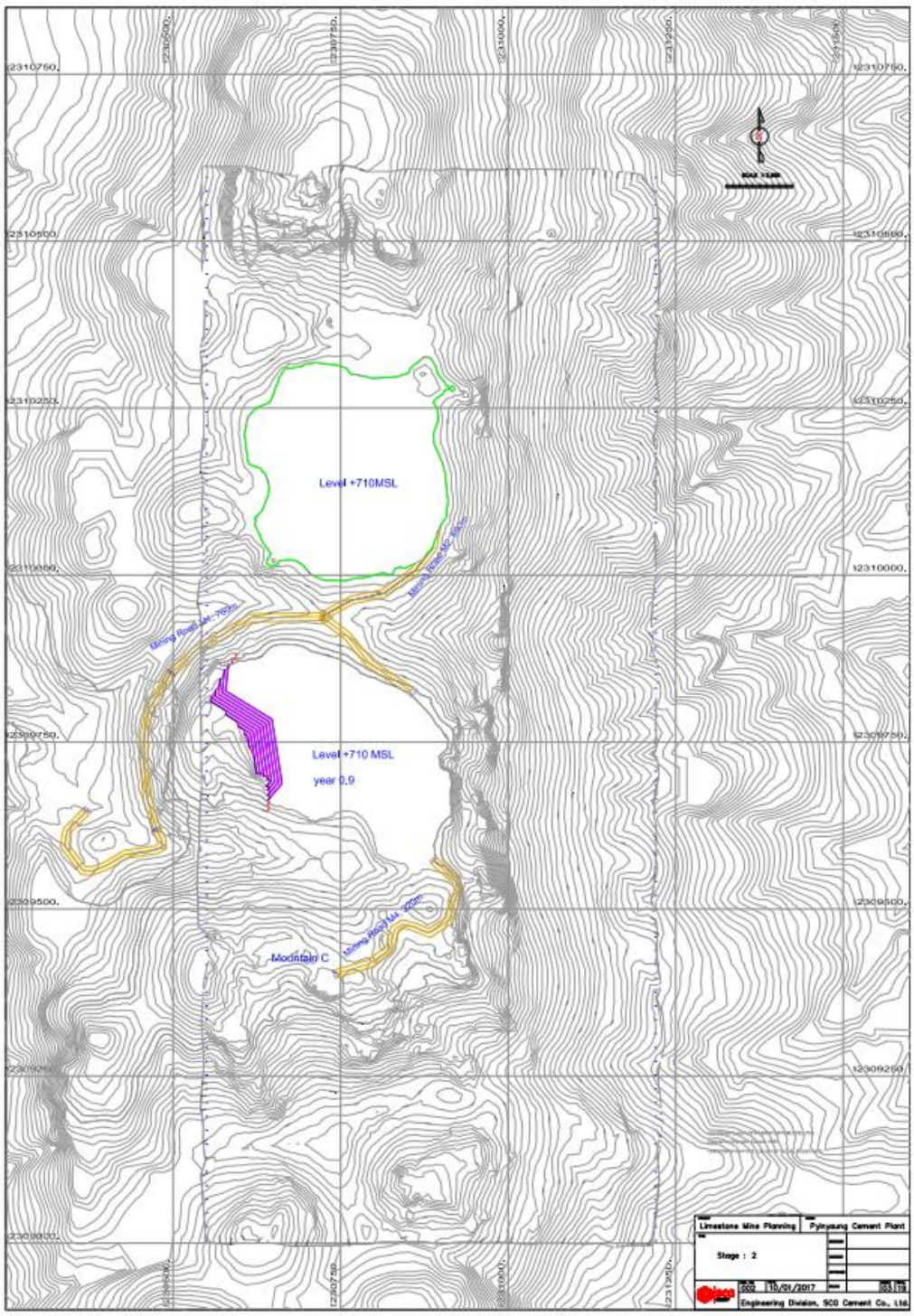
Source: STC, 2018

Table 4.3 Detailed Mining Plan for 37 Years

Stage	Year	Elevation (MSL)	Mining Year	Details
2	1	795 - 710	0.9	Produce limestone from Mountain B Decrease level of working until + 710 MSL. And develop mining road M4 from level +710 MSL to level +740 MSL. Develop mining area from top of Mountain C.
3	2.2	740 - 700	3.1	Produce limestone from Mountain A, B and C decrease level of working until + 700 MSL. And develop mining road M5 from level +700 MSL to level +800 MSL. Develop mining area from top of Mountain D.
4	1	820 - 700	4.0	Produce limestone from Mountain D decrease level of working until + 700 MSL.
5	9.7	700-650	13.7	Decrease level of working until + 650 MSL.
6	11.5	650 - 600	25.2	Decrease level of working until + 600 MSL.
7 Final Pit	11.6	600 - 550	36.8	Decrease level of working until + 550 MSL.

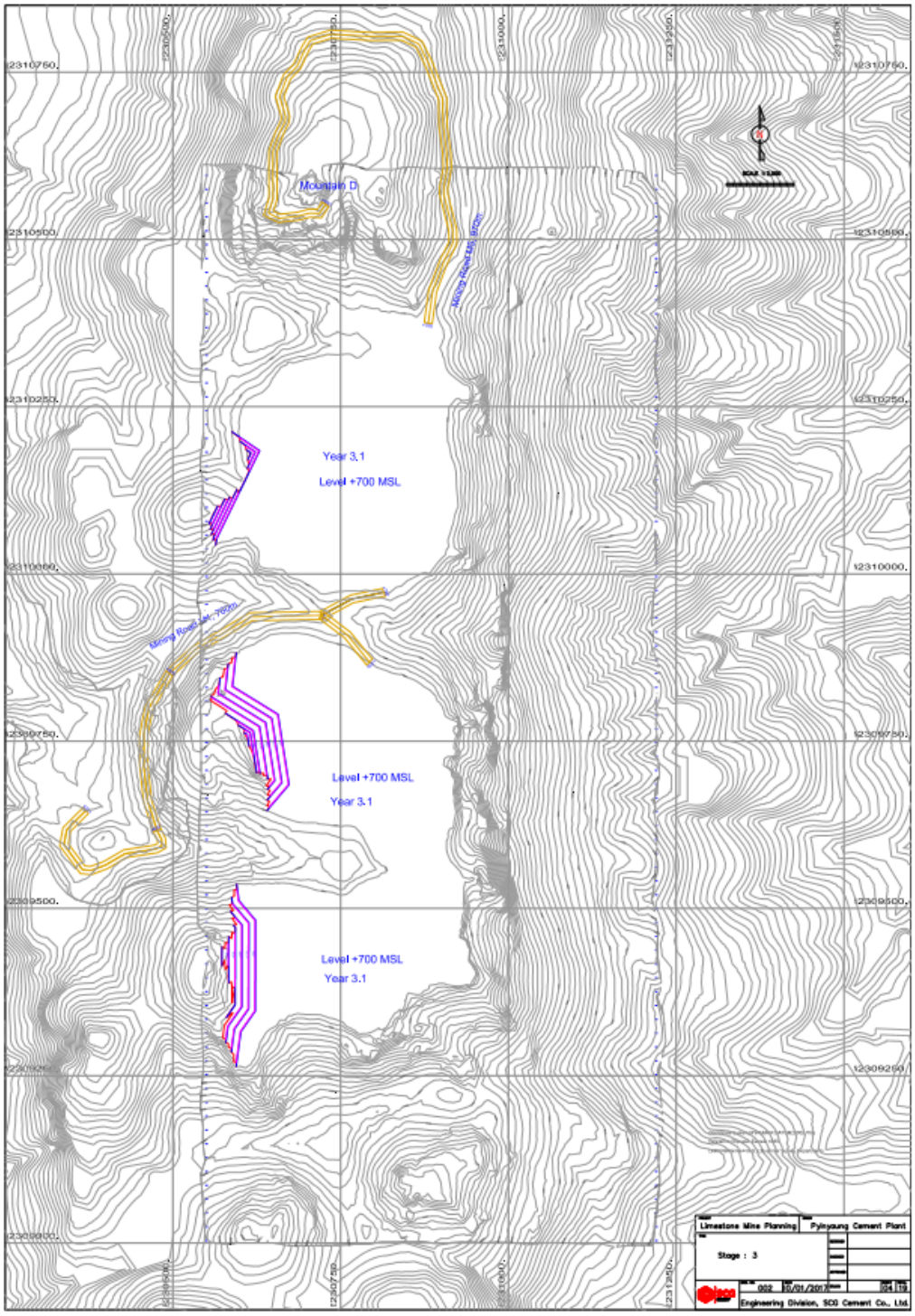
Note: SG 2.7; Geology Factor 0.7; Mining Factor 0.9
Source: STC, 2018

Figure 4.4 Stage 2 Contour Map



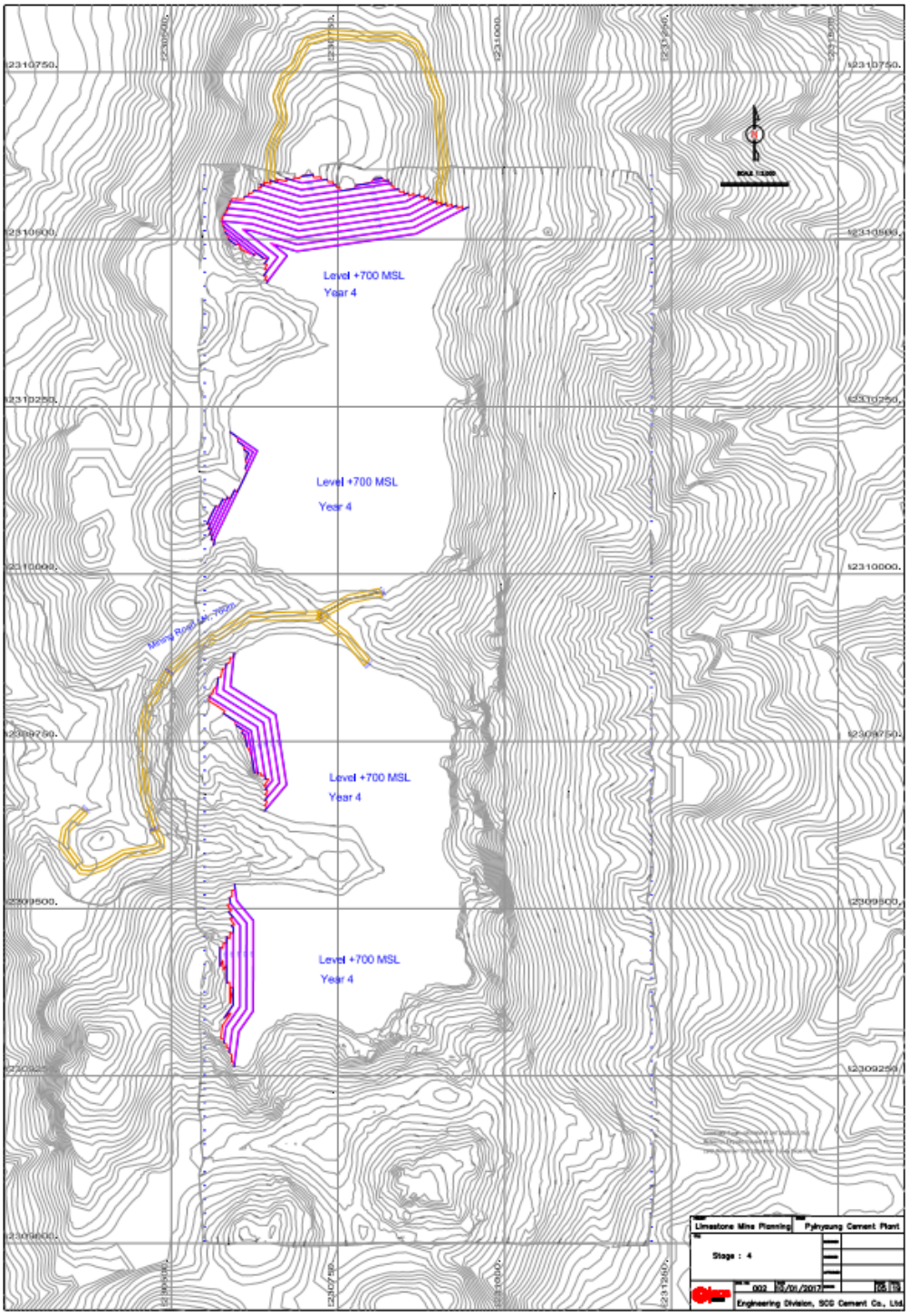
Source: STC, 2017

Figure 4.5 Stage 3 Contour Map



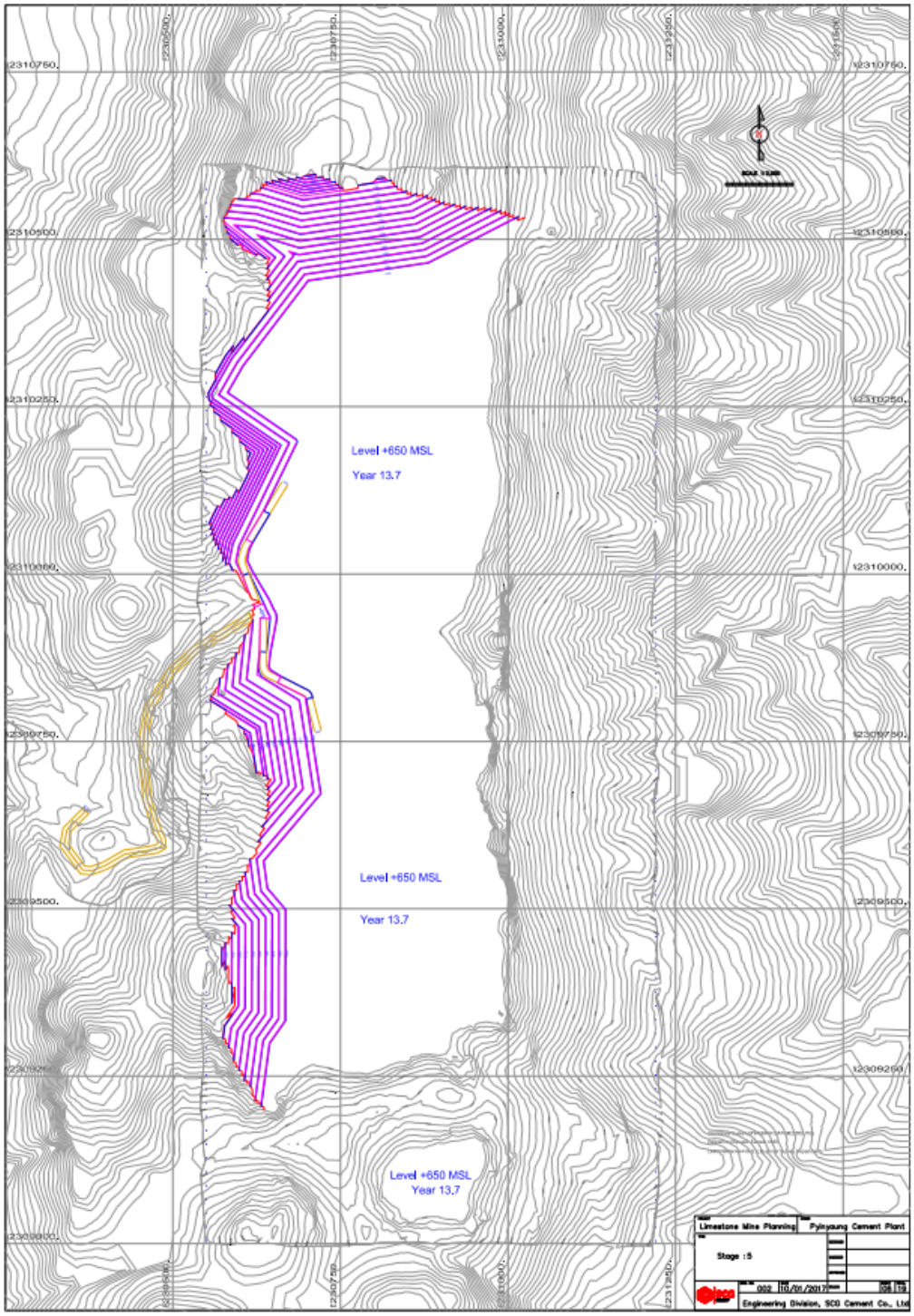
Source: STC, 2017

Figure 4.6 Stage 4 Contour Map



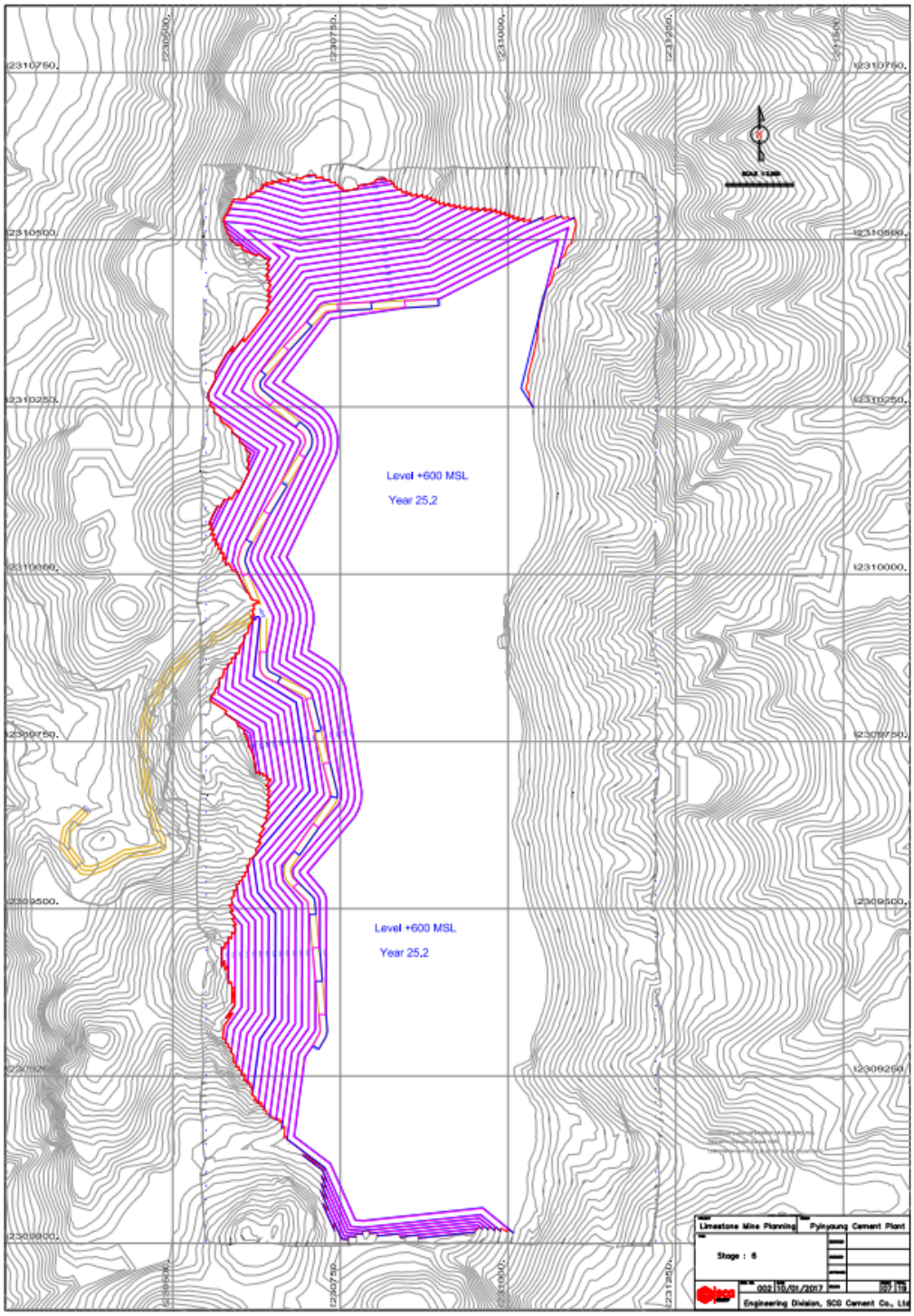
Source: STC, 2017

Figure 4.7 Stage 5 Contour Map



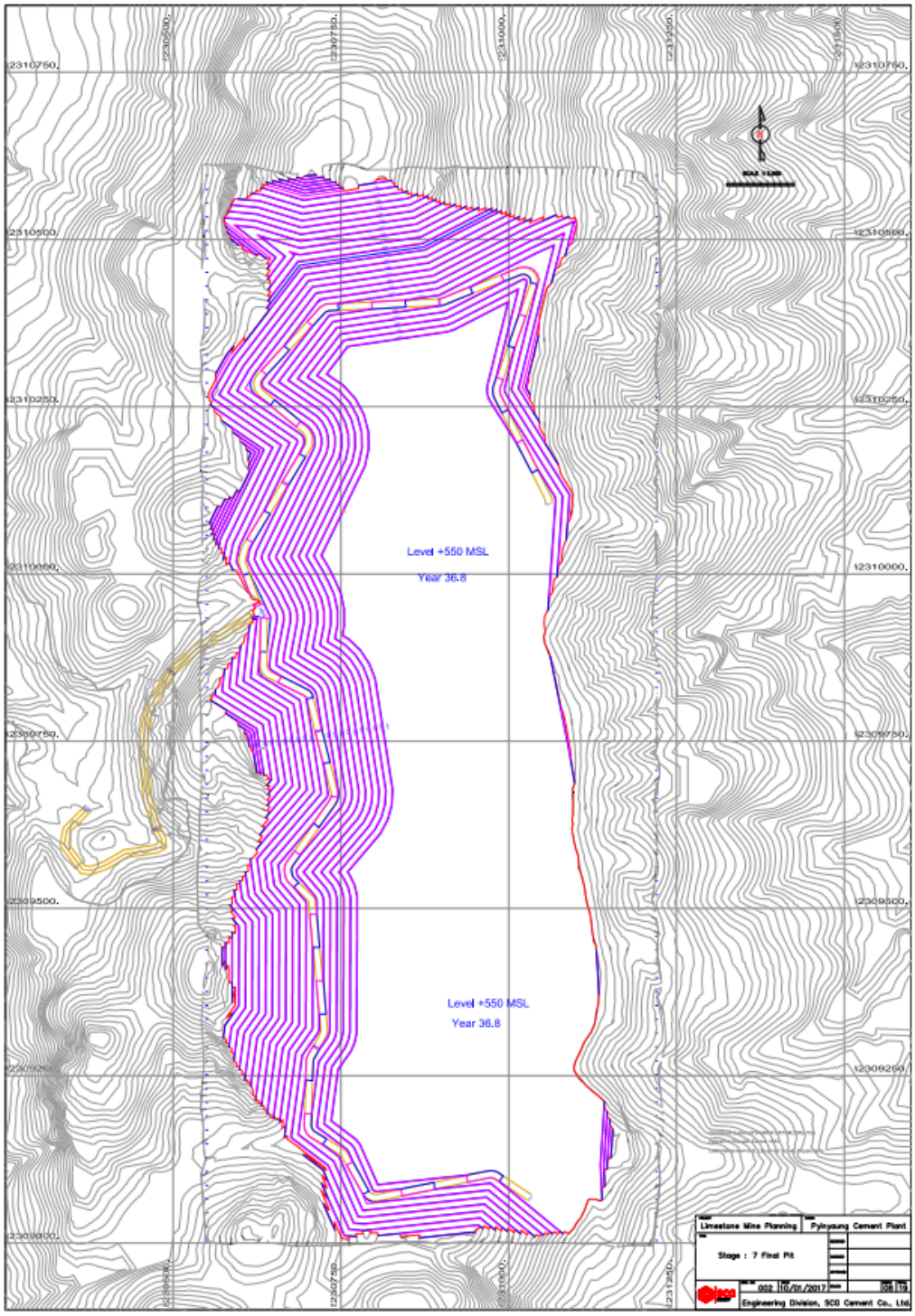
Source: STC, 2017

Figure 4.8 Stage 6 Contour Map



Source: STC, 2017

Figure 4.9 Stage 7 Contour Map



Source: STC, 2017

4.1.2 Mining Procedure

The limestone quary adopted drill and blast method to extract the limestone in seven stages as shown in *Figure 4.4* to *Figure 4.9*. *Table 4.4* summarizes the blasting pattern designs. A total of 107 holes will be drilled for one time of exploration. For each exploration, the holes will be arranged in rows in a staggered pattern, with a separation distance of 2.5 m for adjacent holes and 3 m for adjacent row. Each hole will measure 76 mm in diameter, with a depth of 5 m. Explosive will be used in each hole for blasting to fragment the rock. The amount and types of explosive materials used for each exploration is shown in *Table 4.4*. The permit for approval of using explosive materials for blasting is appended in *Annex I*.

A permit to work system is currently adopted by STC which covers works of higher risk works activities including blasting operation and excavation at the limestone quarry. Blasting is registered with the Military and approved based on detailed consideration of safety requirements. Transportation of the explosives to the storage will be in strict compliance with safety requirements and the storage is constructed in compliance with safety requirements of the Ministry of Defence. All explosives are stored as per required regulations. A security guard is posted at the explosives magazine 24 hours per day and the two main keys of the storage are kept and checked by heads of administration and mining departments of STC. The material in-out record is systemically recorded and must be carried out with strict material handling procedures.

Three types of equipment, including: drilling machine; loading equipment (production) and hauling equipment will be used for mining.

Table 4.4 Details of Blasting Pattern Designs

Item	Details
Exploration System	Above the ground
Proposed Exploration Volumn Per Year	1,440,000 m^3
Number of Exploration Per Year	360 times
Proposed Exploration Volumn Per One Time	400,000 m^3
Number of Holes Per One Time of Exploration	107 holes
Distance of the Holes between Each Other	2.5 m
Distance between Each Row of the Holes	3 m
Dimater of the Hole	76 mm
Depth of the Hole	5 m
Proposed Amount of Ammonium Nitrate Per One Time of Exploration	1,600 kg
Proposed Amount of Emulsion Explosive Per One Time of Exploration	400 kg

Item	Details
Proposed Amount of Cordtex Per One Time of Exploration	1,000 m
Proposed Number of Plain Detonator Per One Time of Exploration	3
Proposed Number of M/S Electric Detonator Per One Time of Exploration	50
Proposed Length of Safety Fuse	5 m
Proposed Quantity of Primer CE Type-C	100

Source: STC, 2018

Drilling Machine

Details on drilling machines possessed by STC is shown in *Table 4.5*. Two T35 drilling machines are adequate for the drill and blast operation and the other machines are being used as backup if necessary. *Table 4.6* illustrates the drilling method.

Table 4.5 Details of the Project's Drilling Machines

Model	Number	Manufacturer	Diameter of Hole
T35	2	Atlas Copco	89
CM 470	1	Atlas Copco	76
PC 655 & PCR 200 R	1	JO7C & Furukawa	76
PCS 655 & PCR 200	2	JO8C & Furukawa	76

Source: STC, 2018

Table 4.6 Details of the Drilling Method

Item	Details
Drilling Pattern	Staggered
Specific Gravitiy	2.5
Burden	3 m
Spacing	3.5 m
Bench Height	10 m
Sub Drilling	1.2 m
Depth of Drilling Hole	11.2 m
Yield per hole of 10 m	3x3.5x10x2.5 = 262.5 tons
Average Drilling Rate	25 m/hr (Hole Diameter 89mm) Hydraulic 30 m/hr (Hole Diameter 76 mm) Hydraulic 25 m/hr (Hole Diameter 76 mm) Pneumatric
Output machine per shift	300 m (6 effective working hours)
No. of machine required	2 (Hydraulic Drill T35)

Note: One machine will be kept as standby in case of breakdown.

Source: STC, 2018

Loading Equipment (Production)

Once drilling and blasting operation is completed, the limestone will be excavated using excavators and loaded onto the hauling equipment. The

excavators used by STC are Liebherr 964 R and Liebherr 944 R, with their details and excavating paramters shown in *Table 4.7* and *Table 4.8*, respectively.

Table 4.7 Liebherr 964 R's Excavating Parameters

Item	Details
Nominal Bucket Capacity	4.5 m^3
Bucket Fill Factor	0.85
Swell Factor	1.5
Time cycle per pass at 90° swing	30 sec
Overall efficiency	0.9
Seconds per hour	3,600 sec
Number of working shifts/day	1 shift
Hours per shift	8.5 hours
Working days in a year	344 days
No. of machine required	1
Output (ton/hour)	619.65 tons
Outpout (ton/year)	1,811,856.60 tons

Source: STC, 2018

Table 4.8 Liebherr 944 R's Excavating Parameters

Item	Details
Nominal Bucket Capacity	2.2 m^3
Bucket Fill Factor	0.85
Swell Factor	1.5
Time cycle per pass at 90° swing	30 sec
Overall efficiency	0.9
Seconds per hour	3,600 sec
Number of working shifts/day	1 shift
Hours per shift	8.5 hours
Working days in a year	344 days
No. of machine required	2
Output (ton/hour)	302.94 tons
Outpout (ton/year)	1,771,593.12 tons

Source: STC, 2018

Hauling Equipment (Production)

The extracted limestone will be loaded on the hauling equipment (Scania P380 with specification shown in Table 4.9. A total of 12 hauling equipment will be used for the Project. The extracted limestones will be transported to the conveyor belt by the hauling equipment, where they will be sent to the crusher for further crushing (*Figure 4.3*).

Table 4.9 Scania P380's Hauling Parameters

Item	Details
Nominal Dump Capacity	22 m^3
Dump Fill Factor	0.85
Swell Factor	1.5

Item	Details
Distance of handling	3 km (up and down)
Truck Cycle Time	15 minutes
Overall efficiency	0.9
Seconds per hour	60 minutes
Number of working shifts/day	1 shift
Hours per shift	8.5 hours
Working days in a year	344 days
No. of machine required	12
Output (ton/hour)	100.98 tons
Outpout (ton/year)	3,543,186.24 tons

Source: STC, 2018

4.1.3 Ancillary Facilities

This section discusses the ancillary facilities related to the limestone quarry, which are under shared use with the STC cement plant and mudstone quarry (e.g. power supply, water supply, wastewater facilities, worker accommodations etc.). These are presented here to facilitate better understanding of the operation of the limestone quarry expansion Project. It should be noted that the environmental and social impacts related to these ancillary facilities are assessed under the standalone Final EIA Report for the cement plant expansion since the cement plant project is the key user of these facilities which are located mostly in within the cement plant boundary.

Access Road

A concrete access road was constructed by STC from Pyi Nyaung Village to the cement plant, which is a public road accessible to all parties, and in particular residents of Kubyin village. Previously this was a small dirt track, accessible only by foot or by bullock-cart. Upon upgrading of the road between Pyi Nyaung Village and the cement plant, STC constructed a bypass road to divert village traffic around the west side of the cement plant to Kubyin village.

Apart from the abovementioned concrete access roads, four mining roads will be constructed for this Project. Their alignments are shown from *Figure 4.4* to *Figure 4.9*. Their lengths are summarized in *Table 4.10*.

Table 4.10 Lengths of the Mining Roads

Mining Road	Length
M1	760 m
M2	690 m
M4	320 m
M5	970 m

Source: STC, 2017

Power Demand

Electricity required for the operation of the existing and expanded cement plant, limestone quarry and mudstone quarry is sourced from the Yay Paung Sone (Yabauzong, Yebokson) Power Station which is located 11km away from

the plant. Its construction was subsidised by Shwe Taung, Asia World, Htoo and YCDC Companies. The cement plant and the associated quarries currently consumes 11 MW supplied via a 33kV transmission line that subsequently feeds the base camp to the west of Pyi Nyaung, the cement process for the existing line, the staff housing and, during the expansion Project, the construction works. STC will construct a new 10.64 km 66kV transmission line from Yabauzong Power Station to the cement plant and then hand it over to the Ministry of Electric Power and Energy (the route is illustrated in *Figure 4.2*). Approximately half the new transmission line route follows the alignment of the existing transmission line. The Yebauzong Power Station will be extended by approximately 17 m along 80 m of its east side. The new single conductor double circuit six string transmission line is planned to be along 35 towers of 15 to 27 m height on four footing. The new 66kV line will supply the STC cement plant and assocaiated quarries; additional supply to STC will be 36 MW and requires a new transformer on-site.

A 2,000 kVA backup diesel generator is deployed on site for instances of power outage. The fuel is stored near the fuel filling station situated along the road leading to the cement plant opposite the staff main housing area (as illustrated in the pictures of *Figure 4.10*). The fuel is purchased from local dealers or from the petrol distribution subsidiary of the Shwe Taung Group.

Figure 4.10 Fuel Storage Area - Cement Plant

The significant energy users are:

- At the limestone section: the jaw crusher (315kW) and the hammer crusher (630kW);
- At the raw mill section: the raw mill (1,400kW), the raw mill fan (1,400kW), the high temperature fan (1,250kW) and the chimney fan (400kW);
- At the cement mill section: the cement mill fan (400kW) and the cement mill (2,000kW); and
- At the coal mill section: the coal mill fan (355kW) and the coal mill (400kW).

The monthly electricity usage for the existing first line has approximately been 5,500 MWh since operations started in 2014.

Overall, the average energy usage for operations at STC is equivalent to 103 KWh/ton of cement production.

Water Supply and Demand

Water is currently sourced from two reservoirs situated within the plant area, with capacities of 6 million US gallons (equivalent to approximately 22,712 m^3) and 45 million US gallons (equivalent to approximately 170,343 m^3), respectively. There are two dams which are designed to Irrigation Department Design Standard by an experienced personnel with 40 years of experience in water resources development works. The dams are earth filled dam with sand chimney, horizontal filter and rock toe. The areas of the dams are ~32,000 m^2 and 66,000 m^2, respectively. According to STC, the design of the dams has considered the potential hazard of earthquake and is considered safe. Water was pumped into the reservoirs from Kubyin Stream at Kubyin Village, approximately 4 km north of the cement plant, during the dry seasons of 2014, 2015 and 2016 (the rivers surrounding the cement plant are highlighted in *Figure 4.11)*. Photo of the water intake point of Kubyin Stream is shown in *Figure 4.12* and the width of the corresponding stream section is ~7 m. Since the 2017 dry season, water was not pumped from the Kubyin Stream as there was sufficient capacity in the reservoirs. During the wet season, the reservoirs are replenished by rain water and there is no need to pump water from the Kubyin Stream. The reservoirs supply water to the cement plant and associated quarries for road watering (to reduce dust), washdown water, landscaping and domestic use. There are two water treatment systems near the main canteen by the staff housing area for staff usage: workers and employees currently transport water in 20 litre plastic containers. Piped water for showers and toilets will be delivered to the new accommodation quarters that are being constructed. There is also a water treatment system situated between the reservoir and the main plant process for use in the plant. The reservoirs do not supply the nearby villages but STC has sponsored and installed water purification systems in Kubyin and in Pyi Nyaung and STC is currently investigating the feasibility of providing additional water for Pyi Nyaung Village as part of the water supply study for the second line.

Figure 4.11 Rivers and streams around the Limestone Quarry

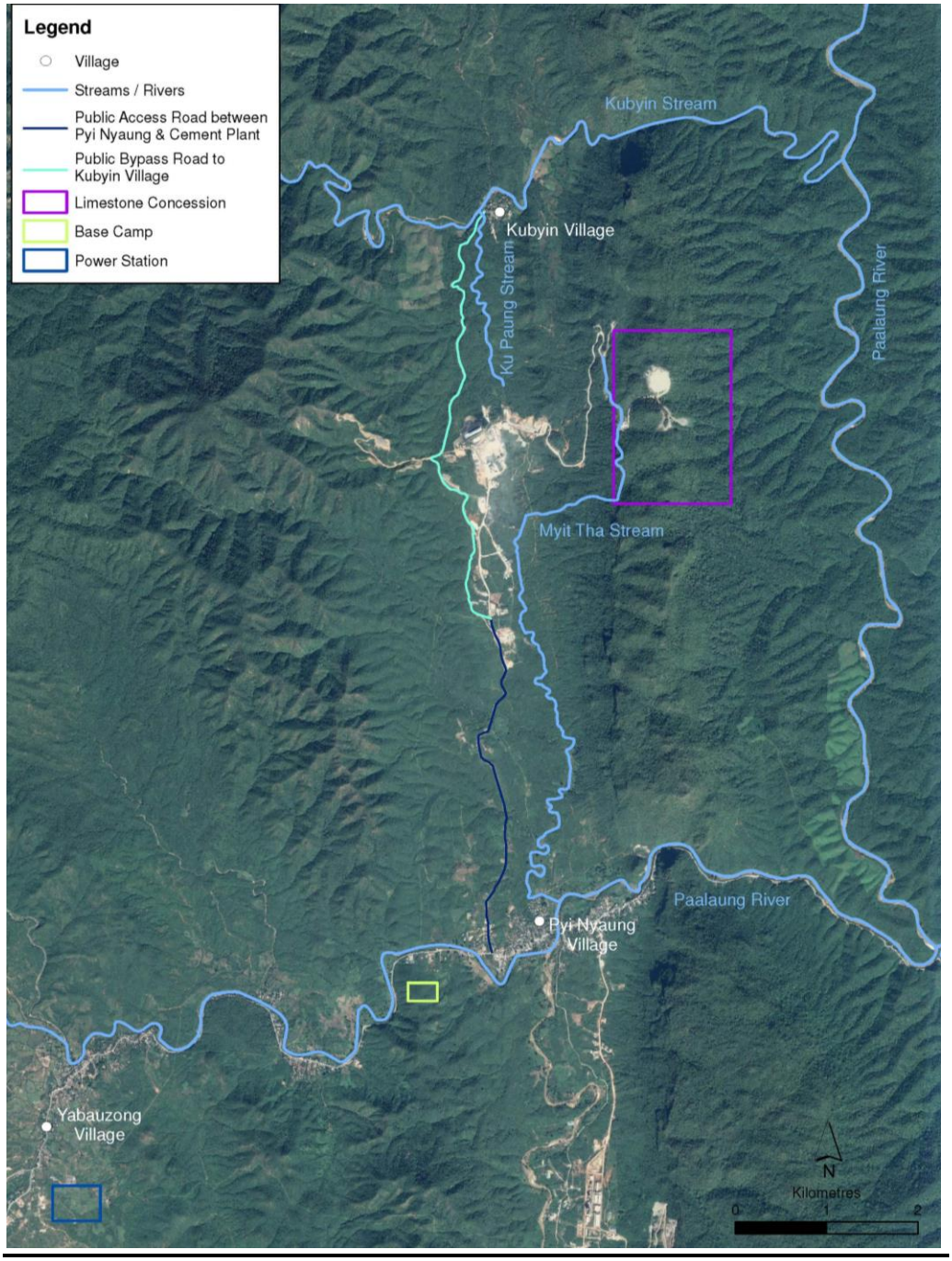


Figure 4.12 Panoramic View of Water Intake Point at Kubyin Stream

Note: The width of Kubyin Stream was 7 m at this point.
Source: STC, 2018

Table.4.11 provides a summary of current and expected water use for the cement plant and associated quarries:

Table.4.11 Current and Expected Water Use

Water Use	Actual Water Use (2017) m^3/day	Design –Basis Water Use m^3/day
Existing first Line		
Plant usage	132	250
Domestic usage	265	500
Total usage	*397*	*750*
Expansion 2nd Line		
Plant usage		550
Domestic usage		250
Total usage		*800*
Expected 1st and 2nd Lines		
Plant usage		800
Domestic usage		750
Total usage		*1,550*

According to latest estimation by STC, water supply from the two reservoirs within the plant area would be adequate to supply water required for the expanded plant and associated quarries. STC did not take any water from the Kubyin Stream or any nearby water bodies used by the communities since the dry season of 2017. Nevertheless, STC is committed not to extract any water from the Kubyin Stream or any nearby water bodies used by the local communities for use by the Project. If it is required to extract water from the Kubyin Stream or any water bodies, STC is committed to assess the annual and seasonal water flow volume and speed of Kubyin Stream or any water bodies and address potential impacts to the local community before such extraction.

Wastewater and Stormwater Facilities

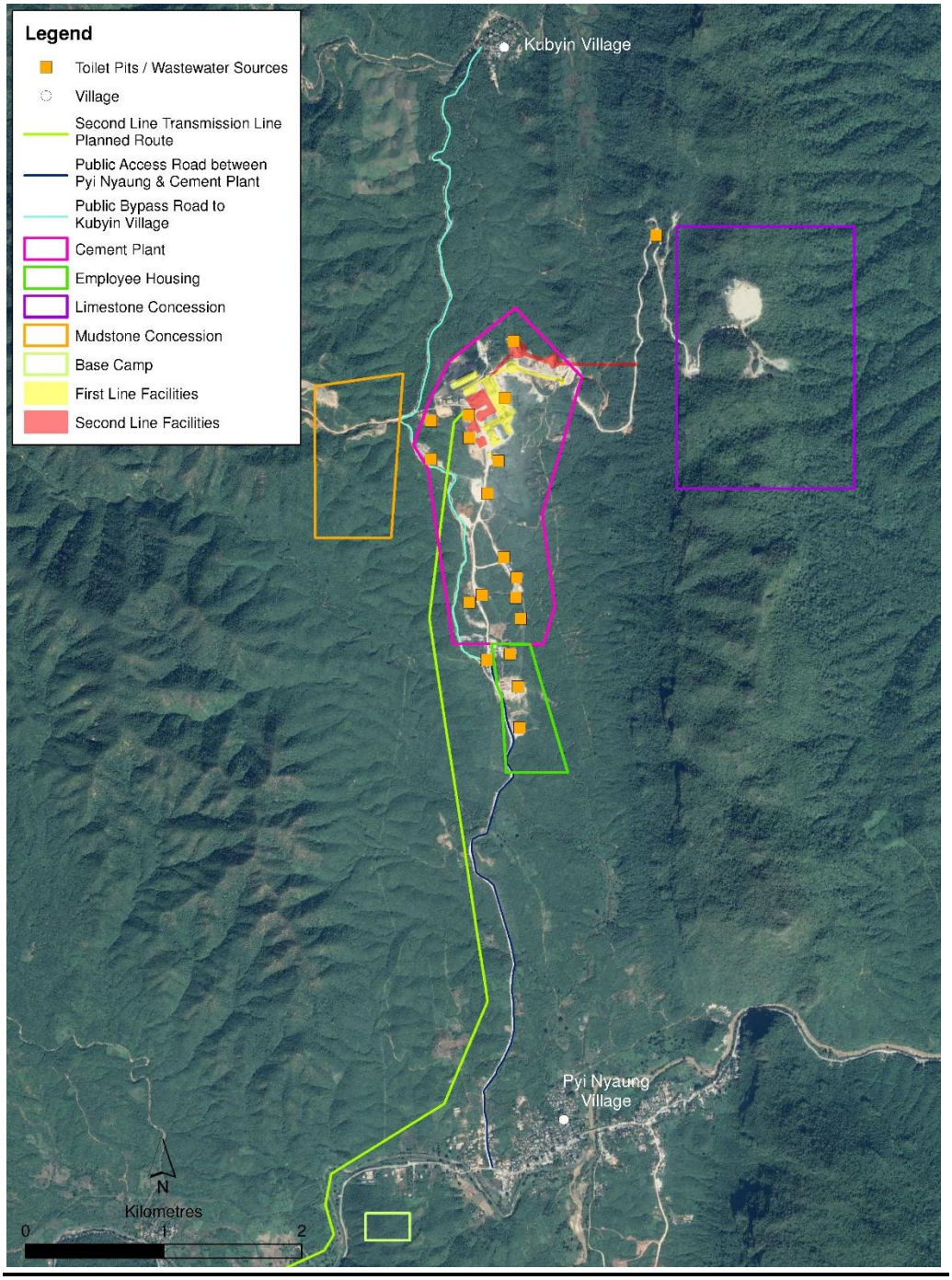
Nineteen wastewater discharge points/toilet pits have been identified throughout the plant area which are also used by the workers at the quarries as illustrated in *Figure 4.13.* The majority of these are storage tanks that are emptied as they fill (approximately twice per year). Some domestic wastewater is collected through a two-stage pond treatment system with the first pond filtering wastewater with pebbles, charcoal and river sand before entering the second pond.

Greywater from washing and showering in the three canteens and the housing areas is used for greening. A small amount (<4m^3/year) of wastewater is generated from the onsite laboratory. The resulting chemical wastewater is neutralised by using potassium permanganate and discarding the treated liquid effluents into a concrete pond. At the concrete pond the wastewater is evaporated and there is no requirement for discharge yet due to the small residual volume after evaporation. Other non-hazardous chemical wastewater is treated and discarded in an enclosed plastic container that is

emptied regularly. It is planned to discharge the treated wastewater from the laboratory to the wastewater treatment facilities that STC is currently designing to improve the wastewater treatment performance of the Project.

Figure 4.13 shows the sources of wastewater around the cement plant and the quarries.

Figure 4.13 Existing Locations of Wastewater Sources and Toilet Pits



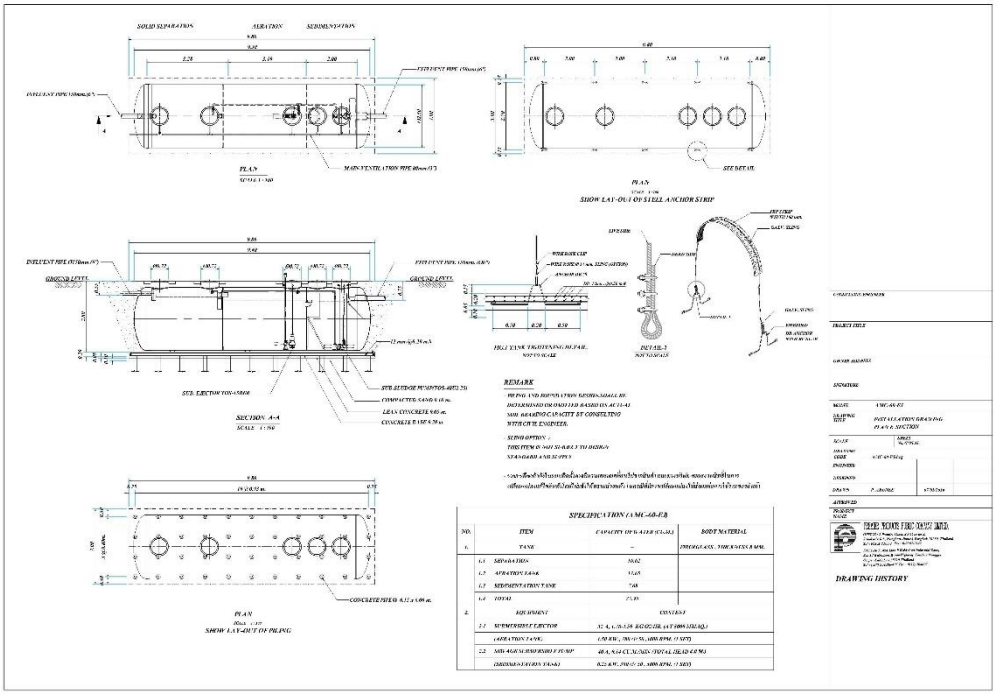
Stormwater from the limestone quarry flows west and south to the Myit Tha Stream and drains into STC's reservoirs.

The conceptual study for a wastewater system including a wastewater treatment plant is completed. This study aims to achieve zero discharge of wastewater effluent (excluding stormwater). Treated greywater is anticipated to be used for greening and dust suppression. A conceptual stormwater management plan is also completed and envisages including four designated areas for stormwater settling and retention within the cement plant complex: one near each quarry, one by the plant and another one by the staff main housing area, as well as a stormwater diversion trench (a bund) in parallel to a drain directing wastewater into three new settling ponds along the north boundary of the cement plant complex. Detailed designs are not yet available, however these sedimentation ponds will be designed to be sufficiently deep and wide, with overflow channels and concrete pipes, clearly marked, cleared of unwanted vegetation, their banks aligned, some walls will be reinforced and others built (such as by the existing reservoirs). Six further retention ponds are also planned in the 55 acre-housing area, south of the cement plant complex, with a focus on the employee housing area, the weigh bridge and fuel depot area, the labour camp area and the family housing area. The stormwater management system will be designed such that any discharge will be treated to comply with Myanmar National Environmental Quality (Emissions) Guidelines for construction materials extraction (which is noted to be the same as the Myanmar National Environmental Quality (Emissions) Guidelines for site runoff and wastewater discharges). STC is committed to provide the detailed design of the stormwater management system to the ECD once it is available.

STC is in the process of designing the wastewater treatment facilities. It is intended to install separate modular wastewater treatment units to collect and treat wastewater from different zones of the site considering the technically and economically feasibility of the piping arrangement. *Figure 4.14* illustrates, as an example, the detailed design and photo of a modular wastewater treatment unit that has been installed on site to collect and treat wastewater from the employees' family housing within the 55 acres area adjacent to the cement plant. This treatment unit has separation, aeration and sedimentation tanks for wastewater treatment and the quality of treated wastewater from all wastewater treatment units will be designed to comply with paramters of Myanmar National Environmental Quality (Emissions) Guidelines for Wastewater, Storm Water Runoff, Effluent and Sanitary Discharges (General Application). Treated wastewater from these units will be conveyed to a centralized tank for reuse in the cement plant. Treated wastewater will be monitored monthly at the centralized tank for compliance with the NEQEG on BOD, COD, pH, SS, oil and grease, TN, TP and residual chlorine and monitored annually for compliance with the full list of parameters on the NEQEQ for Wastewater, Storm Water Runoff, Effluent and Sanitary Discharges (General Application) (*Table 3.4*). Sludge generated from the units will be dewatered to meet with the Myanmar NEQEG for Biosolids and Sludge Disposal before disposal to the non-hazardous solid waste management facility (Table 3.5). Sludge samples from each modular tank will be checked yearly for compliance with the NEQEG for Biosolids and Sludge Disposal.

STC will prepare and implement a Stormwater Management Plan and a Sewage Management Plan taking into account the mitigation committed above.

Figure 4.14 Detailed Design and Photo of the Wastewater Treatment Plant



Source: STC, 2018

Accommodation Facilities

Operational staff are housed on-site in the main staff housing area or the staff family housing area where three main canteens, dormitories and individual houses are provided by the company.

Approximately 1,400 workers are currently onsite (640 staff on the existing first line, 550 labour on the existing first line, and construction workers), excluding visitors, families and truck drivers (which together number around 400).

During construction of the second line and operation of the associated quarries expansion, it is estimated that 500 construction workers will be housed in construction camps within the cement plant. The dedicated areas for construction workers' camps are to the west of the process plant area, near the main entrance gate to the plant area and within the staff family housing area.

There will be around 460 operational staff who will mainly stay in staff accommodation within the plant and a total of about 2,500 to 3,000 people are expected to be based at the plant once the second line and quarries expansion is in operations (including about 640 staff and 550 labour on the existing first line for a total of 1,190 and about 730 staff and 550 labour on the expansion second line for a total of approximately 1,280). Other ancillary facilities within the plant include the office building, as well as the control centre and laboratory.

Waste Management and Hazardous Materials

Organic waste generated from the canteens is recycled as pig food or used as compost. A waste management procedure is in place and is being updated to minimise waste generated at the cement plant and associated quarries and to investigate the possibility of incineration of high calorific waste in the new kiln.

Hazardous waste generated from fuel, lubricants, used engine oil, used hydraulic oil and fluid, compressed gas cylinders, from the laboratory such as chemicals or from the clinic is limited in volumes. Hazardous waste and materials storage are confined to the heavy mechanical equipment area, the petrol station and near the laboratory which are in the process of being fully paved. Approximately 8 drums of used oils are collected monthly and sold to third parties for recycling. Other hazardous wastes are generally mixed with domestic waste. Medical waste is regularly collected by Thazi Township municipal waste collection system and mixed with waste from the Thazi hospital at the cemetery in Thazi Township.

STC is in the process of upgrading the waste management system. Hazardous waste will be transported and disposed of at suitable facilities of Golden Dowa Eco-system Myanmar Co.Ltd, which is located at Thilawa SEZ of Yangon Region. The waste disposal facility in Yangon can also handle faecal and general wastes, if required. Non-hazardous waste will be recycled

and reused as far as possible or disposed in the non-hazardous waste management facility within the cement plant. The estimated volume of non-hazardous waste generation is ~40,000 kg per month. It is estimated that ~32 drums of used oil will be generated for disposal /recycling for the future second line. Other hazardous wastes are expected to be limited in volume and will be sent to the treatment facility in Thilawa SEZ for disposal.

4.1.4 Project Schedule

The mining plan is shown in *Table 4.3* with *Figure 4.4* to *Figure 4.9* demonstrate the detailed mining sequences in the limestone quarry area during the 37 years of lifespan of the limestone quarry.

4.2 PROJECT ALTERNATIVES

Given that the Project is a brownfield extension of an existing quarry, there are no feasible alternatives for Project siting.

Currently the drill and blast method is adopted and this will be the method adopt for the further Stage 2 to Stage 7 limestone extraction. With the drill and blast method to fragment the limestone before excavation, the requirement of excavation is reduced which would reduce the dust generation. In addition, less Powered Mechanical Equiment (PME) will be required for the excavation which would reduce the generation of noise.

Installation of a conveyor will reduce the use of vehicles to transport quarried material and will therefore be more efficient in terms of fuel consumption.

5 DESCRIPTION OF THE SURROUNDING ENVIRONMENT: ENVIRONMENTAL BASELINE

This section is structured to provide information on the environmental baseline characteristics and conditions in the Project Site and its AOI. The discussion is limited to the factors and environmental components that could have a direct impact on the Project, or which may be impacted by the Project.

Baseline information has been collated from a range of sources including publicly available information, primary data collection and through consultation.

5.1 AREA OF INFLUENCE: SETTING THE STUDY LIMITS

The AOI of the Project encompasses:

- The primary Project Site of the limestone quarry; and
- Areas potentially affected by the cumulative impacts from other developments or future expansion of the Project as well as induced activities of the Project.

It should be noted that the AOI for a particular resource/ receptor may vary depending on the nature of the change caused by the Project activities and the type of effect being considered, but in each case it is defined to include all the area within which it is likely that potentially significant impacts could result. For example, a 300 m AOI would be considered as sufficient for noise given the localised nature of noise impacts while the AOI for water quality impacts due to unplanned spills would cover the downstream area where elevated pollutant level is expected, which is often more than 300 m. As such, the AOI for each specific resource / receptor / impact will vary and these are defined in the sections below.

5.2 PUBLIC ADMINISTRATION AND PLANNING

Two public socio-economic development plans relevant to the Project have been identified. The Tharsi-Nyaung Yan, Nyaung Yan Substation project is being developed and should include a 33/11kV substation (5MVA), a 10-mile long 33kV single-pole with earthing wire line as well as a 24-mile long 11kV aluminium-conductor steel-reinforced cable (ACSR). The Tharsi Township (Myoma) 33/11kV substation (10MVA) is another regional project relevant to the Project; it is part of a wider regional development program for poverty reduction and aims to enhance existing agro-productions to enable self-sustaining local development [1].

[1] Source: Japan International Cooperation Agency (2017) Preparatory Survey for Regional Development for Poverty Reduction Phase II Final Report (accessed from: http://open_jicareport.jica.go.jp/pdf/12270443_01.pdf on 14 December 2017)

5.3 PHYSICAL ENVIRONMENT

5.3.1 Air quality

An AOI of 5 km around all the Project Site has been established for the Air Quality Impact Assessment. The AOI has been determined so that all potentially impacted sensitive receptors closest to the Project activities during the operation phase have been identified. The AOIs also considered cumulative impact of the limestone quarry expansion Project and the nearby STC cement plant and mudstone quarry expansin projects.

Sensitive receptors are split into three categories as described below.

- Human – these are locations of human settlement, schools, hospitals, clinics and government offices. The relevant pollutants of interest for sensitive human receptors are particulate matter, PM_{10} and $PM_{2.5,}$ NO_2 and SO_2.

- Ecological – these are locations where there are local, national or internationally protected habitats. The relevant pollutants of interest for sensitive ecological receptors are particulate matter, SO_2 and NO_x.

- Agricultural - these are locations where there are crop growing activities, as crop growth may be detrimentally affected and crops soiled as a result of project activities. The relevant pollutants of interest for sensitive agricultural receptors are particulate matter, SO_2 and NO_x.

A number of representative human sensitive receptors were identified in the vicinity of the limestone quarry and the related STC facilities (i.e. the cement plant and the mudstone quarry) as presented in *Table 5.1* and *Figure 5.1*. Of the identified sensitive receptors, it should be noted that AQ1 and AQ4 - AQ6 are onsite worker accommodation. The main offsite villages are Kubyin Village and Pyi Nyaung Village, more than 1.5 km to the north and more than 5 km to the south of the limestone quarry respectively.

Table 5.1 Representative Air Sensitive Receptors near the Limestone Quarry

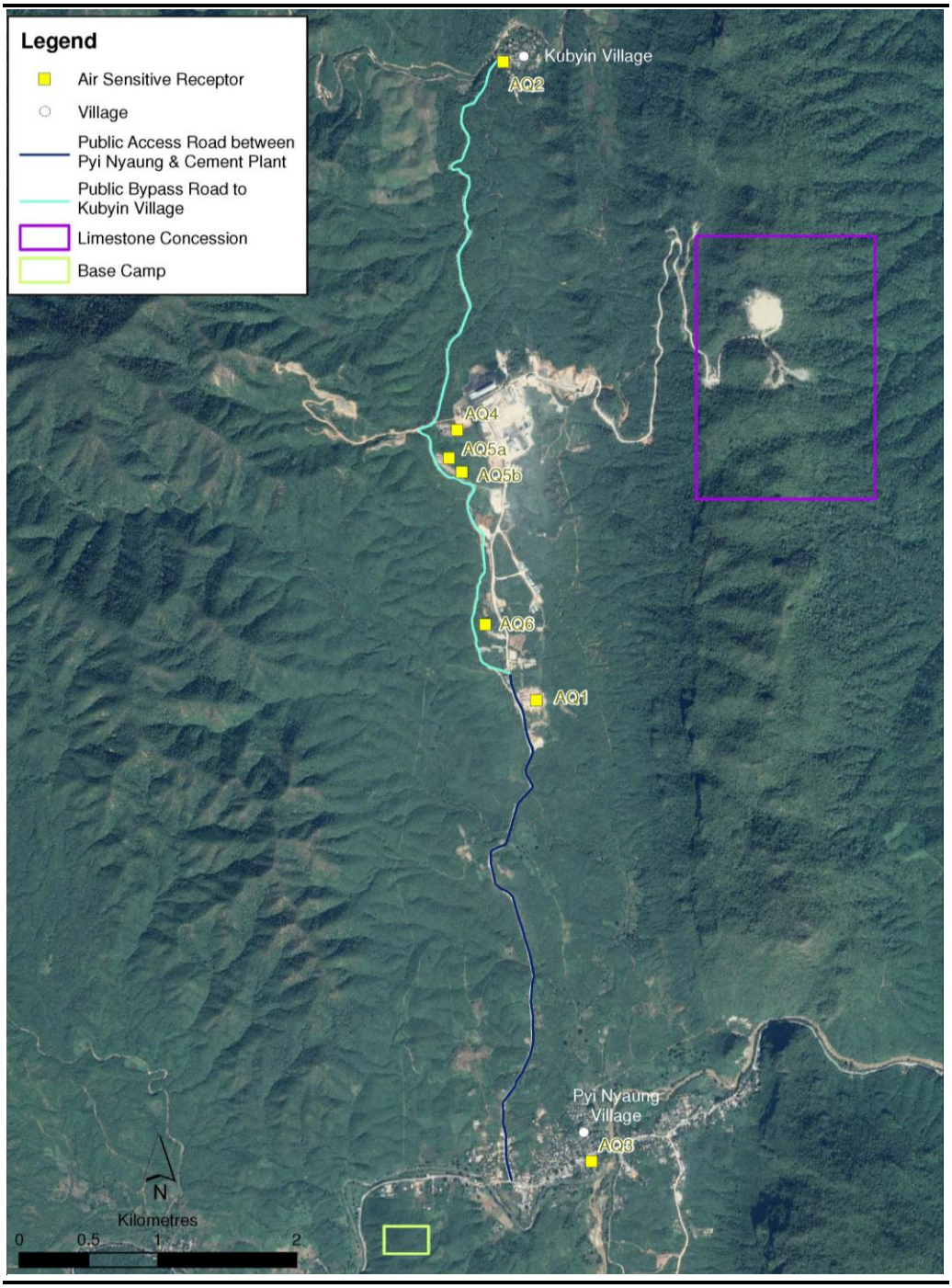
Receptor ID	Receptor Name[1]	Type of Receptor	Approximate Location		Approximate Distance to Project Components[2]	
			Latitude	Longitude	Limestone Quarry	Project Road
AQ1	Worker Accommodation	Human	20°50.56.15'N	96°23.35.97'E	<2000m	<50m
AQ2	Kubyin Village	Human	20°53.25.83'N	96°23.25.07'E	<2000m	<50m
AQ3	Pyi Nyaung Village	Human	20°49'6.34"N	96°23'35.42"E	<5000m	<50m
AQ4	Worker Accommodation	Human	20°51'59.29"N	96°23'15.09"E	<2000m	<50m
AQ5a	Worker Accommodation	Human	20°51'52.66"N	96°23'13.16"E	<2000m	<50m
AQ5b	Worker Accommodation	Human	20°51'49.43"N	96°23'16.43"	<2000m	<50m
AQ6	Worker Accommodation	Human	20°51'13.74"N	96°23'22.86"E	<2000m	<50m

Notes:

(1) Each receptor identified is not necessarily a single point and may represent a cluster of receptors.

(2) Distances from project components have been estimated using aerial imagery.

Figure 5.1 Representative Air Sensitive Receptors near the Limestone Quarry



In accordance with WBG guidelines (1), measurement of existing air quality is required for emissions associated with the Project processes over time that have potential to impact the surrounding land use. The primary pollutants associated with the Project are PM_{10} and $PM_{2.5}$, NO_x, NO_2, and SO_2.

Ambient concentrations of NO_2 and SO_2 were measured by means of a diffusion tube survey undertaken by ERM in January 2017. This data was supplemented by monitoring of particulate matter ($PM_{2.5}$ and PM_{10}) by

(1) International Finance Corporation (IFC) (2007) Environmental, Health and Safety Guideline: Air Emissions and Ambient Air Quality

specialist subcontractor REM and United Analyst and Engineering Consultants Co., Ltd. (UAE) in January 2018.

The findings from both surveys are presented in the following section.

ERM Baseline Monitoring Survey

Ambient air quality monitoring of NO_2 and SO_2 was undertaken for one week from the 17th to the 23rd January 2017 to provide an indication of baseline concentrations in ambient air.

Air quality monitoring locations were selected by identifying potentially affected communities, with consideration given to the prevailing wind conditions and Project activities. There is limited local monitoring of meteorology and therefore Weather Research and Forecasting Model data (1) was used to generate meteorological data for the purpose of reviewing climatic conditions, air quality and identifying sensitive receptors.

ERM monitored three locations for NO_2 and SO_2 at locations in the vicinity of the limestone quarry given the likely future emissions from the cement manufacturing process (*see Table 5.2*). The measured baseline air quality data are conservatively considered representative of the entire Project AOI.

At each monitoring location, measurement of NO_2 and SO_2 was undertaken using Palmes type diffusion tubes in triplicate. Diffusion tubes are passive samplers that consist of small plastic tubes which contain a chemical reagent to absorb the pollutant to be measured directly from the air. The use of triplicate diffusion tubes enhances the robustness of the data set and allows potentially outlying values to be identified and investigated. Preparation and analysis of the diffusion tubes was undertaken in accordance with BS EN 13528. There is best practice guidance, adopted by this assessment, available from the US EPA (2) and from the UK Department for the Environment, Food and Rural Affairs (DEFRA) (3) on the siting and deployment of tubes. The analysis of the exposed tubes was undertaken using Ion Chromatography (United Kingdom Accreditation Service (UKAS) Accredited Method ISO/IEC 17025:2005).

Monitoring locations were initially selected using aerial photography, local knowledge about villages, accessibility and security to determine the location of operations and nearby sensitive receptors in addition to typical wind directions for the time of year of the monitoring. The final decision on locations was then made while in the field to determine the most suitable and representative locations for monitoring equipment to be deployed.

(1) Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, M. G Duda, X.-Y. Huang, W. Wang, and J. G. Powers, 2008: A Description of the Advanced Research WRF Version 3. NCAR Tech. Note NCAR/TN-475+STR, 113

(2) United States Environmental Protection Agency (USEPA) Ambient Monitoring Technology Information Centre [Online] Available at: https://www3.epa.gov/ttn/amtic/ [Accessed 12th September 2016]

(3) AEA Energy and Environment on behalf of the Department for Environment, Food and Rural Affairs (Defra) and the Devolved Administrations (2008) Diffusion Tubes for Ambient NO_2 Monitoring: Practical Guidance for Laboratories and Users

Monitoring locations were chosen to determine general background concentration levels. Primarily, sites were located to measure typical concentrations in areas of high population density i.e. where sensitive receptors are located. Locations were also chosen to reflect local wind conditions with locations downwind of prevailing winds being of important consideration. The monitoring locations identified are presented in *Figure 5.1* with photos shown in *Figure 5.2* to *Figure 5.4* and further information is provided in *Table 5.2.*

Table 5.2 Air Quality Monitoring Summary

Site	Name	Location		Monitoring	Period
		Latitude	Longitude		
AQ1	Worker Accommodation	20°50'56.15"N	96°23'35.97"E	NO_x, NO_2, SO_2	17 to 23 January 2017
AQ2	Housing Kubyin Village	20°53'25.83"N	96°23'25.07"E		
AQ3	Pyi Nyaung Village	20°49'8.19"N	96°23'51.55"E		

Figure 5.2 Air Quality Monitoring Station at AQ1: Worker Accommodation Quarters

Figure 5.3 Air Quality Monitoring Station at AQ2: Kubyin Village

Figure 5.4 Air Quality Monitoring Station at AQ3: Pyi Nyaung Village

The monitoring data from the air quality survey undertaken by ERM between 17 and 23 January 2017 for NO_2 and SO_2 are presented below in *Table 5.3*.

Table 5.3 NO_2 and SO_2 concentrations measured by ERM, 17 - 23 January 2017

Site	Name	Tube No.	NO_2	SO_2[1]
			µg/m³	µg/m³
Annual Mean Air Quality Standard[2][3]			**40**	**n/a**
AQ1	Worker Accommodation	Tube 1	3.68	<DL
		Tube 2	3.61	
		Tube 3	3.59	
		Average	3.63	
AQ2	Kubyin Village	Tube 1	10.5	<DL
		Tube 2	10.3	
		Tube 3	10.1	
		Average	10.3	
AQ3	Pyi Nyaung Village	Tube 1	9.09	<DL
		Tube 2	10.6	
		Tube 3	10.7	
		Average	10.1	

Note:

(1) Results reported as <0.03µgS on tube are below the reporting limit.

(2) WBG General EHS Guidelines, 2007

(3) Myanmar Environmental Quality (Emission) Guidelines, 2015

The data presented in *Table 5.3* have conservatively been used to represent indicative annual background concentrations of NO_2 and SO_2. A review of the baseline data collected concludes that the baseline concentrations are consistently below the relevant annual AQS presented in *Table 3.2*. Baseline concentrations of SO_2 were found to be below the limit of detection at all monitoring sites.

The baseline also needs to be interpreted for short-term periods. The United Kingdom Department for Environment, Food and Rural Affairs (DEFRA) (1) recommends that the short-term baseline is derived by multiplying the long-term by a factor of two. This conversion has been undertaken using the figures presented in *Table 5.3* to provide baseline concentrations for comparison against the one hour NO_2 air quality standards presented in *Table 3.2*. This is considered a conservative approach. The results from applying this methodology are presented below in *Table 5.4*.

Table 5.4 Derived Hourly NO_2 Background Concentrations

Site	Name	Hourly concentration (µg/m³)
AQ1	Family Housing	7.26
AQ2	Kubyin Village	20.6
AQ3	Pyi Nyaung Village	20.2
Average		16.0
Air Quality Standard[1][2]		200

Notes:

(1) WBG General EHS Guidelines, 2007

(2) Myanmar Environmental Quality (Emission) Guidelines, 2015

(1) Department for Environment, Food and Rural Affairs (DEFRA) (2016) Air emissions risk assessment for your environmental permit [Online] Available from: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Accessed 2nd March 2017]

The results from the monitoring conducted in the area indicate that ambient concentrations of NO_2 and SO_2 are below the relevant air quality standards. The receiving airshed in the area can therefore be classified as 'non-degraded' with regard to these pollutants.

United Analyst and Engineering Consultants Co., Ltd. (UAE) Baseline Monitoring Survey

Ambient air quality monitoring of particulate matter (PM_{10} and $PM_{2.5}$) was undertaken by specialist subcontractor REM and the samples analysed by United Analyst and Engineering Consultants Co., Ltd. (UAE) in January 2018. The monitoring was undertaken during dry season in Myanmar and therefore dust in the study area is expected to be elevated relative to wetter months when rainfall will naturally attenuate ambient dust and particulate matter. The baseline assessment therefore provides a worst case approach to defining the baseline conditions in the study area.

Monitoring of $PM_{2.5}$ and PM_{10} was performed for 14 days consecutively using High and Low Volume Air Samplers. The monitoring took place at two locations from 7th to 21st January 2018.

PM_{10} was monitored using a High Volume Air Sampler with a flow rate of 1.13 m^3/minute. Air was drawn through a quartz fiber filter continuously for a 24 hour period before being replaced. The filters were analyzed using the USEPA approved reference method (1).

$PM_{2.5}$ was monitored using a Low Volume Air Sampler with a flow rate of 16.67 litres/minute. Air was drawn through a PTFE filter continuously for a 24 hour period before being replaced. The filters were analyzed using the USEPA approved reference method (2).

The monitoring locations are presented below in *Table 5.5*, *Figure 5.5* and *Figure 5.6*. The monitoring results are presented in *Table 5.6* and *Table 5.7.*

Table 5.5 Monitoring Locations

Monitoring Site	Location	Parameters Monitored	Monitoring Period
Pyin Nyaung Village (AQ3)	20°49'5.09" N 96°23'44.24" E	PM_{10}, $PM_{2.5}$	07/01/2018 – 21/01/2018
Kubyin Village (AQ2)	20°53'28.00" N 96°23'24.94" E	PM_{10}, $PM_{2.5}$	07/01/2018 – 21/01/2018

(1) The United States Environmental Protection Agency (USEPA) Code of Federal Regulation, 40 CFR- Chapter 1 Part 50, Appendix J to Part 50 (High Volume Method) by using Electronic Balance 4pt

(2) The United States Environmental Protection Agency (USEPA) Code of Federal Regulation, 40 CFR- Chapter 1 Part 50, Appendix L to Part 50 by using Electronic Balance 6pt

Figure 5.5 Monitoring Location at Pyin Nyaung Village

Figure 5.6 Monitoring Location at Kubyin Village

Table 5.6 Monitoring Results at Pyin Nyaung Village (µg/m³)

Monitoring Site	Date on	Date off	Period	PM_{10}	$PM_{2.5}$
Pyin Nyaung Village (AQ3)	07-01-2018	08-01-2018	24-hrs	57	25
	08-01-2018	09-01-2018	24-hrs	54	22
	09-01-2018	10-01-2018	24-hrs	51	25
	10-01-2018	11-01-2018	24-hrs	76	36
	11-01-2018	12-01-2018	24-hrs	66	32
	12-01-2018	13-01-2018	24-hrs	99	38
	13-01-2018	14-01-2018	24-hrs	100	42
	14-01-2018	15-01-2018	24-hrs	103	53
	15-01-2018	16-01-2018	24-hrs	84	48
	16-01-2018	17-01-2018	24-hrs	76	47
	17-01-2018	18-01-2018	24-hrs	68	37
	18-01-2018	19-01-2018	24-hrs	76	45
	19-01-2018	20-01-2018	24-hrs	83	43
	20-01-2018	21-01-2018	24-hrs	75	30
Maximum (µg/m³)				103	53
Average (µg/m³)				76.3	37.4
Air Quality Standard (µg/m³) (1,2)				50	25

Notes:
(1) *WBG General EHS Guidelines, 2007*
(2) *Myanmar Environmental Quality (Emission) Guidelines, 2015*

Table 5.7 Monitoring Results at Kubyin Village (µg/m³)

Monitoring Site	Date on	Date off	Period	PM_{10}	$PM_{2.5}$
Pyin Nyaung Village (AQ2)	07-01-2018	08-01-2018	24-hrs	31	18
	08-01-2018	09-01-2018	24-hrs	26	17
	09-01-2018	10-01-2018	24-hrs	18	12
	10-01-2018	11-01-2018	24-hrs	39	17
	11-01-2018	12-01-2018	24-hrs	30	14
	12-01-2018	13-01-2018	24-hrs	49	19
	13-01-2018	14-01-2018	24-hrs	29	20
	14-01-2018	15-01-2018	24-hrs	39	28
	15-01-2018	16-01-2018	24-hrs	18	19
	16-01-2018	17-01-2018	24-hrs	31	27
	17-01-2018	18-01-2018	24-hrs	42	26
	18-01-2018	19-01-2018	24-hrs	31	22
	19-01-2018	20-01-2018	24-hrs	33	25
	20-01-2018	21-01-2018	24-hrs	35	14
Maximum (µg/m³)				49	28
Average (µg/m³)				32.2	19.9
Air Quality Standard (µg/m³) (1,2)				50	25

Notes:
(1) *WBG General EHS Guidelines, 2007*
(2) *Myanmar Environmental Quality (Emission) Guidelines, 2015*

The baseline also needs to be interpreted for long-term periods. Using the DEFRA approach previously discussed, the annual average concentrations at monitoring locations has been derived by dividing the 24-hour maximum concentration by a factor of 2. This conversion has been undertaken using the maximum PM_{10} and $PM_{2.5}$ concentration from any 24-hour monitoring period at each site presented in *Table 5.6* and *Table 5.7*. This is considered a conservative approach. The results from applying this methodology are presented below in *Table 5.8*.

Table 5.8 Derived Annual Average PM_{10} and $PM_{2.5}$ Background Concentrations

Name	PM_{10} Annual average concentration (µg/m³)	$PM_{2.5}$ Annual average concentration (µg/m³)
Pyin Nyaung Village (AQ3)	51.5	26.5
Kubyin Village (AQ2)	24.5	14
Air Quality Standard(1)(2)	20	10

Notes:

(1) WBG General EHS Guidelines, 2007

(2) Myanmar Environmental Quality (Emission) Guidelines, 2015

Analysis of the data collected by REM indicates that concentrations of PM_{10} and $PM_{2.5}$ at Pyin Nyaung Village exceed the Myanmar 24-hour average air quality standard continuously over the 14 day monitoring period with the exception of one 24-hour period where $PM_{2.5}$ is below the standard. The maximum PM_{10} and $PM_{2.5}$ concentrations were 103µg/m³ and 53µg/m³ respectively, over two times higher than the relevant air quality standards in Myanmar. The indicative annual average concentration is also in exceedance of the Myanmar annual average air quality standard for both PM_{10} and $PM_{2.5}$. The elevated concentrations of PM_{10} and $PM_{2.5}$ at Pyin Nyaung Village are likely associated with vehicles on the main road that runs through the village, the operation of lime kilns, and the combustion of wood for domestic use which is common in rural Myanmar.

In contrast, the baseline data collected at Kubyin Village indicates no exceedances of the PM_{10} 24-hour air quality standard with a maximum of 49 µg/m³ during the monitoring period. The $PM_{2.5}$ monitoring information indicates fewer exceedances of the relevant air quality standard and a maximum of 28µg/m³ which is substantially less than that found at Pyin Nyaung Village but still in exceedance of the 24-hour average air quality standard of 25µg/m³. The derived annual average concentration is in exceedance of the Myanmar annual average air quality standard for both PM_{10} and $PM_{2.5}$. However it is noted that this is likely a conservative assumption given that PM levels will be considerably higherin the dry season than in the wet season.

It is considered likely that the relatively higher concentrations at Pyin Nyaung Village are associated with traffic movements along the main and the operation of some 30 lime kilns. Kubyin Village is accessed by an unpaved road, however the use of this road is less frequent. There are no lime kilns in Kubyin Village and at a distance of 7-8km from Pyi Nyuang, the operation of these kilns is unlikely to substantially affect air quality in Kubyin Village.

The evidence presented suggests that ambient $PM_{2.5}$ and PM_{10} concentrations at both Pyin Nyaung Village and Kubyin Village are likely to exceed the Myanmar 24-hour air quality standards for the protection of human health during the dry season. The indicative annual average concentration at both sites is based on the maximum 24-hour average concentration measured at each site during the monitoring period and is therefore considered a worst case approach. In reality the annual average is expected to be lower given that ambient concentrations of particulate matter in the wet season will be substantially less.

Although particulate matter concentrations will vary throughout the study area depending on relative distance to different emission sources and the meteorological conditions, the airshed throughout the study area has been classified as 'degraded' for both $PM_{2.5}$ and PM_{10} as a worst case approach. The magnitude of the impacts for the impact assessment is defined based on this finding (please refer to *Annex C1* for the air quality impact assessment methodology).

5.3.2 Climate and Meteorology

In order to fully define the baseline meteorology and climate, hourly sequential meteorological data is required for:

- Wind speed;
- Wind direction;
- Precipitation;
- Relative humidity;
- Temperature; and
- Cloud cover.

Following IFC recommendations, data are required for five (5) years in order to capture year on year variability.

There are no meteorological stations in the vicinity of the Project that capture all these parameters or have sufficient data availability. Therefore, five years of meteorological data were simulated using a 12 km x 12 km grid resolution with the Weather Research and Forecasting Model (WRF) (1). The WRF model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. The model is extensively validated using actual observations to ensure the best possible accuracy and precision.

Figure 5.8 to *Figure 5.11* illustrate the monthly meteorological characteristics at the Project site for a five year period from 2012 to 2016. The data show that the climate in this part of Myanmar is characterised by a dry season that occurs December and April and winds that blow from the east.

(1) Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, M. G Duda, X.-Y. Huang, W. Wang, and J. G. Powers, 2008: A Description of the Advanced Research WRF Version 3. NCAR Tech. Note NCAR/TN-475+STR, 113.

Figure 5.7 Total Monthly Rainfall

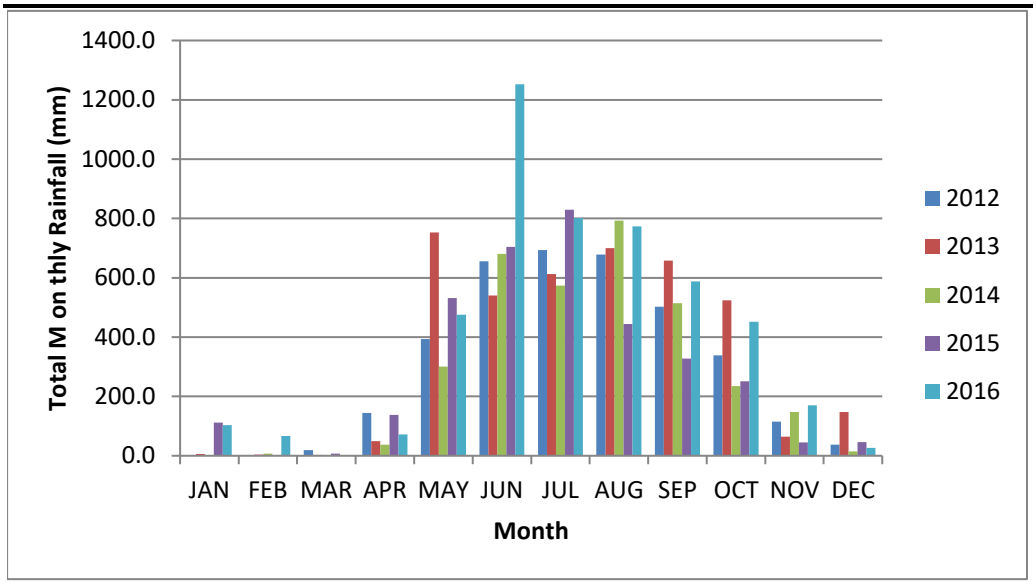


Figure 5.8 Relative Humidity

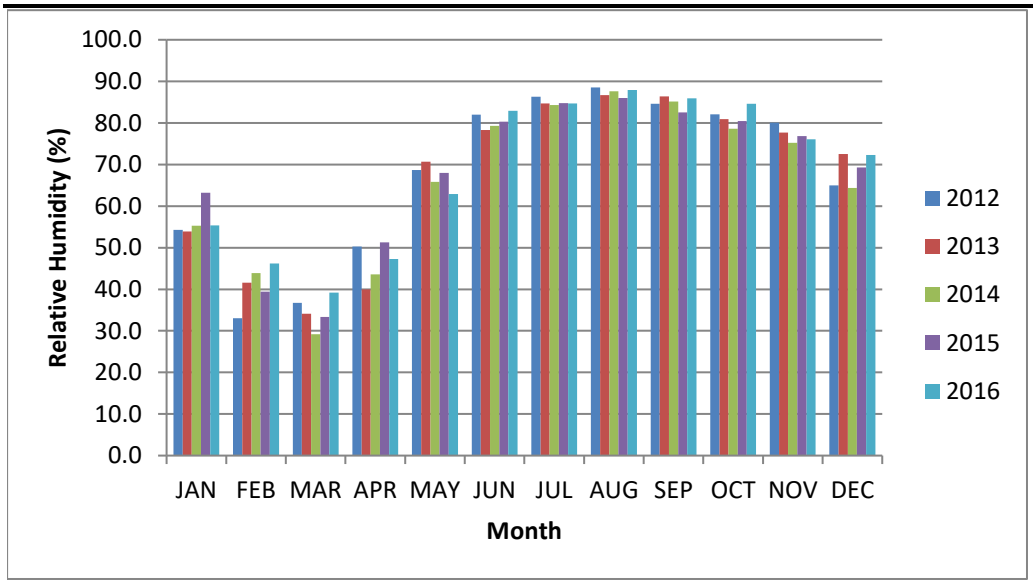


Figure 5.9 Mean Monthly Temperature

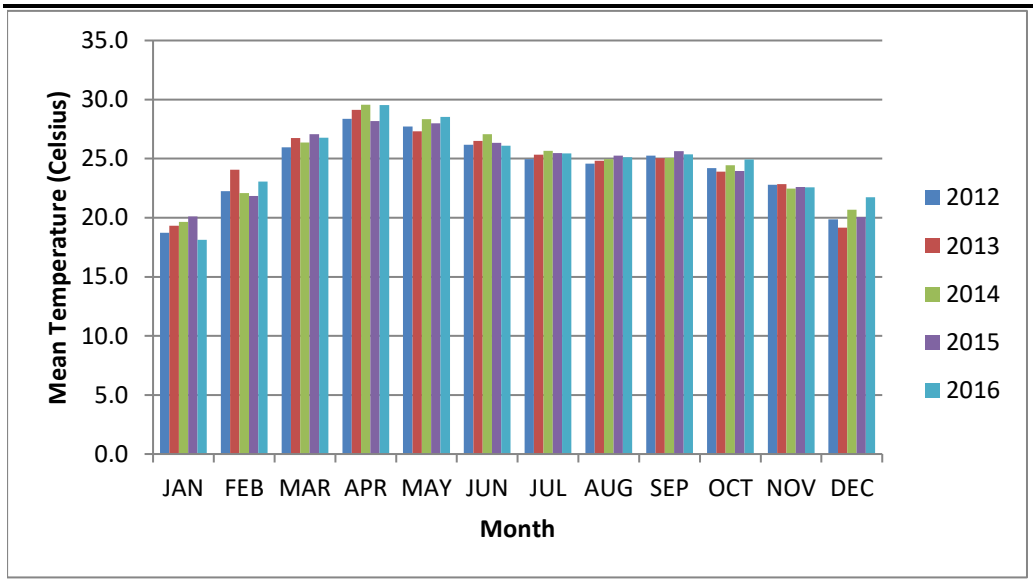


Figure 5.10 Mean Wind Speed

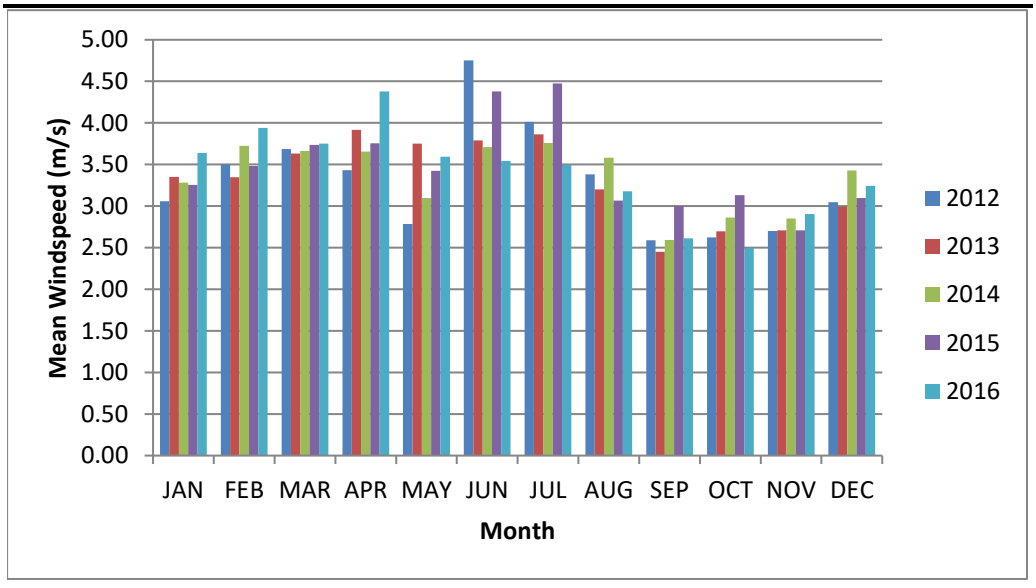


Figure 5.11 Wind Rose 2012 - 2016

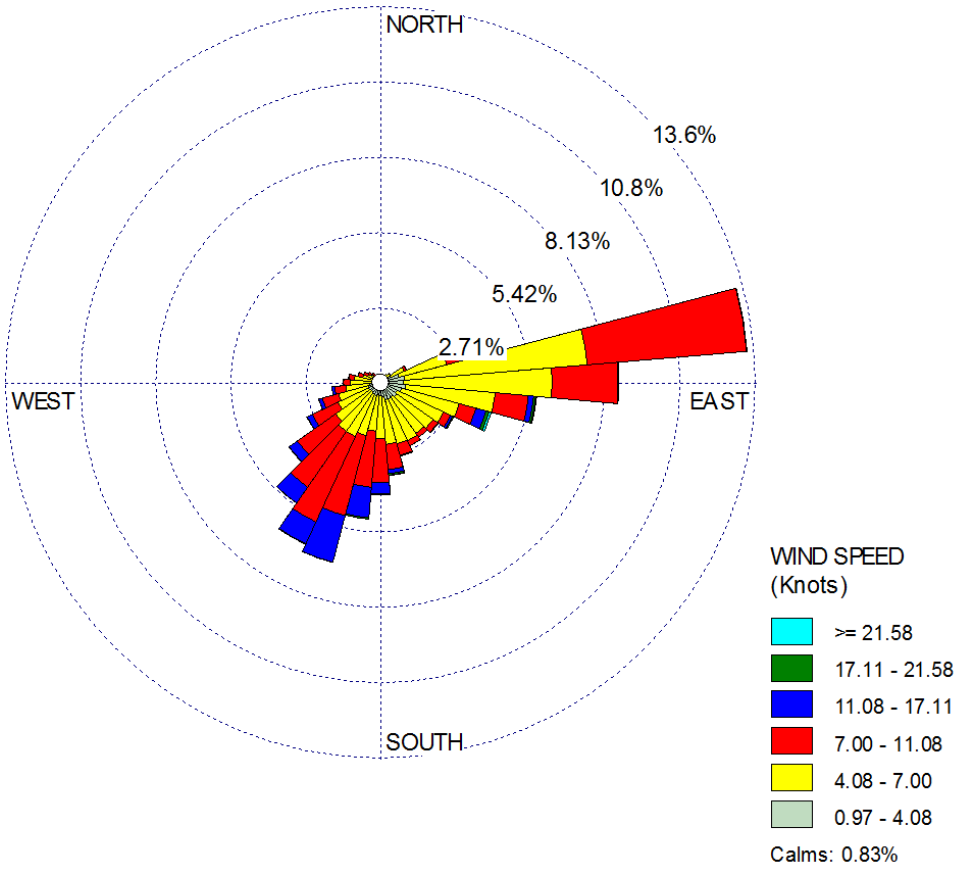


Figure 5.7 indicates that most rainfall is received at the Project Site from May to October, with June, July and August being the most consistently wet months in comparison to the rest of the year.

Relative humidity is presented in *Figure 5.8.* The modelled data show that humidity in the area is highest from July through to September with March recorded as least humid. The average temperatures presented in *Figure 5.9* correlate with average humidity with the highest average temperatures recorded during periods of low relative humidity.

Mean wind speeds are presented in *Figure 5.10* and tend to fluctuate throughout the year. Lower wind speeds are more pronounced during the latter part of the year from September through to December.

A wind rose based on the WRF data is shown in *Figure 5.11.* The figure shows that easterly and south westerly winds dominate. Wind speeds average 3.36 m/s, with a maximum one hour average of 14.4 m/s. Wind direction and wind speed are both important factors when considering air pollution dispersion. Prevailing winds mean receptors downwind are more likely to be exposed to increased concentrations with higher wind speeds leading to increased dispersion.

Emissions of dust are only likely to occur from open exposed surfaces (such as stripped ground and stockpiles) at wind speeds of greater than 5.3 m/s. (1) The data indicate that the wind speed is equal to or greater than 5.3 m/s for 10% of the time. The prevailing wind direction will mean receptors to the west and north east of the Project site will be impacted most as a result of operation activities.

5.3.3 Noise

The nearest representative NSRs that may potentially affected by the noise impacts due to the Project are identified with locations shown in *Figure 5.12* and summarized in *Table 5.9* below:

Table 5.9 Representative Noise Sensitive Receivers

NSR	Description	Type of Uses
N1	Proposed Permanent Housing	Planned permanent residential
N2	Temporary Housing	Worker's camp during construction phase
N3	Temporary Housing	Will be removed when N1 is ready
N4	Existing Permanent Housing	Existing permanent residential

Note:
N2 and N3 are temporary housing during the construction phase and are not included in the operational noise impact assessment sicne they will not be used during operation of the future second line.

Baseline noise monitoring was conducted on 18 to 23 January 2017 at three selected noise sensitive receivers (NSRs), which are N1, N2 and N3, located near the Project Site to establish the background levels. Based on the site visit carried out in January 2017, the operational noise from the existing cement plant an associated quarries is not noticeable at both N1 and N4. Only noise from occasional traffic could be observed. Background noise environments for both N1 and N4 are considered to be similar. Therefore, baseline noise monitoring was not conducted at N4. The locations of representative NSRs are summarised in *Table 5.10* and are presented in *Figure 5.12* with photos shown in *Figure 5.13-Figure 5.15.*

(1) United States Environmental Protection Agency (1995) AP-42 Section 13.2 Fugitive Dust Sources

Figure 5.12 Representative NSRs of the Project

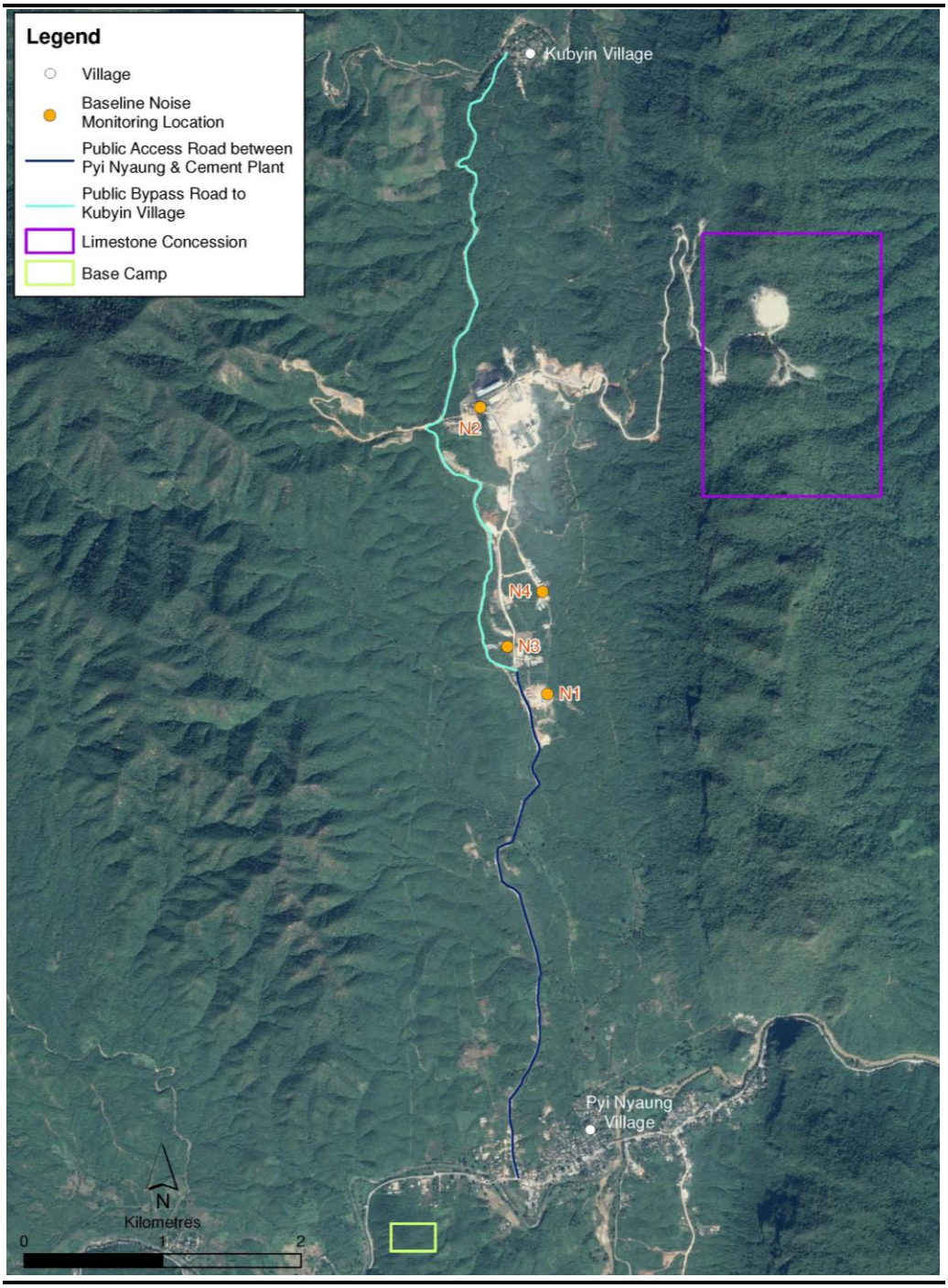


Figure 5.13 Noise Monitoring Station at N1

Figure 5.14 Noise Monitoring Station at N2

Figure 5.15 Noise Monitoring Station at N3

Table 5.10 Baseline Noise Monitoring Locations

NSR	Description	GPS Coordinates
N1	Permanent Housing - 1	20°50'57"N
N2	Temporary Housing - 1	20°52'4"N
N3	Temporary Housing - 2	20°51'18"N

Hourly A-weighted equivalent continuous sound pressure levels ($L_{Aeq,\ 1\ hour}$) were recorded 24 hours continuously at each location. Daytime and night-time L_{Aeq} were calculated by averaging the hourly sound pressure levels measured between 0700 and 2200 hours and between 2200 to 0700 hours, respectively.

Noise levels (L_{Aeq}) were recorded by a Type I sound level meter, *01dB-Stell Solo,* at about 1.5 m above ground with no reflecting surface within 3m in accordance with the IFC Guidelines.

Background noise levels exceeded the noise limits set out in Myanmar NEQEG (the same as those specified in WBG *General EHS Guideline* (2007)) during daytime and night-time periods at both temporary worker accommodation areas which are located several hundred metres from the cement plant but more than 1.5 km away from the limestone quarry. The dominant source of noise was mainly from the traffic along the access road. Results of the baseline noise monitoring are summarised in *Table 5.11*.

Table 5.11 Summary of Baseline Noise Monitoring and Noise Criteria

NSR	Type of Uses	Averaged Background Noise Levels, dB(A)		NEQEG and IFC Noise Level Guidelines, dB(A)	
		Daytime	Night-time	Daytime	Night-time
N1	Residential	49	44	55	45
N2	Residential	58	57	55	45
N3	Residential	56	54	55	45

Notes:
Daytime refers to the hours from 0700 hrs to 2200 hrs while night-time refers to the hours from 2200 hrs to 0700 hrs.

5.3.4 Surface Water Quality

Water quality impacts could be a potentially significant issue for the operation of the quarries, for example, in case of sediment loaded run-off from the limestone quarry. Stormwater from the limestone quarry flows west and south to the Myit Tha Stream and drains into STC's reservoirs. Taking into account the locations of the limestone quarry as well as the related STC cement plant and mudstone qurry, a baseline water quality survey was conducted in January 2017 to establish baseline conditions and to inform the impact assessment of the limestone expansion Project and related STC cement plant and mudstone qurries expansion. The sampling locations and the rationale for inclusion are presented in *Table 5.12*. *Figure 5.16* illustrates the locations of the sampling station with photos shown in *Figure 5.17-Figure 5.20*

Table 5.12 Baseline River Water Quality Sampling Locations- Limestone Quarry

Station	Coordinates		Description
	Latitude	Longitude	
WP1	20° 51' 58.850" N	96° 23' 35.700" E	Located at the cement plant reservoir. Reported to release water during the wet season.
WP2	20° 52' 11.900" N	96° 23' 25.000" E	Discharge point from the drainage of the coal staging area.
WP3	20° 52' 11.876" N	96° 23' 25.316" E	Discharge point from the drainage of the coal staging area.
WP4	20° 51' 55.770" N	96° 22' 51.370" E	Stream located downgradient of the mudstone quarry and upstream of Kubyin Village.
WP5	20° 53' 25.640" N	96° 23' 20.560" E	Section of Kubyin River besides Kubyin Village which is near the freshwater intake point of the cement plant.

During the baseline survey in January 2017, two water samples were taken at each sampling location using sampling bottles provided by a laboratory certified under the Hong Kong Laboratory Accreditation Scheme (HOKLAS). These samples were stored at chilled condition and sent to the laboratory for analysis. Water quality parameters measured include *in-situ* measurement of pH and temperature as well as laboratory analysis of chemical oxygen demand (COD), 5-day biochemical oxygen demand (BOD_5), oil and grease, total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS) and total coliform. These parameters are pollutants of concern specified in the NEQEG for Treated Sanitary Sewage Discharge and Site Runoff and

Construction Materials Extraction (*Table 3.3*). For the Project, it is noted that the Myanmar National Environmental Quality (Emissions) Guidelines specified the guidance levels for site runoff and wastewater discharges, which are the same as those specified for treated sanitary sewage discharge by WBG *General EHS Guidelines* (2007).

The baseline water quality data collected in January 2017 are presented in *Table 5.13*. At WP2 and WP3, which are discharge locations of the coal staging area of the cement plant, the level of TSS exceeded the NEGEQ for construction material extractions and for treated sanitary sewage discharge (the same as those specified in WBG *EHS Guidelines for Construction Materials Extraction* (2007) and WBG *General EHS Guidelines* (2007) for treated sanitary sewage discharge). The *E. coli* level at WP2 also exceeded the NEGEQ for construction material extractions and for treated sanitary sewage discharge. These exceedances were not related to the limestone quarry, but indicate contamination due to existing operations at the coal staging area through sediment loaded discharge and possibly sewage. In addition, higher COD levels were reported at the coal staging area when compared to other locations which indicated potential issues of contaminated run-off from the coal staging area. Other measurements were generally within the NEQEG with no specific concern identified.

Figure 5.16 Water Sampling Locations Stations at the Project Area

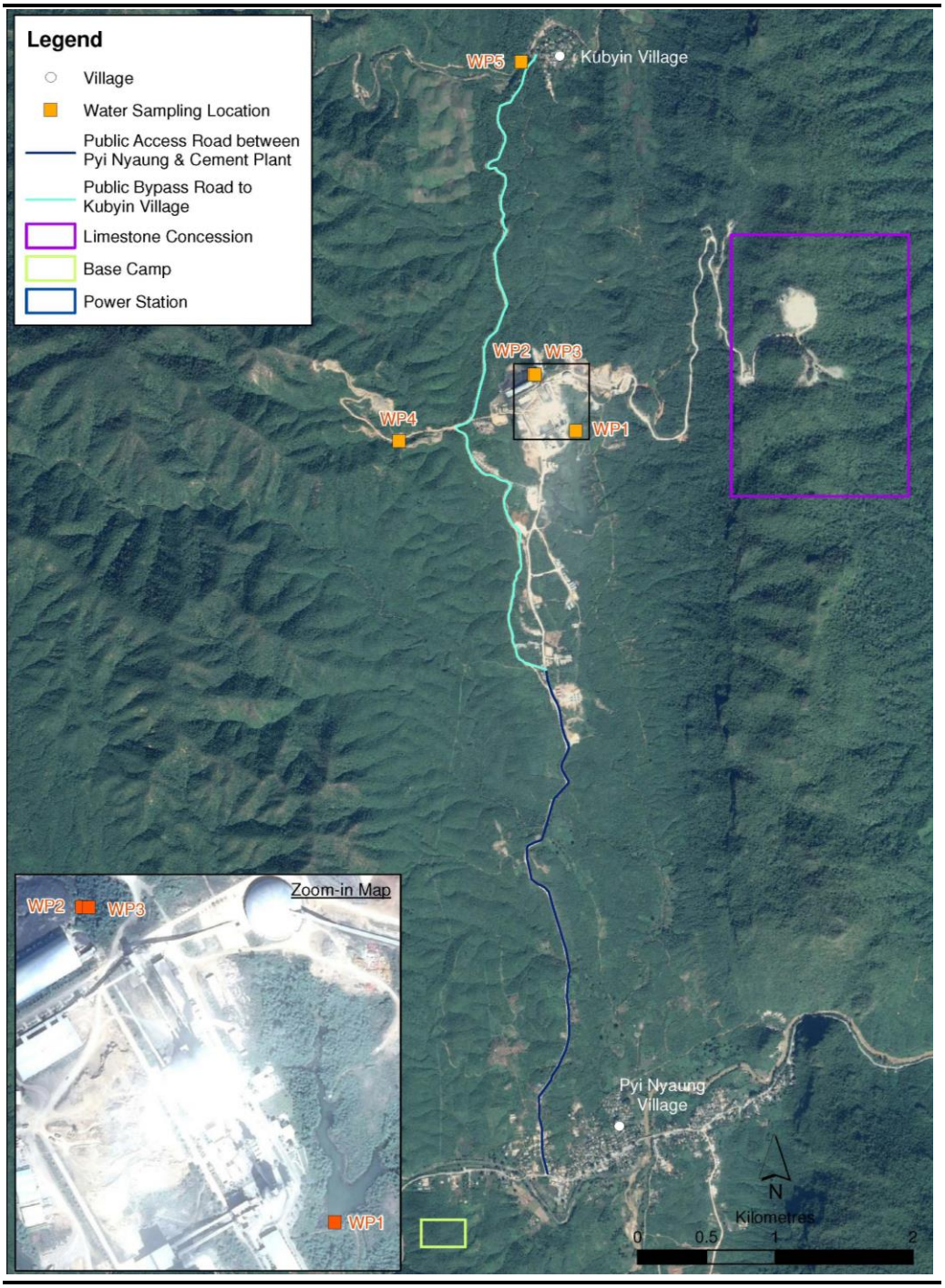


Figure 5.17 Water Quality Sampling Station at WP1

Figure 5.18 Water Quality Sampling Stations at WP2 and WP3

Figure 5.19 Water Quality Sampling Station at WP4

Figure 5.20 Water Quality Sampling Station at WP5

Table 5.13 Baseline Water Quality at the Limestone Quarry, Mudstone Quarry and Cement Plant, January 2017

Parameter	Unit	Detection Limit	Analytical Method Reference	WP1 - Reservoir	WP2 – Coal Downstream Staging Area	WP3 – Coal Downstream Staging Area	WP4 – Downstream Mudstone Quarry	WP5 – Kubyin Village	NEQEG for Treated Sanitary Sewage Discharge and for Constructin Materials Extraction
TSS	mg/L	2.00	APHA 2540 D	11.00	118.00	215.50	9.00	23.00	50
TP	mg/L	0.01	APHA 4500P:J	0.01	0.03	0.06	0.01	0.06	2
TN	mg/L	0.10	APHA 4500P:J APHA 4500-NO3:I	0.40	1.25	1.70	0.30	0.30	10
Total Coliforms	CFU/100mL	1.00	DoE Sec 7.8 & 7.9	7.00	2,00.00	45.50	N.D.	14.50	400
BOD_5	mg/L	2.00	APHA 5210 B	1.00	5.50	6.50	1.00	1.00	30
COD	mg/L	5.00	APHA 5220 C	10.00	21.50	41.50	2.50	4.75	125
Oil & Grease	mg/L	5.00	APHA 5520 B	D.L.	D.L.	D.L.	D.L.	D.L.	10
pH	Standard Unit	n.a.		7.60	8.00	7.60	5.60	6.30	6-9
Temperature	^oC	n.a.		24.50	24.00	24.00	20.50	24.00	

Notes:

(1) D.L. = value detected below detection limit for all samples at the station.

(2) n.a. = not applicable

(3) N.D. = not detected

(4) To determine the average level at a station with one of the two samples reported to be below detection limit, value below detection limit is halved for the calculation.

Exceedance of NEQEG is shaded grey.

5.3.5 Natural Disasters

Myanmar regularly experiences cyclones, storm surges, floods, landslides, earthquakes, drought and forest fires. Over the last 10 years, Myanmar has been impacted by two major earthquakes, three severe cyclones, floods and other smaller-scale hazards, according to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). OCHA works closely with the Ministry of Social Welfare, Relief and Resettlement and humanitarian partners to ensure a more systematic, inclusive and coordinated approach to disaster management, preparedness and response.

In 2015-2016, the El Niño phenomenon has been one of the strongest since 1950, with a significant influence on weather patterns. This resulted in drought conditions with intermittent 'very severe' category cyclones in different parts of Asia and the Pacific. Myanmar sits on two major faults, including the Sagaing (Silver) Fault that runs north to south of the country over about 1,000km, and the Chittagong-Tripura Fold Belt. At least 18 major earthquakes have occurred during the 20th century in Myanmar with the largest measured at a magnitude of 8.0 on 23 May 1912 in the Sagaing Region.

Figure 5.21 highlights Myanmar natural hazard risks and *Figure 5.22* highlights natural disaster risks and most recent past events as at 2016 in Myanmar.

Pyi Nyaung area is not situated in the areas classified as most prone to flooding and cyclones in Myanmar. According to information from the United States Geological Survey (USGS), a total of 201 earthquakes were recorded within 300 km of the Project Area between 1962 and 2008. The magnitude was between 4.0 M and 6.9 M.

Figure 5.21 Myanmar Natural Hazards Risks by OCHA (March 2011)

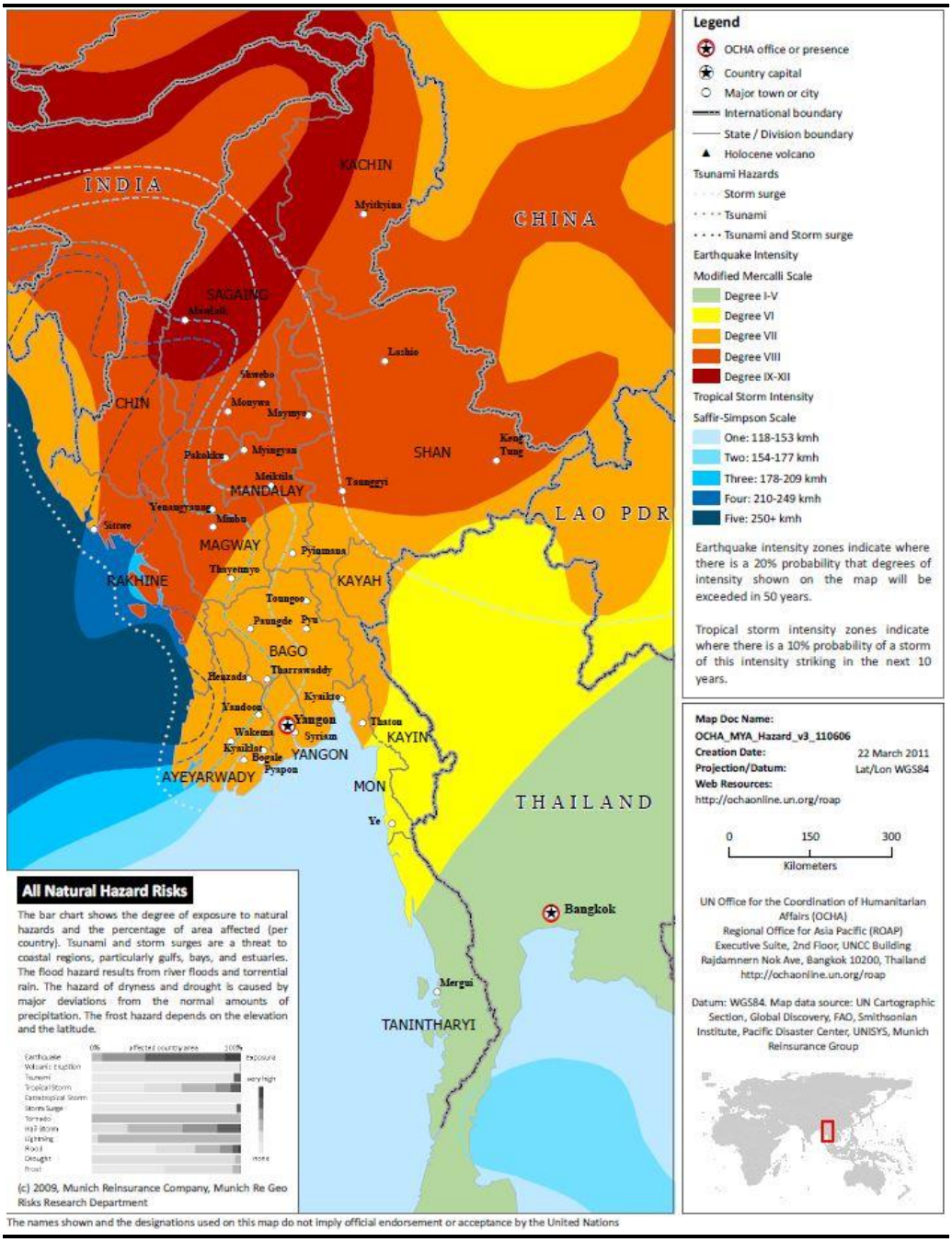
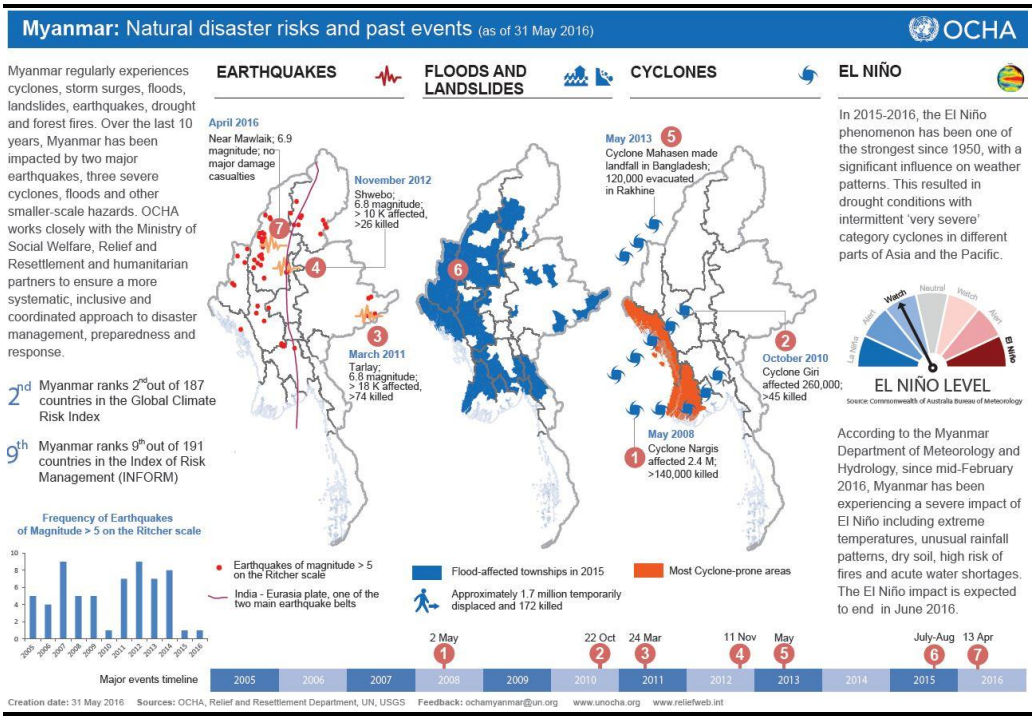


Figure 5.22 Myanmar Natural Disaster Risks and Past Events by OCHA (May 2016)



The Pyi Nyaung area is not situated in the areas classified as most prone to flooding and cyclones in Myanmar.

5.4 BIODIVERSITY

5.4.1 *Protected Areas within 50km of the Project*

As of 2015, there are a total of 39 Protected Areas in Myanmar covering an area of 38,906 km². Based on Myanmar's NBSAP for 2015 to 2020, there are plans to establish 9 more Protected Areas in three phases from 2020 to 2021. With the addition of these 9 proposed areas, the total area under protection in Myanmar will be 52,932 km², representing a coverage of 7.82% of the country's total land area (1).

National Protected Areas within a 50 km buffer of the Project Site are listed in *Table 5.14* below and their locations in relation to the Project Site is shown in *Figure 5.23*.

(1) Republic of the Union of Myanmar, National Biodiversity Strategy and Action Plan 2015-2020 (Oct, 2015) Retrieved from https://www.cbd.int/doc/world/mm/mm-nbsap-v2-en.pdf

Table 5.14 Protected Areas within 50 km of the Project Site

Project Sites	Protected Area	Details and Triggers (1)
Limestone Quarry	Panlaung-Pyadalin Cave Wildlife Sanctuary (6 km north)	• Lat: 96.3738 • Lon: 21.0218 • IUCN Category IV • Wildlife Sanctuary • Banteng (*Bos javanicus*) EN; Gaur (*Bos gaurus*) EN; Dhole (Cuon alpinus) EN; Serow (*Capricornis sumatraensis*) VU; Asian Elephant (*Elephas maximus*) EN; Clouded Leopard (*Neofelis nebulosi*)VU;

Internationally Recognised Sites for Biodiversity

Internationally recognised areas (2) within 50 km of the Project Site are listed in *Table 5.15* below. Some project sites have been evaluated together as they are located in close proximity to each other. The location of these sites in relation to the Project Site is shown in *Figure 5.23*.

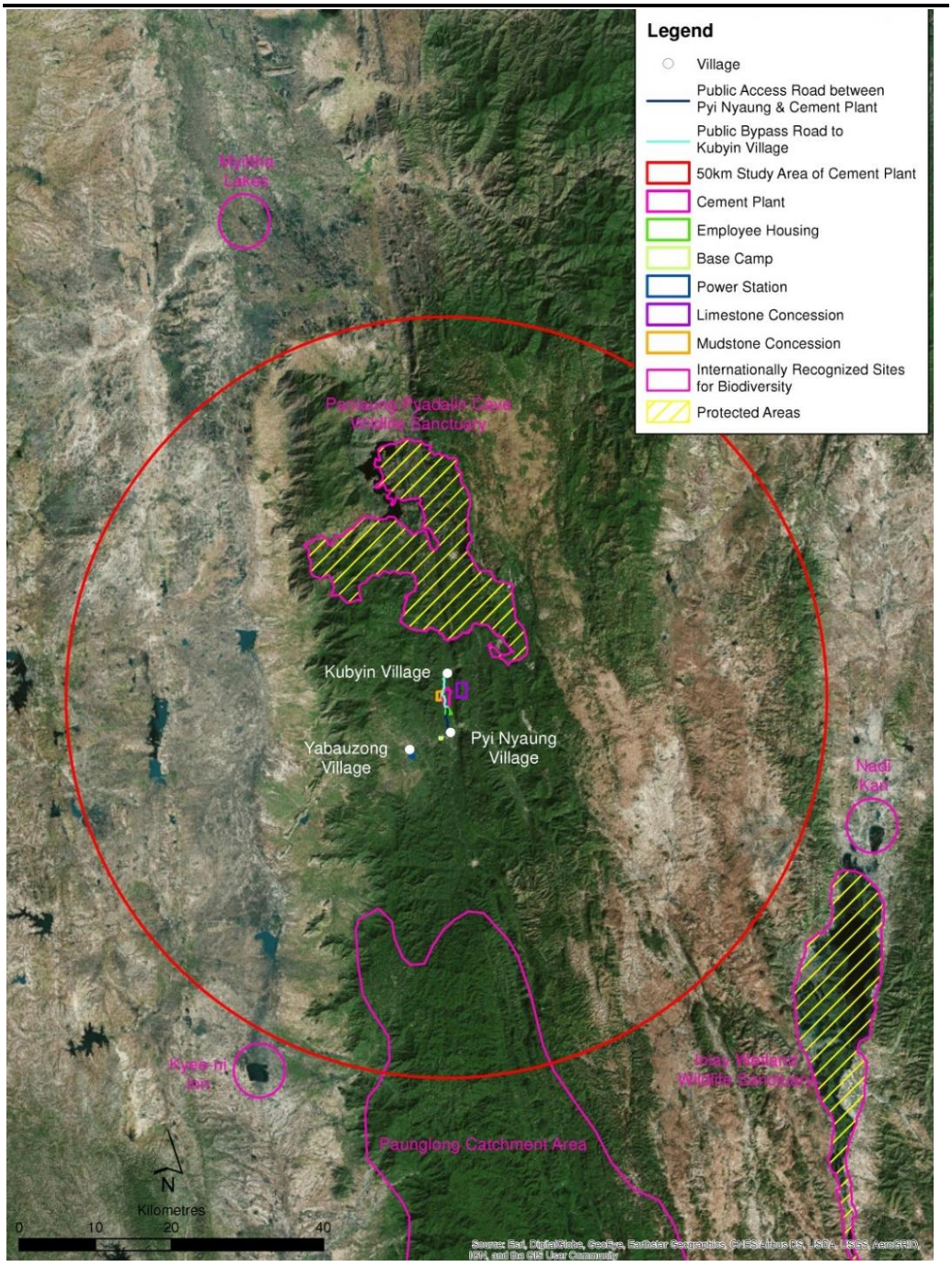
(1) Istituto Oikos and BANCA (2011) Myanmar Protected Areas. Context, Current Status and Challenges. Milano, Italy. Ancora Libri.

(2) According to IFC PS6, internationally recognized areas are exclusively defined as UNESCO Natural World Heritage Sites, UNESCO Man and the Biosphere Reserves, Key Biodiversity Areas, and wetlands designated under the Convention on Wetlands of International Importance (Ramsar Convention)

Table 5.15 Internationally Recognised Areas within 50 km of the Project Site

Project Sites	Internationally Recognised Area	Type	Details and Triggers
Limestone Quaarry	Panlaung-Pyadalin Cave Wildlife Sanctuary (6 km north)	Protected Area KBA	• Lat: 96.3738 • Lon: 21.0218 • IUCN Category IV • Wildlife Sanctuary • 33,380ha • Banteng (*Bos javanicus*) EN; Dhole (*Cuon alpinus*) EN; Asian Elephant (*Elephas maximus*) EN; Northern Pig-tailed Macaque (*Macaca leonina*) EN
	Paunglong Catchment Area (29 km south)	KBA	• Lat: 96.4979 • Lon: 20.2326 • 254,750ha • Gaur (*Bos gaurus*) EN; Dhole (Cuon alpinus) EN; Serow (*Capricornis sumatraensis*) VU; Asian Elephant (*Elephas maximus*) EN; Northern Pig-tailed Macaque (*Macaca leonina*) EN; Clouded Leopard (*Neofelis nebulosi*)VU; Himalayan Black Bear (*Ursus thibetanus*) VU

Figure 5.23 Area of Interest, Protected Areas and Internationally Recognised Sites for Biodiversity, Limestone Quarry



5.4.2 *WWF EcoRegions related to the Project Site*

The WWF EcoRegions [1] that coincide with the Limestone Quarry sits is shown in *Table 5.16.*

Table 5.16 WWF EcoRegions coinciding with Project Sites

Site	EcoRegion	Size (ha)	Status
Limestone Quarry	Northern Indochina Subtropical Forests	437,000,000	Vulnerable

Northern Indochina Subtropical Forests

The ecoregion experiences a summer monsoonal climate with precipitation averaging 1,200 to 2,500 mm a year during April to October. Dry conditions prevail from November to March. Some mountains in the ecoregion are composed of limestone, typically below 2,000 m.

Important tree taxa in the ecoregion belong to the families Theaceae, Magnoliaceae and Fagaceae at high elevations; and families Betalaceae, Fagaceae, Hamamelidaceae, Lauraceae, Magnoliaceae, Sapotaceae, Elaeocarpaceae and Theaceae at lower elevations. The dominant vegetation type is subtropical broadleaf evergreen forest with a three-layered structure and upper crowns reaching about 30 m in height.

In Myanmar, forests within this ecoregion (eastern Shan State, along the border with Laos and China), have largely been cleared. A few large blocks of habitat still persist in the ecoregion in Myanmar. Biodiversity in this ecoregion faces threats in the form of land clearing for shifting cultivation and logging; and hunting for food and income.

Karst/Limestone Ecosystems

As the Limestone Quarry involves quarrying of limestone from karst formations, particular attention has been paid to karst ecosystems and landscapes in Myanmar.

Limestone karsts occur over an area of approximately 400,000 km^2 in Southeast Asia, an estimated 10% of the total land area [2]. Karst landforms occur most extensively in Indonnesia, Thailand, Vietnam, and to some extent Malaysia, Cambodia, Laos, Myanmar and the Philippines. Karst environments possess economic, cultural, spiritual and scientific values [3]. Karsts are also viewed as drivers of key evolutionary processes. Due to a

(1) Ecoregions are large units of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions. Ecoregions are used to classify the entire globe based on original ecological characteristics, and do not imply conservation priority or current conditions. Some ecoregions are however considered priorities for conservation due to past or current threats.

(2) Watson J, Hamilton-Smith E, Gillieson D, & Kiernan K (1997) IUCN World Commission on Protected Areas: Guidelines for cave and karst protection. IUCN, Gland, Switzerland and Cambridge, UK. 63 pp

(3) Watson J, Hamilton-Smith E, Gillieson D, & Kiernan K (1997) IUCN World Commission on Protected Areas: Guidelines for cave and karst protection. IUCN, Gland, Switzerland and Cambridge, UK. 63 pp.

variety of habitats (including caves), complex terrains and unique soil properties, karst-dwelling species often display highly specialized adaptations. These features contribute to the high levels of species diversity and endemism found at karsts, giving these landforms high scientific value and ecological importance.

Karst areas in Myanmar face the same threats as with their counterparts throughout Southeast Asia. Pressures on karst areas extend from quarrying for cement, tourism, wildfires and hunting.

Some studies have been conducted on caves in Myanmar but the body of literature remains small. Cave expeditions in 2012 and 2013 in the Shan plateau have collected 251 specimens comprising 62 taxa in 17 different caves. Typically encountered cave fauna include bats (both fruit and insectivorous), caves spiders (Genus: Heteropoda), cave centipede (*Thereupoda longicornis*) and cave crickets (Genus: Diestrammena) (1).

5.4.3 2014 Field Survey Findings

Previous local EIAs were undertaken for the Limestone Quarry site in 2014. Flora and fauna surveys were conducted at both sites; the latter focused on fish, mammals, herpetofauna, birds and insects. A summary of the environmental baseline in 2014 is presented in the following sections. Dates of survey are outlined in *Table 5.17* for all surveys conducted at the Project sites.

STC Limestone Quarry

The forest cover within this area consists of mixed semi-evergreen forest and lower mixed deciduous forest. These forest types exist on well drained slopes interspersed with limestone formations with distinct floristics.

Previous surveys were undertaken in April 2014 of the Project Area. In total, 28 tree species belonging to 26 genera were identified. The major tree species identified include: *Dipterocarpus tuberculatus* (LC), *Shorea obtusa* (Thit-ya) (LC), *Shorea siamensis* (In-gyin) (LC), *Avogeissus accuminata* (Yon) (NA), *Dalbergia cultrata* (Yin-daik) (NT), *Pterocarpus microcarpus* (Pa-dauk) (NA), *Bombax sp*: (Let-pan) (NA) and *Lannea sp.* (Na-be) (NA), *Tectona grandis* (Kyun) (LC), *Xylia xylocarpa* (Pyin-ka-do) (NA), *Millettia ovalifolia* Kurz (Thin-win) (DD).

Previous surveys for fauna were undertaken from March to April 2014. The survey identified 80 species of fauna, including: 16 species of fishes; 13 species of herpetofauna; 26 species of birds; 9 species of mammals; and 18 species of insects. Species identified during the 2014 surveys include the following species. Reptiles: King cobra (*Ophiophagus Hannah*) (VU); Burmese python (*Python reticulatus*) (Appendix II of CITES); Birds: Black Kite (*Milvus migrans*) (LC); Crested Serpent Eagle (*Spilornis cheela*) (LC); Peregrine Falcon (*Falcon peregrines*) (LC); Mammals: Guar (*Bos gaurus*) (VU); Banded langur (Presbytis

(1) Dreybrodt J & Steiner H (2015) Karst and Caves of the Shan Plateau in Myanmar. Asian Transkarst Conference. Lichuan, China. Retrieved from http://www.myanmarcaves.com/reports/Transkarst%202015%20Myanmar.pdf

femoralis) (NT); East Asian Porcupine (*Hystrix brachyura*) (LC); Jungle cat (*Felis chaus*) (LC); Red Goral (*Naemorhedus baileyi*) (VU).

5.4.4 2017 Field Survey Findings

Field surveys of the Limestone Quarry site were conducted to obtain an understanding of baseline diversities for a selection of taxa groups. *Table 5.17* lists the surveys that were undertaken during the 2014 and more recent 2017 surveys including, their targeted taxa and dates conducted. Camera survey was not undertaken given the karst and scrubland identified in the Project area are unlikely to support significant population of mammals. Instead, transect survey and interviews were undertaken to collect data on mammals given their low expected abundance.

Table 5.17 Surveys Conducted at Limestone Quarry

Target Organism Group	Method Summary	Survey Dates	Surveyor
Limestone Quarry			
Bird, herpetofauna, mammals and flora	Transect Survey Interviews	March – April 2014	Unknown
Bird, herpetofauna, arboreal mammal/primate and ground dwelling mammals	Transect Survey Interviews	27th January – 31st January 2017	Dr Christian Matauschek (Contracted by FFI)
Flora	Transect Survey	31st January – 7th February 2017*	Dr Win Myint (Contracted by FFI)
Snails	Soil sampling Handpicking of snail shells	13th February – 19th February 2017	Dr Jaap Vermeulin (contracted by ERM)
Reptiles	Targeted Surveys at selected locations	8th March – 10th March 2017 11th October – 12th October 2017	Dr Lee Grismer (Contracted by FFI)
Limestone range flora	Targeted Surveys at selected locations	13th February –19th February 2017 16th August – 20th August 2017	Dr Jaap Vermeulin (Contracted by ERM)
Flora and habitats along transmission line route	Transect Survey	11th January – 14th January 2018	Dr Win Myint (Contracted by FFI)

Methodologies

Detailed methodologies can be found in *Annex D1 Survey Reports*.

5.4.5 Field Survey Results

Field survey findings are summarized in the following sections. No cave was identified in the Project area. Detailed survey findings may be found in *Annex D1 Survey Reports*.

Mammal Survey

The interviews and transect walks confirmed either directly or indirect the presence of 17 species of mammals within and around the project area. Of these species, the Chinese Pangolin (*Manis pentadactyla*) and the Shan State

Langur (*Trachypithecus phayrei shanicus*) are listed on the IUCN Red List as Critically Endangered and Endangered respectively. The list of species found from the project area and its surroundings is presented in *Table 5.18.*

It should be noted that no tigers were identified during surveys from local villager interviews, tracks/traces or physical surveys. Consultation with FFI (personal communication with F. Momburg, FFI Myanmar) confirms that tigers are unlikely to remain in the area of survey.

Table 5.18 Mammal Species in the proximity of the limestone quarry

S/N	Common Name	Scientific Name	Evidence	Within Project	Adjacent to Project	IUCN Red List Status
1	Chinese Pangolin	*Manis pentadactyla*	Interview	+	+	CR
2	Bengal Slow Loris	*Nycticebus bengalensis*	Interview	+	+	VU
3	Shan Langur	*Trachypithecus phayrei shanicus*	Interview	-	+	EN
4	Rhesus Macaque	*Macaca mulatta*	Interview	+	+	LC
5	Assamese Macaque	*Macaca assamensis*	Interview	+	-	NT
6	Eastern Hoolock Gibbon	*Hoolock leuconedys*	Interview	-	-	VU
7	Leopard Cat	*Prionailurus bengalensis*	Interview	+	+	LC
8	Jungle Cat	*Felis chaus*	Interview	-	+	LC
9	Common Palm Civet	*Paradoxurus hermaphroditus*	Interview	+	+	LC
10	Small-toothed Palm Civet	*Arctogalida trivirgata*	Interview	+	+	LC
11	Large-toothed Ferret Badger	*Melogale personata*	Interview	+	+	LC
12	Yellow-throated Marten	*Martes flavigula*	Interview	+	+	LC
13	Hog Badger	*Arctonyx collaris*	Interview	-	+	VU
14	Chinese Serow	*Capricornis milneedwardsi*	Interview	+	-	NT
15	Red Muntjac	*Muntiacus muntjac*	Interview	+	+	LC
16	Wild Boar	*Sus scrofa*	Interview Tracks	+	+	LC
17	Black Giant Squirrel	*Ratufa bicolor*	Sighting	+	-	NT

The main threats to mammal species within and around the Limestone Quarry area were identified to be habitat degradation, logging and habitat fragmentation. Hunting appeared to be a minor threat as most interviewees said that hunting has become more inefficient given the drastic decline in wildlife in recent years.

Vegetation Survey

A total of 136 vegetation plots along 5 random transects were established across the limestone quarry. Additional surveys were conducted in January

2018 along the transmission line route. *Table 5.19* captures the findings of the flora survey for these areas.

Table 5.19 Flora Survey Findings, Limestone Quarry

Site	Total Number of Species	Number of IUCN Red List Species	EN/CR IUCN Red List Species	Number of Invasive Species
Limestone Quarry	226	23	*Dalbergia oliveri* (EN)	10

Table 5.20 lists the invasive species found within the limestone quarry. These species are generally extensively distributed throughout Myanmar and are established within areas of higher rainfall.

Table 5.20 Invasive Flora Species, Limestone Quarry

S/N	Scientific Name	Family
1	*Ageratum conyzoides*	Asteraceae
2	*Bidens pilosa*	Asteraceae
3	*Caesalpinia decapetala*	Caesalpinaceae
4	*Chromolaena odorata*	Asteraceae
5	*Hiptage benghalensis*	Malpighiaceae
6	*Leucaena leucocephala*	Mimosaceae
7	*Mimosa pudica*	Mimosaceae
8	*Oroxylum indicum*	Bigoniaceae
9	*Paederia foetida*	Rubiaceae
10	*Ziziphus jujuba*	Rhamnaceae

Eight types of plant associations were derived from the field survey. Based on these associations, three types of vegetation classifications were developed for the project and surrounding areas. These are deciduous and mixed evergreen forests, mixed broad-leaved deciduous forest and bamboo forest. Dominant species common throughout the 12 types of plant associations are *Terminalia* spp., *Tectonia grandis* and *Xylia xylocarpa*.

Limestone Range Endemic/Restricted Flora Survey

Flora on the limestone range was surveyed in two surveys; the first survey was conducted opportunistically alongside a snail survey from 13-19 February 2017 during the dry season, and the second survey was a focused limestone flora survey conducted from 16 August to 20 August 2017 during the wet season. The limestone range was partitioned into sectors A to E from north to south and surveyed, with sectors C and D falling within the Limestone Quarry. The quality of vegetation along the limestone range was also investigated in the August 2017 survey to inform the biodiversity offset site selection.

The February survey during the dry season found that flora on the limestone range comprised mostly non-woody species, including some species that are

restricted to limestone habitats and a small number of local-endemics [(1)]. Local-endemics from the genus *Orinthoboea* were recorded from one sampling site and *Amorphophallus* spp. were found from various sites. The dry season survey was hampered by the lack of flowers as an additional parameter for identification.

The August survey during the wet season was focused on identifying endemic or restricted-range flora species, with a specific objective of understanding how the Project's quarrying activities might affect the conservation statuses of these species. The survey generated a list of 70 species comprising largely herbaceous plants of which one species, *Impatiens* sp. (Balsaminaceae), is suspected to be new to science. Five species were shortlisted for further assessment (*Table 5.21*) as they deemed likely to be affected by the Project's quarrying activities. Potentially endemic aroid species (*Amorphophallus* sp. and *Arisaema* sp.) were also collected and sent for specialist identification through cultivation.

The study additionally assessed species from a flora species list from the 2014 EIA deemed likely to be affected by the Project's quarrying activities. The full list of species evaluated from on the field survey and desktop assessment is presented in *Table 5.21*.

Table 5.21 Flora Species of Interest within the Limestone Concession

S/N	Species of Interest	Source	Status	Assessment
1	*Impatiens* sp.	2017 survey	Local endemic/ regional endemic[2] Potentially new to science	Found in only 2 places within the Project concession, suspected to occur over most of the limestone range but advisable to establish its occurrence outside the concession.
2	*Boesenbergia kerrii*	2017 survey	Regional endemic	Appears tolerant to disturbance from variety of habitats recorded. Unlikely to be impacted by the Project as it survives and spreads easily in degraded woodland.
3	*Curcuma cordata*	2017 survey	Regional endemic/ widespread	Found in abundance in a variety of habitats. Unlikely to be impacted by the Project.
4	*Curcuma myanmarensis*	2017 survey	Regional endemic	Appears tolerant to disturbance from variety of habitats recorded. Unlikely to be impacted by the Project.
5	*Canscora helferiana* *	2017 survey	Regional endemic	Appears to be very localized due to specialized habitat requirements. Further investigation may be warranted in the future offset area.
6	*Dalbergia cultrata*	2014 EIA	Widespread IUCN Red List: NT	Appears to be a resilient species although numbers are dwindling due to over-exploitation and habitat fragmentation

(1) Locally endemic plants are defined as those with extent of occurrence <2000km^2

2 Regional endemic is defined as a species that are generally present with an area of less than 50,000km^2

S/N	Species of Interest	Source	Status	Assessment
7	*Dalbergia kurzii*	2014 EIA	Potential regional endemic	Unlikely to be seriously impacted by the Project.
8	*Dalbergia oliveri*	2014 EIA	Widespread IUCN Red List: EN	Threatened by logging. Mitigation may be required through preservation of large stands of mature trees complemented by enrichment planting.
9	*Firmiana kerrii*	2014 EIA	Regional endemic/ widespread	Potentially endemic to the Shan Plateau and adjacent mountain ranges in Thailand. Advisable to see how the limestone range population of species would be impacted if concession quarried to limit.
10	*Terminalia oliveri*	2014 EIA	Regional endemic	Unlikely to be seriously impacted by the Project.

In terms of vegetation quality, Moderately Disturbed forest (ie. least disturbed forest type on the limestone range) was found in greater abundance along the range in areas that experienced lower population pressure and industrial activity. The largest stretches of Moderately Disturbed Forest were found in the northern extent of area surveyed (ie. sectors A, B and C); conversely in sector E, only patches remain. In sectors A, B and C, this forest type was found to extend from low along the mountain flanks to the topographic based of the carbonate rock. Given the larger expanse of Moderately Disturbed Forest on the northern extent of the limestone range, there is a higher probability of finding site and regional endemics at this area.

Limestone Range Snail Fauna Survey

The snail survey adopted the same segmentation of the limestone range into Sectors A to E for targeted surveys. As stated previously, the snail fauna survey proceeded from 13-19 February 2017 during the dry season.

The survey has preliminary identified a potential local-endemic, *Anauchen* sp., from within the Limestone Quarry which has been identified in areas adjacent. Three other local-endemic species have been recorded, namely *Diplommatina* sp. 3, *Diplommatina* sp. 4 and *Diplommatina* sp. 5 aff. *crispata*.

One new-to-science species *Anauchen sp.* was only identified within the Limestone Quarry; however the specialist involved in the survey (Dr J Vermeulen) suggests that this species is a local endemic (1) species (i.e. not restricted to the project site or a site endemic (2)), although restricted in range. Further sampling for the species in August 2017 did not identify the species

(1) Locally endemic fauna are defined as those with a limited extent of occurrence, generally <2000km^2

(2) Site endemic fauna are defined as those species that exist within a defined site and do not occur elsewhere. Where that site is the same as the project site, this would be of highest concern to the project.

within the area sampled during the flora survey along the limestone range. Dr Vermeulen maintains that this species is likely to be a local endemic species and was not identified at other sites outside of the concession. Dr Vermeulen has concluded that the species is likely to be more broadly distributed within the project area as sampling was restricted due to low accessability within the Project Area.

The compiled results of the surveys are shown in *Table 5.22*and *Table 5.23* below.

Table 5.22 Results of snail fauna within the limestone range

SPECIES	AUTHOR, YEAR	INFORMATION ON RSC-STATUS	RSC	9	10	11	8	4	5	6	7	16	17	14	12	13
Local-endemic species (RSC=2) of the Pyinyaung limestone range only Localities 4 to 17 arranged from North to South				N of concession				Concession				S of concession				
Dicharax sp.		No known records in collections	2			1	1									
Dioryx pingoungensis	(Godwin Austen, 1914	Recorded in literature from Pyinyaung only	2			1								1		
Diplommatina crispata new subsp.	Stoliczka, 1871	A local form of a widespread complex species	2			1	1			1	1		1	1	1	
Khasiella pingoungensis	(Godwin Austen, 1888	Recorded in literature from Pyinyaung only. May prove to be more widespread	2	1	1	1	1	1	1	1	1			1	1	1
Bradybaena schanorum	(Moellendorff 1899)	Recorded in literature from Kalaw only	2	1	1	1	1	1	1		1		1		1	1
Plectotropis new sp.		No known records in collections	2	1	1											
Chloritis anserina	(Theobald, 1866)	Recorded in literature from `Shan States` only, without precise locality data	2	1	1	1	1	1	1	1	1					1
Pseudonenia shanica	(Godwin Austen, 1888	Recorded in literature from Pyinyaung only	2	1	1	1			1		1		1			
Sinoennea new sp.		No known records in collections	2	1												
Anauchen new sp.		No known records in collections	2					1	1							
# local-endemic species per locality				6	5	7	5	4	5	3	5	0	3	3	3	3

Table 5.23 Similarities between sampling sites

# species shared	N of concession	concession	S of concession	Pyinyaung lst range	E of Kalaw	low alt. (see text)	high alt. (see text)
N of concession	**67**	44	44				
concession		**48**	38				
S of concession			**54**				
Pyinyaung lst range				**79**	22		
E of Kalaw					**33**		
low alt. (see text)						**58**	43
high alt. (see text)							**56**

Dice Similarity Coefficient	N of concession	concession	S of concession	Pyinyaung lst range	E of Kalaw	low alt. (see text)	high alt. (see text)
N of concession		0,77	0,73				
concession			0,75				
S of concession							
Pyinyaung lst range					0,39		
E of Kalaw							
low alt. (see text)							0,75
high alt. (see text)							

The study has found that a north-south gradient in fauna composition is present within the limestone range, but these findings could potentially be limited by incomplete sampling of the southernmost part of the range.

Two snail species that were indicators of disturbance were found from the limestone range. These were *Achatina fulica* and *Allopeas gracile*. The former

is an agricultural pest species introduced from Africa and listed as an invasive species in Myanmar. These species are generally spread throughout moist tropical woodlands in the country. However, the survey found no more than the two abovementioned species, and attributed this lack of disturbance indicators and introduced species to low levels of intensively farmed agricultural land in the vicinity of the limestone range.

Limestone Range Reptile Survey

Reptiles on the limestone range were surveyed in two surveys; the first survey was conducted from 11th to 12th October 2016, and the second survey was conducted from 8th to 10th March 2017 during the wet season. The second survey focused on assessing the status and habitat requirements of three newly discovered gecko species from the first survey, *Cyrtodactylus* sp. no. 1, *Cyrtodactylus* sp. nov. 2, and *Hemidactylus* sp. nov. Both surveys sought to build on a reptile and amphibian species list developed by Thura (2016)[1].

The 2016 study by Thura recorded 3 species of frogs, 7 species of lizards and 4 species of snakes. The first survey (October 2016) added 3 species of frogs and 4 species of lizards. Of the species of lizards observed, 3 were suspected to be new to science: *Cyrtodactylus* sp. no. 1, *Cyrtodactylus* sp. nov. 2, and *Hemidactylus* sp. nov. The second survey (March 2017) added 1 species of lizard and 2 species of snakes. This brings the total number of species recorded at the Project concession to 6 species of frogs, 12 species of lizards and 6 species of snakes.

The March 2017 survey yielded more information about the natural history, status and distribution of the 3 lizard species that were new to science. Nine (9) sites were surveyed throughout the limestone range; descriptions of the sites are provided in *Annex D1 Survey Reports*. *Table 5.24* summarises information about the species' natural history, status and distribution.

(2) It should be noted that the listing of Critical Habitat values has been completed to align with local regulatory requirements for each project component and is not standard practice under the IFC Performance Standards. A separate Critical Habitat assessment completed for the IFC against the IFC Performance Standards for the Project was assessed for all related project components combined and is compliant with best practices contained within the Standards.

Table 5.24 Natural History, Status and Distribution of Target Species

Species of Interest	Natural History	Status and Distribution
Cyrtodactylus sp. nov. 1	Found from disturbed, secondary bamboo forest on limestone outcroppings; apparent that limestone boulders are critical components of the species' habitat.	Findings suggest that species is restricted to specific habitats within the limestone range. Preference for microhabitats in areas sheltered from the sun, with requirements for extensive karst walls and very large boulders. No specimens found on mudstone hills. There is a potential for this species to be endemic to the limestone range. Species was not uncommon. Believed not to occur outside the limestone range where the concession sits.
Cyrtodactylus sp. nov. 2	Found from disturbed secondary forest. Hatchlings found during the survey indicate presence of a viable population.	Findings suggest that species is not a limestone adapted species endemic to the limestone range. Appears to be a habitat generalist, occurring in rocky areas at both mudstone and limestone habitats. Likely to be found outside the Project concession.
Hemidactylus sp. nov. 1	Appears to use all substrates in its habitat (ie Trees, wood piles, bamboo, karst boulders and rocks).	Utilises all substrates in its habitat, indicating it is a habitat generalist. Likely to be found outside the Project concession.

Cyrtodactylus sp. nov. 1 was identified to be a potential local endemic to the limestone range where the Project concession is found. Should mining at the Project concession extend into the sheltered valleys where this species resides, its habitat would be rendered uninhabitable. The existing habitat conditions where this species was found were observed to be heavily degraded with no large trees remaining. These were a result of annual burning of bamboo thickets, logging and bamboo collection. These combination of pressures pose a serious threat to the viability of *Cyrtodactylus* sp. nov. 1.

The study concluded that at this stage there are no primary or secondary threats to *Cyrtodactylus* sp. nov. 2 and *Hemidactylus* sp. nov. along the limestone range. These 2 species appear to be habitat generalists and are found outside the Project concession.

5.4.6 Application of IFC PS6

Determination of Critical Habitat is a process that usually follows determination as to whether the habitat area in question is Natural or Modified. Natural habitats are generally of higher biodiversity value than Modified Habitats, although both can still support species that trigger Critical Habitat (as regularly happens in man-made wetland habitats which support large assemblages of migratory birds).

Critical Habitat is defined as habitat which supports species or assemblages of species that fulfil one or more of the five criteria as set out below and provided in detail within IFC PS6 (*IFC, 2012a, IFC 2012b*).

For IFC PS6 Criterion 1-3 (1 - Critically Endangered and Endangered Species; 2 - Endemic or Restricted Range Species; and 3 - Migratory or Congregatory species) a tiered system is used whereby Critical Habitat of the highest importance is Tier 1 and Critical Habitat of slightly lower importance is classed as Tier 2 (see *Table 5.25* for further details).

Critical Habitat criteria as defined in PS6 Guidance Note 6 (GN6) Paragraphs GN69 – GN97 (*IFC 2012b*), and shown in *Table 5.25*. This table provides detail of the qualifying requirements for Criteria 1-3 while details of the likely qualifying interests are given for Criterion 4 and 5 which will be defined based on research and expert opinion (as will those for Criteria 1-3 where data is lacking).

The criteria listed in *Table 5.25* have been used to complete this assessment.

Table 5.25 Critical Habitat Criteria

Criteria	Tier 1[1]	Tier 2[1]
Criterion 1: Critically Endangered (CR) / Endangered (EN) species:	• a) Habitat required to sustain ≥ 10 % of the global population of a CR or EN species /sub /species and where there known regular occurrences of the species and where habitat could be considered a discrete management unit for the species. • b) Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.	• c) Habitat that supports the regular occurrence of a single individual of a CR species and/or habitat containing regionally-important concentrations of Red-listed EN species where that habitat could be considered as a discrete management unit for the species/subspecies. • d) Habitat of significant importance to CR/EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species. • e) As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.
Criterion 2: Habitat of significant importance to endemic and/or restricted-range species;	• a) Habitat known to sustain ≥ 95 % of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species.	• b) Habitat known to sustain ≥ 1 % but < 95 % of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment.

Criteria	Tier 1[1]	Tier 2[1]
Criterion 3: Habitat supporting globally significant concentrations of migratory species and/or congregatory species;	• (a) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 % of the global population of a migratory or congregatory species at any point of the species' lifecycle where that habitat could be considered a discrete management unit for that species.	• (b) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 % but < 95 % of the global population of a migratory or congregatory species at any point of the species' lifecycle and where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment. • (c) For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for Identifying Wetlands of International Importance. • (d) For species with large but clumped distributions, a provisional threshold is set at ≥ 5 % of the global population for both terrestrial and marine species. • (e) Source sites that contribute ≥ 1 % of the global population of recruits.
Criterion 4: Highly threatened and/or unique ecosystems; and/or	Criterion 4 has no tiered system although recent publication (*Keith et al*, 2013) may introduce this. This criterion must include one of the following a) the ecosystem is at risk of significantly decreasing in area or quality; b) has a small spatial extent; and /or c) contains unique assemblages of species including assemblages or concentrations of biome-restricted species. Highly threatened or unique ecosystems are defined by a combination of factors which may include long-term trend, rarity, ecological condition, and threat.	
Criterion 5: Areas associated with key evolutionary processes	The criterion is defined by: a) the physical features of a landscape that might be associated with particular evolutionary processes; and/or b) subpopulations of species that are phylogenetically or morphogenetically distinct and may be of special conservation concern given their distinct evolutionary history. The latter includes evolutionarily significant units and evolutionarily distinct and globally endangered species.	

Note: [1] *No Tier system is in place for Criterion 4 and Criterion 5.*

The five criteria are 'triggers' in that if an area of habitat meets any one of the criteria then it is considered to be Critical Habitat, irrespective of any other criterion. Hence Critical Habitat can be determined through a single criterion or where a habitat area holds biodiversity meeting all five criteria. This approach is generally more cautious but is used more widely in conservation (*McDonald-Madden et al, 2009*). Critical Habitat criteria therefore have two distinctive characteristics. First, components of biodiversity are essentially assigned to only two levels of conservation significance, those that trigger Critical Habitat and those that do not (Tier considerations being secondary to this primary Critical Habitat determination). Second, each criterion is

applied separately, not in combination, meaning that the scores are not cumulative (*TBC, 2012*).

For the first three Criteria it should also be noted that each species has been considered individually.

5.4.7 Discrete Management Unit

Based on IFC PS 6 Guidance Note 6, the project is required to 'determine a sensible ecological or political boundary that defines the area of habitat to be considered for the Critical Habitat assessment'. Termed as a Discrete Management Unit (DMU), this is an area with a 'definable boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas'. DMUs may hence be defined using ecological boundaries such as rivers and mountain ridges/valleys where wildlife is determined to be unable to cross, management boundaries such as a Protected Area, or artificial barriers to movement such as roads and urban areas.

The DMU identified at the Limestone Quarry includes 3 main components:

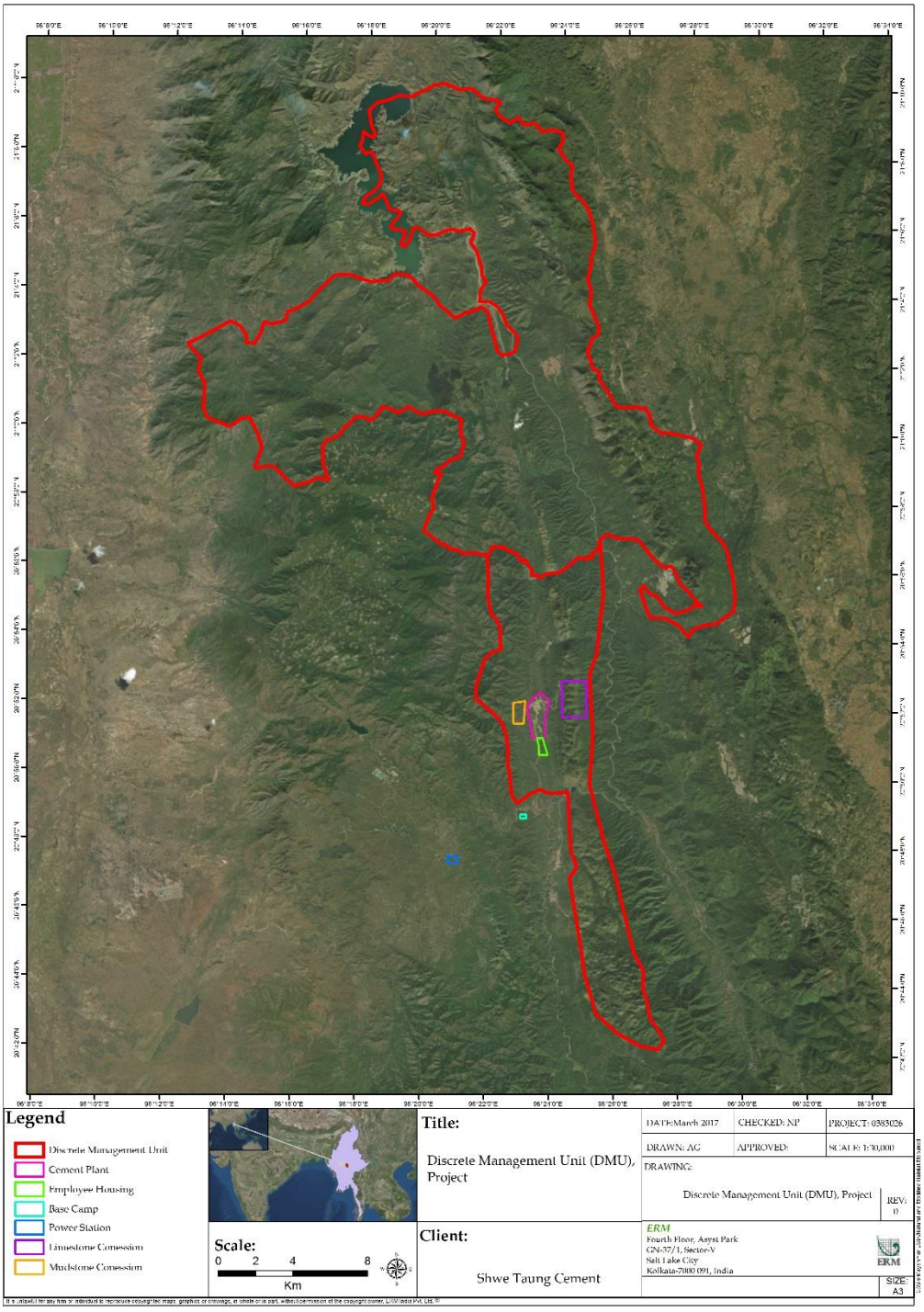
- The limestone outcrop spanning north of the limestone quarry to south of Pyinyaung town;
- Contiguous vegetation within and around the project area, up to the ridge to the west of the project; and
- Panlaung-Pyadalin Cave wildlife sanctuary, 6 km north of the cement factory.

Although the limestone outcrop is bisected by a road at Pyinyaung, the two sections maintain a common geological and geomorphological history. As a result, they are likely to share the same local-endemics and ecosystem types. The sections are essentially part of the same limestone cluster within the Shan plateau. The limestone outcrop in its entirety was thus used to define the DMU.

Based on a review of satellite imagery, it was observed that vegetation within and around the project area was contiguous with Panlaung-Pyadalin Cave wildlife sanctuary. This indicates there is a possibility that there is movement of wildlife between Panlaung-Pyadalin and the Project, hence warranting the inclusion of the protected area into the project DMU.

The DMU for the Limestone Quarry occupies a total area of 45,000 hectares and is shown in *Figure 5.24*. As the base camp and power stations will be established within built up areas and do not share a contiguous forest with the main project components, they are not included in the DMU delineation.

Figure 5.24 Discrete Management Unit (DMU), Limestone Quarry



5.4.8 *Vegetation Classes at Project Sites*

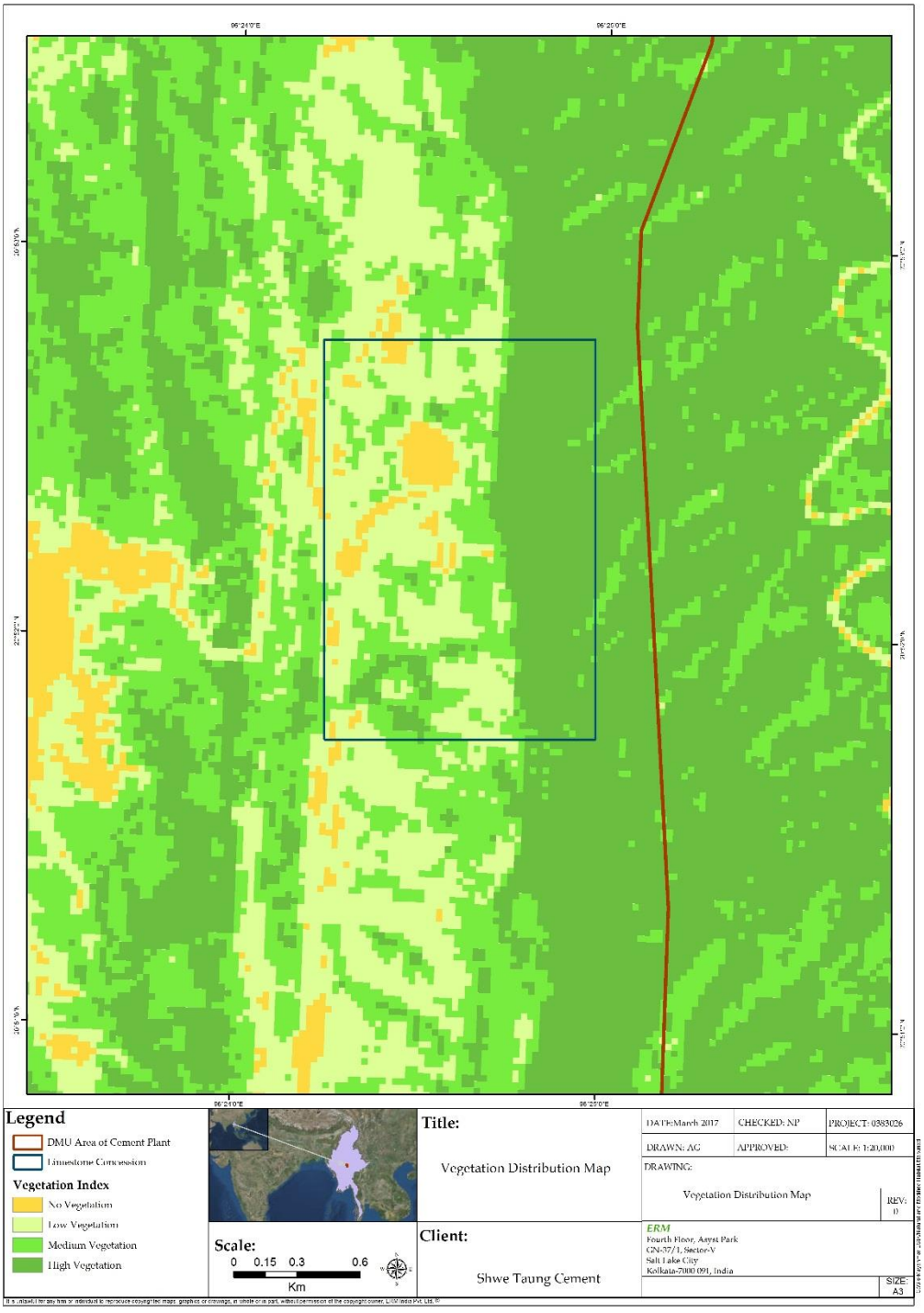
The vegetation classes identified from the Limestone Quarry project area are:

- Deciduous forest;
- Mixed evergreen forest;
- Mixed broad-leaved deciduous forest;

- Dry deciduous forest; and
- Bamboo forest.

Deciduous forest, dry deciduous forest and mixed broad-leaved deciduous forests were found largely at the limestone quarry area. Vegetation density identified within the limestone quary is shown in *Figure 5.25*.

Figure 5.25 Vegetation Density Distribution: Limestone Quarry



5.4.9 *Land Class Assessment*

Land classes within each site were developed based on a review of existing baseline information, satellite imagery and field observations.

Remote sensing was used to determine the land cover at each concession using LandSat imagery. A number of indices were tested for suitability to map bare ground in the AOI, including the Normalised Differential Vegetation Index (NDVI) and the Bare Ground Index (BGI), however it was found that the following index was most effective: Landsat8 (Band 4 – Band 2) / (Band 4 + Band 2); and Landsat5 andLandsat7 (Band 3 – Band 1) / (Band 3 + Band 1).

Threshold values were set for each time step resulting in a binary image (cleared or not cleared). These images were corrected for cloud cover and converted to polygons for area calculations and mapping in GIS.

The following land class types within the Limestone Quarry have been identified and described in *Table 5.26.*

Table 5.26 Land Classes within the AoI, Project Concession and Project Area

Land Class	Description	Photo
Karst	This refers to the limestone outcrop ranging from the north to south of the AOI; a section of the outcrop falls within the project Limestone Quarry. The limestone outcrop is part of the Shan plateau series of limestone ranges.	
Scrubland	This refers to the vegetation covering the AOI, project concession and project area.	

5.4.10 *Natural and Modified Habitats*

Given an understanding of the species assemblages within each habitat/land class, and supplemented with field observations of the general quality of these habitats, natural-modified habitat classifications have been assigned as shown in *Table 5.27.* The distribution of Natural Habitat and Modified Habitat for the limestone quarry is shown in *Figure 5.26*.

Table 5.27 Natural and Modified Habitats within the Limestone Quarry DMU

Land Class	IFC PS6 Habitat Classification	Justification
Karst	Natural	Majority of vegetation and karst fauna are native species. Ecological functions of the karst areas remain intact.
Scrubland	Modified	The vegetation and soils of these areas are heavily degraded through resource extraction. Little natural ecological function remains.

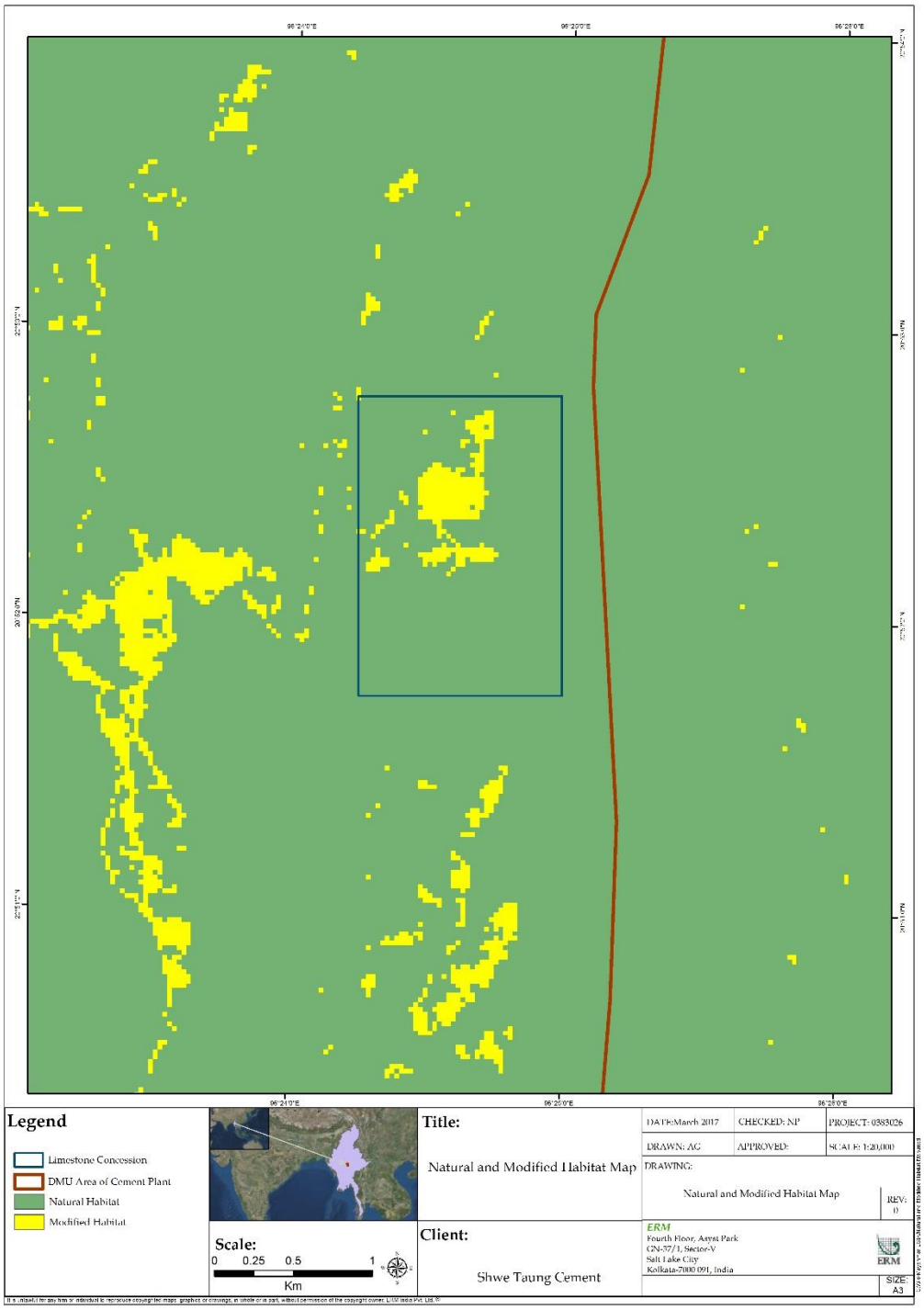
The Natural Habitat and Modified Habitat areas found within the Limestone Quarry in *Table 5.28* below.

It should be noted that STC has advised that not all of the Project areas will be impacted due to project operations. An exact footprint of the project areas was not available at the time of writing. For the limestone quarry, STC advised that 68% of the concession area would be impacted due to operations.

Table 5.28 Natural Habitat and Modified Habitat within Limestone Quarry

Project Area	Natural Habitat Area (Ha)	Modified Habitat Area (Ha)	Total (Ha)
Limestone Quarry	235.58	118.79	354.37

Figure 5.26 Natural and Modified Habitat Limestone Quarry



5.4.11 Critical Habitat Screening Assessment [1]

Critical Habitat Candidate Species

For Critical Habitat Criterion 1-3 this exercise has used species identified as threatened species. Threatened species were evaluated as threatened based on IUCN status (CR or EN), endemicity, restricted range and habitat requirements.

Further desktop assessment and consultation did not identify any additional data sources for threatened species that may be considered CH candidates within both Project sites.

Potential Critical Habitat Species (Criterion 1-3)

The CH Screening Assessment identified three (3) species for the Limestone Quarry that are CH species for Criterion 1-3. These Critical Habitat candidates are considered as part of the impact analysis and outlined in *Table 5.29*.

The complete Critical Habitat Screening Assessment for Criterion 1-5 is contained in *Annex D2*.

Table 5.29 Candidate Critical Habitat Assessment Summary

SN	Species	Common Name	IUCN Listing
Limestone Quarry			
1	*Manis pentadactyla*	Chinese Pangolin	CR
2	*Trachypithecus phayrei shanicus*	Shan Langur	
3	*Dalbergia oliveri*	Burma Rosewood	EN
4	*Trachypithecus phayrei* spp. *shanicus*	Shan State Langur	EN
5	Karst Snails	-	New-to-science
6	Karst Flora	-	New-to-science
7	Karst Reptiles	-	New-to-science

Criterion 4) Highly Threatened and /or Unique Ecosystems

Highly threatened and unique ecosystems as defined by the IFC are those that are a) under significant threat; b) small in size; and/or c) have unique species assemblages. An assessment of the presence of habitats within the concessions at the Limestone Quarry which meet these criteria and relevant discussions are provided below.

Ecosystems at Risk of Significantly Decreasing in Area or Quality

The forests associated with the Northern Indochina Subtropical Forest have been largely reduced in Vietnam and in the eastern Shan State of Myanmar,

(1) It should be noted that the listing of Critical Habitat values has been completed to align with local regulatory requirements for each project component and is not standard practice under the IFC Performance Standards. A separate Critical Habitat assessment completed for the IFC against the IFC Performance Standards for the Project was assessed for all related project components combined and is compliant with best practices contained within the Standards.

along the border with Laos and China. A few large blocks of habitat remain, but these are either degraded, or found within protected areas scattered throughout the ecoregion. Based on field observations at the Limestone Quarry, the forests surrounding the site are highly degraded due to firewood harvesting, limestone extraction and associated bushfires.

Based on the assessment, habitats in the ecoregion and DMU are not decreasing rapidly in area. However, the quality of forest habitats within and surrounding the project area was noted to be highly degraded, with intense pressure from extraction of limestone resources and associated vegetation cover for lime production. Panlaung-Pyadalin Wildlife Sanctuary within the DMU was reported to be poorly staffed and ill-equipped for enforcement, hence at risk of degradation. Given this baseline of existing severe degradation, subsequent activities leading to further degradation are unlikely to be significant in the current context. Hence, forest ecosystems at the Limestone Quarry DMU do not qualify as Critical Habitat under Criterion 4.

Karst Ecosystem

Karsts in Southeast Asia face a number of threats and lack adequate levels of protection. Poorly planned quarrying operations may destroy whole karst landforms, wiping out site-endemics and greatly reducing the populations of regional-endemics. There is also a lack of representation of karst ecosystems in Protected Area networks in Southeast Asia, with the percentage of protected karst areas ranging from 0 – 45% of total karst areas depending on the country. An assessment of protected karst areas in Southeast Asia reported that only 1 % of karst areas in Myanmar is protected (within Shwe U Daung and Shwesettaw Game Reserves, and Pindaya Cave) (1).

While there is no reported data on the decrease of karst ecosystems in Southeast Asia and Myanmar in particular, the under-representation of karsts in Protected Areas and the country's burgeoning economic growth suggests that resource extraction will continue to threaten this ecosystem. In the context of the DMU, an estimated quarter of the limestone range is within the project concession and will be lost from quarrying. However, the same limestone range exists further south and other geologically and geomorphologically related outcrops are distributed across the Shan Plateau.

Whilst karst ecosystems are not well represented in the protected area system, there is insufficient data available to suggest that they are currently highly threatened in Myanmar. Therefore, it is not likely that karst ecosystems in Myanmar qualify as Critical Habitat under Criterion 4.

Ecosystems with a Small Spatial Extent

<u>Limestone Quarry</u>

(1) Day M & Urich P (2000) An Assessment of Protected Karst Landscapes in Southeast Asia. Cave and Karst Science. Volume 27, No.2

The limestone ecosystems within the DMU were considered in the context of the Shan plateau – an extensive karst occurring over an area of 500 km by 300 km. The limestone outcrops within the Shan Plateau are assumed to be geologically and geomorphologically related. As limestone outcrops can differ significantly from each other in terms of habitat, a review of the findings of the karst survey was also conducted to understand if the karst ecosystem present on the limestone within the concession was replicated elsewhere across the range.

No site endemics were recorded from the limestone within the project concession and preliminary findings indicate that local-endemic species are likely to occur across the limestone range and its extension further south. This suggests that the limestone ecosystem within the DMU does not occur within a small spatial extent, and hence is unlikely to trigger Critical Habitat Ecosystems Containing Unique Assemblages of Species Including Assemblages or Concentrations of Biome-Restricted Species

Limestone Quarry

The forests around the project were also observed to be highly degraded. These suggest that the forest ecosystem around the project area has a low capacity for an assemblage of species that can be deemed unique. Therefore, forest ecosystems at the project do not qualify as Critical Habitat under Criterion 5.

Surveys of the limestone range indicate an absence of site-endemics in the project concession but a presence of local-endemics across the range. Limestone areas are typically known for containing limestone-restricted species and display high levels of endemism. The limestone range in the DMU thus qualifies as Critical Habitat under Criterion 5.

Criterion 5) Key Evolutionary Processes

Criterion 5 recognises the attributes of a region that can influence evolutionary processes and give rise to regional configuration of species and ecological properties. Examples can include isolated areas where populations are phylogenetically distinct, areas of high endemism, environment gradients or ecotones and biological corridors.

While no site endemic species were recorded within the Limestone Quarry, several local-endemic species were found throughout the limestone range, including within the project concession. Most of the unidentified species (constituting a third of all recorded species) are also potentially new to science. Two limestone restricted flora species were recorded. It is likely that there are more local-endemic and limestone restricted species within the range as the surveyors could only access sites that were severely degraded or where access was possible. Geomorphology of the limestone landscape means that areas will remain inaccessible to survey and any fauna within those areas is possible to remain unknown. The findings reflect the richness limestone-restricted species within the range. This is testament to the

evolutionary significance of limestone ecosystems; hence the limestone range within the DMU qualifies as Critical Habitat under Criterion 5.

5.4.12 Ecosystem Services Assessment

The International Finance Corporation's (IFC) performance standards require projects to assess and preserve the benefits from ecosystem services. The IFC also requires that the environmental and social risks and impacts identification process considers a project's dependence on ecosystem services. A fundamental component is to apply the mitigation hierarchy to determine measures to limit impacts on ecosystem services.

ERM has utilized the World Resources Institute (WRI) Guidelines: *Weaving Ecosystem Service into Impact Assessment* to guide the approach used to assess ecosystem services in relation to the project.

Ecosystem service Data Collection

ERM visited the two project sites in January 2017 to consult with the Project stakeholders explaining the concept of the project and administering questionnaires to individuals and groups. The stakeholder engagement included specific discussions regarding ecosystem services.

ERM undertook the following consultation as part of EIA:

- Consultation with 100 households living in close proximity to the Limestone Quarry from selected communities (5 villages); and
- Consultation meetings with government authorities, NGOs, PAPs and other interested people.

Household survey questionnaires were used to gather data from the communities around the Limestone Quarry to solicit their opinions on both the positive and negative aspects of the Project development to inform the EIA. The data is relevant to understanding current socio-economic conditions in the Area of Influence of the Project, historical impacts associated with the construction of the Limestone Quarry as well as potential issues associated with the on-going operation of the Project.

Prior to conducting household surveys, an introductory meeting was convened in the host community to introduce the purpose of the consultation.

Priority Ecosystem Services

The following priority ecosystem services shown in *Table 5.30* have been identified. Assessment of impacts to ecosystem services is incorporated into Section 8 of this Report. The complete dataset for the ecosystem services assessment is contained at *Annex D3*.

Table 5.30 Priority ecosystem services

Priority Ecosystem Service	Description
Timber and wood products	Evidence indicates that wood is harvested from within the Project Area and AoI for use by local people as fuel. The project may restrict this activity. The amount of timber available to local people has been decreasing. Unsustainable harvesting of timber will lead to continued reductions in availability of timber.
Freshwater	Evidence indicates that freshwater is used by local people from within the Project Area and AoI. The project may restrict or impact this activity. Freshwater impacts were reported by all villages within the Project AoIs.

5.5 SOIL QUALITY

Soil baseline sampling was undertaken in January 2018 within the cement plant and at Kubyin and Pyi Nyaung Villages. The locations for soil sampling are provided in *Figure 5.27*. Two soil samples were taken at each sampling location using sampling bottles provided by United Analyst and Engineering Consultant Co. Ltd. These samples were stored at chilled condition and sent to the laboratory for analysis. Parameters measured included pH, moisture content, electrical conductivity, carbon content, cadmium, copper, lead, zinc, and iron. These parameters have been selected to align with the relevant WBG EHS and Myanmar National Environmental Quality (Emission) Standards for monitoring.

Soil quality monitoring results for laboratory analysed parameters are shown in *Table 5.31*. Generally, the levels of the tested parameters are similar between the soil samples taken from the cement plant and Pyi Nyaung Village, which are both higher than those in soil samples collected from Kubyin Village. Results of the baseline soil quality surveys indicated the soil quality parameters generally comply with the FAO Soil Bulletin 65 & Dutch Standards with no apparent trend of contamination.

Figure 5.27 Soil Sampling Locations

Table 5.31 Soil Quality Monitoring Results

Parameter	Unit	LOR	Pyi Nyaung		Cement Plant		Kubyin		FAO Soil Bulletin 65 & Dutch Standard
			S1a	S1b	S2a	S2b	S3a	S3b	
pH	pH Unit	-	7.7	8.0	8.8	8.4	6.6	5.8	-
Moisture Content (dried @ 103°C)	%	-	19.4	18.8	17.8	13.7	14.6	16.7	-
Electrical Conductivity	dm/s	-	0.27	0.27	1.15	0.03	0.77	0.03	
Carbon Content	%	-	2.21	1.88	1.44	2.35	1.62	1.77	
Cadmium	mg/kg	0.3	DL	DL	DL	DL	DL	DL	0.8
Copper	mg/kg	0.3	14.0	13.0	12.8	7.29	5.92	7.70	20-300
Lead	mg/kg	1.55	18.1	17.4	20.0	17.2	13.3	15.6	85
Zinc	mg/kg	0.35	43.9	41.6	49.5	32.1	20.9	25.7	15-150
Iron	mg/kg	0.5	20,588	19,008	22,339	17,522	14,351	16,065	-

Note: DL – below detection limit

6 DESCRIPTION OF THE SURROUNDING ENVIRONMENT: SOCIO-ECONOMIC BASELINE

6.1 SOCIO-ECONOMIC CONDITIONS

6.1.1 Demographics and Population

The socio-economic baseline is derived from engagement with village leaders, groups of farmers and women and a survey of 50 households from two villages in the vicinity of the Project sites. These villages were selected for study on the basis of them being potentially affected by Shwe Taung's operations and include all villages within five kilometres of the primary Project site. Pyi Nyaung (approximately 7 km from the limestone quarry), within the Project's Area of Influence, was also included in the study. STC's base camp is located in this village and all cement trucks pass through this village. The surveyed households in each village were selected at random by ERM.

Basic information concerning the surveyed households and villages is summarised in *Table 6.1* and *Table 6.2*.

Table 6.1 Population Data of Surveyed Households

Village Name	Number of respondents	Ethnic Group - Bamar	Ethnic Group - Karen	Average number of members per HH	Total number of residents in village	Male / Female Respondents (%)	Average Age of Respondent (years)
Kubyin	25	19	6	4.84	271	12%/88%	42
Pyi Nyaung	25	25	0	4.80	2,569	48%/52%	49

Table 6.2 Economic Data of Surveyed Villages

Village Name	Average Monthly Income (Kyat per HH)	Average Monthly Expenditure (Kyat per HH)	Land Holdings (number of HH / surveyed) (1)	Average Land Holding per household (acres) (1)	Total Land Holding of the Surveyed HH (acres) (1)
Kubyin	284,400	52,020	16 (of 25)	1.81	29
Pyi Nyaung	264,400	180,520	18 (of 25)	3.56	64

Note:

(1) The farmland is state owned forest area which villagers cleared to grow crop, except for Kubyin Village. The farmers of Kubyin Village are farming government owned forest, which is a replantation area under the management of the Forest Department.

6.1.2 Health

The residents consulted in the two villages stated that they considered themselves healthy and do not face any serious diseases. Generally speaking, malaria was noted as the main cause of adult mortality, however, villagers have not suffered new cases of malaria for a long time. In the dry season, sometimes they suffer from minor skin irritation alledgedly due to the water shortage.

Tharzi Township counts four public hospitals, located in Tharzi (50 beds), NyaungYan (16 beds), Yin Mar Pin (16 beds) and Hanzar (16 beds), as well as eight private clinics and 7 rural clinics. Tharzi Township's population is currently about 200,000 and on a decreasing trend, being subject to rural exodus. The Township has 12 registered medical doctors, 20 nurses and 5 medical township officers.

The most common diseases affected the population are malaria, diarrhea, tuberculosis, dysentery and hepatitis; 25 people were affected by AIDS over 2015 and 2017 and 10 people died of AIDS related illness during the same period.

According to communication with GAD officer in Tharzi, the infant mortality rate was about 14.8 deaths of infants under one year old per one thousand live births for a birth rate of 0.8 per one thousand midyear population as at March 2017. The company is in the process of putting together, and will be implementing a community health program including activities to raise local awareness of health issues.

6.1.3 Education

Of those consulted in January 2017, a significant percentage were illiterate. Only one village (Pyi Nyaung) has people that had attended university education. The illiteracy rate in the households consulted ranged from 32 to 44%. Data collected area presented in *Table 6.3*.

Table 6.3 Number of Households (surveyed) within Education

Village Name	Illiterate	Primary	Middle School	Secondary School	University
Kubyin	11 (44%)	9 (36%)	5 (20%)	0	0
Pyi Nyaung	8 (32%)	8 (32%)	6 (24%)	1 (4%)	2 (8%)

6.2 LIMESTONE QUARRY

The Project is located within Pyi Nyaung Village of Tharzi Township in Mandalay Region. The populations of Pyi Nyaung and Kubyin are 2,569 (53% male) and 271 (50% male), respectively. The household surveys indicate that most of the people in both villages are of the Bamar ethnicity and are predominantly Buddhist, and there were also persons of mixed Bamar and Danu descent. There are six ethnic Karen (Christian) households in Kubyin (of the six households; four were met) and one was met in Pyi Nyaung. Consultation with officials and the community revealed that there are no areas or sites of special cultural importance within the Project area.

Pyi Nyaung Village

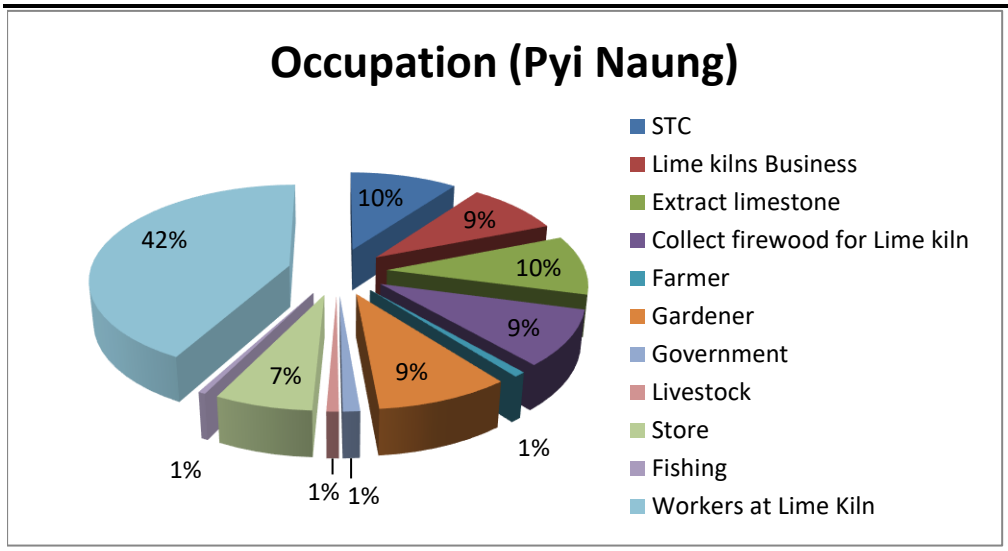
Located 6 km south of the limestone quarry and founded in 1946, Pyi Nyaung Village is home to some 594 households for a population of 2,569. About 500 households include a working age member. The survey was run among 25 households, reaching out to 120 people (4.8 members per household on average). According to the Pyi Nyaung Village Tract leader, 60 HH have a member working at STC on a full time or casual basis and approximately 300 households (80% of the working population) are engaged in lime production from kilns scattered throughout the village: approximately 53 households manage lime kilns, 60 extract limestone from a nearby hill (does not overlap with any other concession) and approximately 56 collect firewood for lime production, which is the main economic activity in the village. About 250 households have at least one member engaged as casual labour for the lime kilns. Another 40 households package and trade lime or run small shops, restaurants, market stalls or are engaged in hawking.

A majority of the households surveyed hold land (72% or 18 households) for an average size of 2.56 acres per household. The farming land for the 25 surveyed households spreads over 64 acres (including 30 acres belonging to the same household). According to the Village Tract Leader, about 55 households are small scale gardeners. Of the 25 surveyed households, only one household is involved in large scale farming and holds 30 acres of land.

Rice cultivation is widespread on the outskirts of the village. The average land holding size in the village is two to four acres and a total of five households are engaged in this activity. The main crops grown in the area are summer paddy rice, banana and mango. Rice is sown in June or July and harvested in September or October. Bananas are grown in April through May. Of the 25 surveyed households, a quarter owns livestock (chicken, buffalo, pig, goat and duck) for consumption (chicken and pigs) or sale (buffalos, cows and goats).

Within Pyi Nyaung Village, three households are engaged in electric fishing (which is illegal) and another seven households work for the government in administration, education and health functions.

Figure 6.1 Employment in Pyi Nyaung Village



Source: ERM, 2017

While limestone production, including the extraction of limestone and firewood, is reportedly the main source of income for residents of Pyi Nyaung, an unknown number of residents are involved in logging of teak and other hardwood timber and its transportation to the nearby towns of Taunggyi, Thazi and Meikhtila.

The average monthly income is Kyat 264,400 per household with 5 households earning double and one more than triple that amount, from his business. The median monthly income of those surveyed is Kyat 210,000. One respondent declared earning double the average from "other sources".

Over half of the respondents (56% or 14 households) stated having taken a loan for their business (28%), to buy food (16%) or for education or medical expenses (12%) but only two-thirds (36%) of those declaring loans mentioned repaying a loan as part of their expenditures.

The majority of the respondents (64% or 25 households) buy purified drinking water and the remaining respondents (36%) source their water for drinking and other domestic usage from the nearby creek. The village relies on water in the Myithar (Myit Tha) Stream and the Panlaung River as its natural water source and there is a supply of piped water from a hand–dug well near to the river that serves a few areas. All of the respondents described the drinking water quality as "good". According to the Village Tract Leader, there is a shortage of water each year in the summer months and this was confirmed by 40% of those interviewed.

Virtually all surveyed respondents (96%) use dry pit latrines and consider sanitation satisfactory for the community's needs (the remaining respondent found it good). The respondents are satisfied with arrangements for solid waste disposal: 24 found it satisfactory and 1 good. There are mixed views concerning the changes in water quality and quantity over the last three years, with an equal number of respondents reporting a decline in quality/availability as those saying that it has not changed.

The electricity supply for Pyi Nyaung Village is from the national grid via a transmission line provided by STC and three other companies. This arrangement has been in place since 2014. Only 60 % of HH have access to electricity from the national grid, which is reflected in the household survey, with the remainder reliant on diesel generators (20% of surveyed households) and solar energy (one surveyed household). Four surveyed households (16%) have no regular access to electricity. A majority of respondents (88%) believes the electricity supply is adequate for the community, including the respondents with no regular access to electricity, with 12 % (or 3 households) describing it as satisfactory (two are connected to the national grid, one to a power generator).

Pyi Naung has a relatively good road network connected to a main highway and all the surveyed respondents described the roads and transport options as good (100%). However, most of the smaller access roads are impassable during the rainy season. The terrain and nature of the soils requires regular maintenance of roads, hence making road maintenance important. An induced impact of the improvement to access routes brought about by the development of the STC cement plant is the increased pressure on forest resources from activity by residents of Pyi Nyaung Village and from settlements further afield. The improved access allows larger trees to be harvested using equipment and transportation that would previously not been able to access these areas. Those travelling from Thazi, Taunggyi and Meikhtila are generally seeking the larger teak and other hardwood north of Kubyin Village rather than competing with local residents for firewood.

The majority of the surveyed respondents (56% or 14 households) use fire as a cooking fuel. The consumption of firewood per day is about 3 kg for one household (90-100kg a month) and one household of three members consuming three times that average. All surveyed respondents but three buy firewood. The firewood can be collected in forest areas 30 minutes by foot from the village. Up to 1 kg of charcoal per day is also used for cooking by about a quarter of villagers. Half of the surveyed households use electricity for cooking.

Three households (12%) described themselves as entirely dependent on forest products for their livelihood for lime production or to sell as firewood: these same households indeed stated that all of their income comes from their business activities. Nearly half (48%) stated they are half dependent on such resources and ten households (40%) assessing themselves as a quarter dependent. A total of 16% (4 households) stated they rely on forest products for lime production and 80% (20 households) for firewood.

No household raised any concern associated with firewood and none described the deforestation that may be happening in their area as a source of concern. Residents reported having multiple options for places to collect firewood for domestic use and for sale.

The respondents spend on average 28% of their income on education: this represents 27% of the total income of the 25 households that is spent by 17 of

them. All the respondents described the education services as good (100%) – there is a secondary school. A slight majority (52%) described the medical services as also good or satisfactory (32%) but 16% (4 households) as unsatisfactory. Nearly a third of respondents incurred recent healthcare expenses with one particular household spending over 60% of its income on healthcare.

About 36% of respondents described the law and order as satisfactory and the remaining respondents as good.

Figure 6.2 ***Socio-economic Survey at Pyi Nyaung Village***

Kubyin Village

Located approximately 2 km north of the limestone quarry, Kubyin Village is home to some 65 households. Situated within the Kubyin Forest Reserve that is under the local administration of the Meikhtila Forest Department, Kubyin is a relatively isolated village established in 1970 by the Forest Department to manage and log the teak plantation. The household survey interviewed 25 households and with an average of 4.8 members per household, the surveyed respondents represented 121 of the 271 residents in the Village.

Prior to the construction of the STC plant, the village was only accessible by bullock-cart or on foot from Pyi Nyaung, approximately 10km to the south. No Kubyin residents owned motor vehicles prior to the construction of the concrete access road to the cement plant and the bypass road to Kubyin Village that were constructed by STC.

There is no grid-supplied electricity in Kubyin. In 2015, the Forest Department donated 46 solar panels to the village. Water supply is from the Kubyin River and a single well installed on the bank of the river that is used mainly in the dry season when the water level is low. Drainage from STC's operations flows into the Kubyin River.

There is very little cultivation within Kubyin Village but the majority (96%) of the surveyed respondents described themselves as farmers, with 16 households earning income from their land and an additional 7 involved in labour work. The Village Tract Leader stated that 58 out of 65 households are engaged in agriculture (summer paddy, maize, sesame). The farmers of Kubyin Village are farming in government owned forest, which is a replantation area under the management of the Forest Department. Agriculture provides 66% of the total income of the sample and on average 56% of the income of those involved in farming on their own land (average plot size of 1.16 acres), and 30% of the income of those involved in labour work. The farming land for the 25 surveyed households spreads over 29 acres. While it was not reported by residents in the surveys, it is clear that a large number of residents in Kubyin village extract forest products as their main source of income.

Of the 25 surveyed households, 80% reported owning livestock (210 chickens, 56 buffalos, 23 cows, 12 pigs) mainly for consumption and a smaller amount for sale.

According to the Village tract Leader, some households collect firewood for delivery to the lime kilns in Pyi Nyaung (there are no kilns in Kubyin). All the respondents (25) of the household survey stated that they rely on firewood as a source of cooking fuel and 92% (23 households) get it from the forest. Only one household (of 4 members) buys it, dedicating 64% of its monthly expenditure to that item (with the outstanding entirely spent on telephone costs), while the other household, the monastery, receives it from donation. It takes households nearly 40 minutes to reach a place in the forest where they can get firewood and the respondents declared consuming on average 465kg of firewood per household a month. Eight households consume on average 886kg a month (225kg per household member) while the remaining 18 households consume on average 267kg a month (63kg per household member). Academic research carried out in the Taungyi District, Shan State[1], reports that the monthly average rural household consumption of fuelwood is 222kg.

About 9 households (36%) described themselves as entirely dependent on forest products for their livelihood while 11 households (44%) stated they are half dependent on such resources and 5 (20%) assessing themselves as a quarter dependent. A large proportion of this income is understood to be related to timber extraction, transportation and trade.

(1) Chaw Sein C., Min Aye Z., Razafindrabe Bam H.N. (2015), Study on consumption of fuel wood and its impacts to forest resources in Taungyi District, Global Journal of Wood Science, Forestry and Wildlife, 2449-1780 Vol. 3 (2), pp.43-51

No household raised any concern associated with firewood, however several households and the village leader described the deforestation in their area as a source of concern.

None of the residents of Kubyin work at STC's cement plant (including the quarries). The market prices for forest products advised by residents of Kubyin Village indicate that the economic incentives favour collection of forest products over working at STC.

Table 6.4 Market Price of Forest Products vs Wages at STC

Item	Market Price (MMK)
Length of regular bamboo	100
Length of elephant bamboo	1,500
Small tree (kiln fuel)	5,000
Large teak tree	120,000-150,000
Minimum Daily Wage at STC	3,600-5,000

Reportedly, residents of Kubyin are not attracted to working at STC's plant given the significant difference between salaries offered at the cement plant compared with what can be earned through timber extraction and harvesting of other forest products. Reportedly, the main source of income for most households in Kubyin is the extraction and sale of teak and other timber. This has intensified since the start of STC's operations due to improved accessibility afforded by the upgraded road to the cement plant. Prior to the construction of STC's cement plant, Kubyin residents transported timber via bullock cart 10 km to Pyi Nyaung and onwards to market. Today, the use of six-wheeled trucks and tractors by Kubyin residents is common. One resident that ERM spoke with sold his house in Pyi Nyaung in 2015, moved to Kubyin and purchased three six- wheel trucks that he rents out to extract timber.

Due to a rapid decline in hardwood timber in and around Kubyin over the last few years, in 2015 residents of Kubyin constructed a 6 km road north along the valley floor to Shan Gate (at the border of Shan State) to allow for timber extraction.

The average monthly income of those interviewed is Kyat 284,400 with 7 households earning more than that amount (the median monthly income was Kyat 180,000 and the Village tract Leader mentioned that all the households earn Kyat 100,000 to 200,000 per month with three earning up to Kyat 300,000 per month). One respondent declared earning an agricultural income which represents 8 times the average agricultural income declared by all the surveyed households. The source of this "agricultural" income is very likely timber extraction.

The average monthly expenditure is Kyat 52,020 per household mostly spent in small amounts on education, diesel/petrol, loan repayments and telephone. The nearest market is in Pyi Nyaung Village, 30 minutes away by motorbike.

Some of the respondents declared having a loan (9 households or 36%) to buy seeds but only two-third of those with a loan mentioned repaying a loan as part of their expenditure.

The feedback from respondents regarding employment is negative, with 88% describing local employment as unsatisfactory and 8% stating it is unavailable. As context, respondents stated that they can generate higher incomes from timber extraction compared with working at the STC cement plant.

The majority of the respondents (96% or 24 households) source their water for drinking and other domestic usage from the Kubyin creek. About 76% of households described the drinking water quality as "good" and 24% as "poor". Regarding the adequacy of the drinking water supply to the community, 76% found it satisfactory and 24% good.

About 84% of respondents use dry pit latrines and overall, 76% of respondents found the sanitation satisfactory and 24% "good" for the community's needs. About 28% of respondents found that the water quality, and 32% that its quantity, have declined over the last three years (the remaining respondents found no change, with the monastery not responding). Whether this has been occurring in the rainy or summer season, or every day or sometimes only, is not conclusive. The respondents raised concerns about the adequacy of the waste disposal system with 68% describing it as unsatisfactory and 16% as non-existent.

As recorded in January 2017, most households (56%) are connected to solar panels donated from the Forest Department for their power supply and about 40% rely on a generator. One household does not have access to electricity supply. It is reported by STC that the company has donated a 60 kVA generator to Kubyin Village in February 2017 and now the whole village has access to electricity supply.

Respondents described the roads and transport options as either satisfactory (32%) or good (68%).

The respondents spend on average 25% of their income on education. All the respondents described the education services as satisfactory (60%) and even good (40%) – there is a middle school - but medical services is not available (except the household representing the monastery). Residents reported that there have been no malaria cases for a long time. Just over a third of the respondents (9 households) faced healthcare expenditure, with three households spending less than 5% of their income on healthcare, 5 spending between 25% and 38% and one spending 55% of its income on healthcare.

Half (48%) of respondents described the law and order as satisfactory or good (16%) but 36% found it unsatisfactory, with concerns raised about "outsiders" coming to the area to (illegally) extract timber and other forest products.

Figure 6.3 Socio-economic Survey at Kubyin Village

Cultural Heritage

Tharzi Township hosts about 160 Buddha statues, 207 pagodas, 302 monasteries, 2 convent schools and 143 Dhamma Halls, as well as 2 churches, 7 mosques and 2 Hindi temples and an ancient Pyu Cemetery classified as a historical building.

There is no cultural heritage of importance identified in the vicinity of the limestone quarry in Pyi Nyaung.

Pyi Nyaung is situated on the road from Meiktila in Mandalay region to Taunggyyi in Shan State, in Tharzi (Thazi) Township, between Yin Mar Bin and Kalaw. Kalaw is in Shan State on the way to He Hoe and Tanuggyi from where the Inle Lake can be accessed.

There are records of ancient sites from bronze and iron ages at Bwe Char Village, Kan Thit Kone Village and Ywar Kone Kyi Village of Tharzi Township. These villages are more than 6 km from the Project Site and thus the cultural heritage resources are unlikely to be affected by the construction and operation of the Project.

7 IMPACT AND RISK ASSESSMENT METHODOLOGY: SCOPING OF THE EIA

The EIA was undertaken in three phases: an initial Scoping Phase followed by an initial Impact Assessment (IA) Phase which was supplemented by a Revised Impact Assessment that addressed comments received during the draft EIA consultation process. The purpose of the Scoping Phase was to identify potentially significant environmental and social impacts that may be caused by the Project (scoped-in impacts). The Scoping Phase was also used to determine the EIA Terms of Reference (ToR), which detailed the baseline studies, stakeholder consultation, impact assessment and management plans that would need to be undertaken and prepared to address these potentially significant impacts. The IA Phase was then conducted in accordance with the EIA ToR to evaluate the significance of these impacts and recommend appropriate mitigation measures as well as management plans. The outcome of this initial Scoping Phase and Impact Assessment Phase was published in a draft EIA published in April 2017, made accessible to stakeholders and presented to the authorities of Myanmar relevant in an EIA process (ECD). The Revised Impact Assessment phase was conducted in accordance with the comments received during this consultation phase.

This section presents the approach and findings of the Scoping Phase of the EIA.

7.1 METHODOLOGY OF EIA SCOPING

EIA Scoping followed a systematic process that involved the following activities:

- Gathering of information on Project activities during each phase of the Project through desktop review of information provided by STC and STM;
- A site visit to the Project Site and its vicinity in November 2016 to obtain preliminary information on existing site conditions as well as environmental and socio-economic receptors and/or resources;
- Identifying environmental and socio-economic receptors and/or resources identified in the AOI;
- Identifying potential interactions between Project activities and resources/receptors based on information obtained above;
- Prioritising potential interactions in terms of their likelihood to lead to significant impacts; taking into consideration the extent and nature of Project activities, and the existing condition/ sensitivities of the resources;

- Developing the EIA ToR which detailed the methodology and requirements of the subsequent IA Phase to address potentially significant impacts that are most likely to affect Project planning, decision-making and which are of stakeholder interest.

Potential impacts which were not likely to be significant, and hence will need little further consideration or associated data gathering during the IA Phase, were "scoped-out" of the EIA at this stage. For example, this included the Project's water demand for the limestone quarry expansion. According to feasibility study data provided bt STC, the combined volume of water to be extracted, both for use by the Project (incudling the cement plant and associated quarries) and for supply to Pyi Nyaung Village, represents <0.1% of the annual average flow rate of the Panlaung River from which it will be extracted . Since this would not have a significant impact on this river, Project water demand was screened out for further assessment. In addition, given that the main offsite villages (i.e. Kubyin Village and Pyi Nyaung Village) are more than 2 km from the limestone quarry, potentially significant noise impact from the operation of the limestone quarry is not expected and thus scoped-out of the assessment. There will be open blasting activities at the limestone and mudstone quarries during daytime period. The duration of each open blasting will be very short and maximum of 1 blast is expected per day. Blasting will be carried out intermittently (3 times per week) at the limestone quarry and once per month at mudstone quarry. The infrequent nature of the use of blasting and the distance between the source and receptors at Pyi Nyuang and Kubyin Village means that noise impacts due to blasting at the quarries is not considerd to be a significant impacts and are thus scoped-out.

7.2 SCOPING RESULTS: KEY IMPACTS & CONCEPTUAL MITIGATION MEASURES

Findings of the Scoping Phase are presented in the Scoping Report of the Project under a separate cover (1). The EIA ToR is extracted from the Scoping Report and appended in *Annex A*.

As presented in the EIA ToR, potential significant impacts to air quality, surface water quality, waste management, biodiversity and ecosystems and socio-economic conditions are expected from the operation of the Project. Baseline data collection, stakeholder consultation, impact assessment and the preparation of management plans have been undertaken, with findings presented in *Sections 5* and *6* of this EIA Report.

Two priority impacts of the Project identified during the Scoping Phase, for which particular attention were paid during the current IA Phase are discussed in detail below.

(1) Scoping Report - Supplementary ESIA for STC Cement Plant & Associated Facilities in Myanmar, ERM, 2016.

7.2.1 Biodiversity

Biodiversity impacts from the operation of the Project have the potential to disturb resident fauna and have ongoing impacts to their habitats. The habitats on site may be classed as Natural Habitat or Critical Habitat, depending on further assessments. Key species of concern will include any endemic/restricted range species identified within the limestone hills.

Residual impacts will require offsetting through the improvement of like-for-like biodiversity values. Loss of the area of the Project will need to be offset to achieve a no-net-loss of biodiversity values (if classed as Natural Habitat) and net-gain (if classed as Critical Habitat).

7.2.2 Enhanced Access for Illegal Logging at the Limestone Quarry

Both legal and illegal timber extraction has been occurring in the vicinity of the limestone quarry for many years before Shwe Taung's arrival in these areas. However, the upgrading of access roads by Shwe Taung has unintentionally improved access to timber resources. The introduction of vehicles and machinery to areas that were previously inaccessible or accessible only by bullock cart has resulted in rapid deforestation. At the limestone quarry, local residents spoke of an increase in "outsiders" coming to the area in search of teak since after Shwe Taung had constructed and/or upgraded access roads.

The economic incentives of illegal timber extraction are compelling for local residents as evidenced by the fact that no residents of the closest villages to Shwe Taung's cement lant and associated quarries (Kubyin Village) are employed by Shwe Taung. Higher incomes are readily available through the illegal extraction of timber via roads that have been built or upgraded by Shwe Taung, an unintended consequence of access road improvement.

8 IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURES: OPERATIONAL PHASE

There are no construction phase impacts of the Project since it is the expansion in production and operation of an existing limestone quarry. The EIA has thus assessed the potential impacts and proposed mitigation to reduce the level of the impact during operation which is presented in the following sections.

8.1 AIR QUALITY

8.1.1 Potential Impacts

Potential impacts to air quality in the vicinity of the limestone quarry may arise from the activities outline in *Table 8.1.* The key air pollutants of interest are particulate matter (PM_{10} and $PM_{2.5}$) from quarrying. For PM_{10} and $PM_{2.5}$, potential impacts cauased by the limestone quarry and the nearby cement plant and mudstone quarries are modelled together as a cumulative impact due to their proximity.

The emission concentrations and the subsequent emission rates used to model the impacts to air quality are presented in *Table 8.2* and *Table 8.3* respectively. The process of deriving emissions from the proposed activities and subsequently informing the dispersion model is set out in *Annex C2* and *Annex C3* and the main inputs, outputs and conclusions are summarised in the following section.

Table 8.1 Project Activities

Project Component	Activity	Substances of Interest
Cement Plant	• the kiln systems and clinker coolers; • material transfers and handling including loading and loading crushers and stockpiles; • the crushing, milling and grinding of auxiliary materials and cement; and • the onsite storage of auxiliary material and clinker.	NO_x, NO_2, SO_2, Dust, PM_{10} and $PM_{2.5}$
Limestone Quarry	• clearing and excavating of surface materials; • bulldozing surface materials; • drilling; • blasting; • loading and unloading haul trucks with limestone and waste rock; • vehicle movements over unpaved surfaces; • wind erosion from limestone and waste rock stockpiles.	Dust, PM_{10} and $PM_{2.5}$

Project Component	Activity	Substances of Interest
Mudstone Quarry	• clearing and excavating of surface materials; • bulldozing surface materials; • drilling; • blasting; • loading and unloading haul trucks with mudstone and waste rock; • vehicle movements over unpaved surfaces; • wind erosion from mudstone and waste rock stockpiles.	Dust, PM_{10} and $PM_{2.5}$

Table 8.2 Point Source Emission Concentrations used in Assessment and Comparison to Emission Limits for Cement Manufacturing

Project Component	Source Type	Source Description	Substance Type	Emission Concentrations used in Assessment (mg/Nm³)	Emission Limit for Cement Manufacturing(1)(2) (mg/Nm³)
Cement Plant	Point	Preheater stack (1,500tpd)	PM	100	100
	Point	Grate cooler stack (1,500tpd)	PM	50	50
	Point	Preheater stack (4,000tpd)	PM	30	30
	Point	Grate cooler stack (4,000tpd)	PM	50	50

(1) *WBG EHS Guidelines for Cement Manufacturing, 2007*
(2) *Myanmar National Environmental Quality (Emission) Guidelines, 2015*
(3) Equipment suppliers for the new kiln will comply with limits specified in WBG EHS Guidelines for Cement Manufacturing, 2007. These have been used to represent a worst case scenario.

Table 8.3 Emission Inventory

Project Component	Source Type	Source Description	Substance Type	Emission Rate (g/s)(1)
Cement Plant	Volume	Fugitive emission from 5,500tpd process	PM	3.28
	Point	Preheater stack (1,500tpd)	PM	6.78
	Point	Grate cooler stack (1,500tpd)	PM	1.56
	Point	Preheater stack (4,000tpd)	PM	3.50
	Point	Grate cooler stack (4,000tpd)	PM	3.62
Limestone Quarry	Volume	Fugitive emission from 5,500tpd process	PM	2.06

Project Component	Source Type	Source Description	Substance Type	Emission Rate (g/s)(1)
Mudstone Quarry	Volume	Fugitive emission from 5,500tpd process	PM	1.05

(1) Refer to *Annex C3* for detailed emission inventory

The process contribution from the project and the predicted environmental concentration (project contribution + baseline) for PM_{10} and $PM_{2.5}$ have been determined based on the methodology outlined in *Annex C2.* The impacts associated with the operation of the Project are set out in the context of the existing airshed and the significance defined based on the approach presented in *Annex C1.*

The significance of the impacts relating to each substance of interest at the sensitive receptor locations in the vicinity of the cement plant are summarised in *Table 8.5* to *Table 8.8.* The sensitive receptor locations included in the assessment are presented in *Table 5.1* and are summarized in *Table 8.4* below.

Where minor, moderate or major impacts are predicted, contour figures showing dispersion across the entire study area are presented (see *Figure 8.1* to *Figure 8.4).*

The results of the assessment comprise the 95th percentile highest ground level concentration predicted over a period of five years from 2012 to 2016 on the receptor grid.

Table 8.4 Representative Air Sensitive Receptors

Receptor ID	Receptor Name	Type of Receptor
AQ1	Worker Accommodation	Human
AQ2	Kubyin Village	Human
AQ3	Pyi Nyaung Village	Human
AQ4	Worker Accommodation	Human
AQ5a	Worker Accommodation	Human
AQ5b	Worker Accommodation	Human
AQ6	Worker Accommodation	Human

Table 8.5 $PM_{2.5}$ 24-Hour Average at Representative ASRs (95th Percentile)

ASR	Baseline Concentration (µg/m³)[1]	Baseline Classification	Air Quality Standard (AQS) [2][3] (µg/m³)	Process Contribution[4][5] (PC) (µg/m³)	PC/ AQS (%)	Predicted Environmental Concentration (PEC) (µg/m³)	PEC/AQS (%)	Impact Significance
AQ1	53	Degraded	25	0.144	<1%	53.1	213%	Negligible
AQ2	53	Degraded	25	0.432	1.7%	53.4	214%	Negligible
AQ3	53	Degraded	25	0.0396	<1%	53.0	212%	Negligible
AQ4	53	Degraded	25	2.04	8.2%	55.0	220%	Negligible
AQ5a	53	Degraded	25	1.67	6.7%	54.7	219%	Negligible
AQ5b	53	Degraded	25	1.23	4.9%	54.2	217%	Negligible
AQ6	53	Degraded	25	0.210	<1%	53.2	213%	Negligible

(1) The highest measured $PM_{2.5}$ 24-hour average concentration from the baseline assessment presented in *Section 5.3.1* was used as indicative of the entire study area as a worst case approach.

(2) *WBG General EHS Guidelines*, 2007

(3) *Myanmar national Environmental Quality (Emission) Guidelines*, 2015.

(4) PM results from fugitive sources were multiplied by a factor of 0.053 to derive the $PM_{2.5}$ fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 13.2.4 Aggregate Handling and Storage Piles)*

(5) PM results from point sources were multiplied by a factor of 0.18 to derive the $PM_{2.5}$ fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 11.6 Portland Cement Manufacturing)*

Table 8.6 $PM_{2.5}$ Annual Average at Representative ASRs

ASR	Baseline Concentration (µg/m³)[1]	Baseline Classification	Air Quality Standard (AQS) [2][3] (µg/m³)	Process Contribution[4][5] (PC) (µg/m³)	PC/ AQS (%)	Predicted Environmental Concentration (PEC) (µg/m³)	PEC/AQS (%)	Impact Significance
AQ1	26.5	Degraded	10	0.0533	<1%	26.6	266%	Negligible
AQ2	26.5	Degraded	10	0.130	1.3%	26.6	266%	Negligible
AQ3	26.5	Degraded	10	0.0143	<1%	26.5	265%	Negligible
AQ4	26.5	Degraded	10	0.860	8.6%	27.4	274%	Negligible
AQ5a	26.5	Degraded	10	0.597	6.0%	27.1	271%	Negligible
AQ5b	26.5	Degraded	10	0.442	4.4%	26.9	269%	Negligible
AQ6	26.5	Degraded	10	0.0830	<1%	26.6	266%	Negligible

ASR	Baseline Concentration (µg/m³)(1)	Baseline Classification	Air Quality Standard (AQS) (2)(3) (µg/m³)	Process Contribution(4)(5) (PC) (µg/m³)	PC/ AQS (%)	Predicted Environmental Concentration (PEC) (µg/m³)	PEC/AQS (%)	Impact Significance

(1) The highest measured $PM_{2.5}$ 24-hour average concentration from the baseline assessment presented in *Section 5.3.1* was divided by 2 and used as an indication of the baseline conditions throughout the entire study areas as a worst case approach.

(2) *WBG General EHS Guidelines*, 2007

(3) *Myanmar National Environmental Quality (Emission) Guidelines*, 2015.

(4) PM results from fugitive sources were multiplied by a factor of 0.053 to derive the $PM_{2.5}$ fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 13.2.4 Aggregate Handling and Storage Piles)*

(5) PM results from point sources were multiplied by a factor of 0.18 to derive the $PM_{2.5}$ fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 11.6 Portland Cement Manufacturing)*

Table 8.7 PM_{10} 24-Hour Average at Representative ASRs (95th Percentile)

ASR	Baseline Concentration (µg/m³)(1)	Baseline Classification	Air Quality Standard (AQS) (2)(3) (µg/m³)	Process Contribution(4)(5) (PC) (µg/m³)	PC/ AQS (%)	Predicted Environmental Concentration (PEC) (µg/m³)	PEC/AQS (%)	Impact Significance
AQ1	103	Degraded	50	0.788	1.6%	104	208%	Negligible
AQ2	103	Degraded	50	1.39	2.8%	104	209%	Negligible
AQ3	103	Degraded	50	0.196	0.4%	103	206%	Negligible
AQ4	103	Degraded	50	12.6	25%	116	231%	Major
AQ5a	103	Degraded	50	10.6	21%	114	227%	Moderate
AQ5b	103	Degraded	50	7.73	15%	111	221%	Moderate
AQ6	103	Degraded	50	1.20	2.4%	104	208%	Negligible

(1) The highest measured PM_{10} 24-hour average concentration from the baseline assessment presented in *Section 5.3.1* was used as indicative of the entire study area as a worst case approach.

(2) *WBG General EHS Guidelines*, 2007

(3) *Myanmar National Environmental Quality (Emission) Guidelines*, 2015.

(4) PM results from fugitive sources were multiplied by a factor of 0.35 to derive the PM_{10} fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 13.2.4 Aggregate Handling and Storage Piles)*

(5) PM results from point sources were multiplied by a factor of 0.42 to derive the PM_{10} fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 11.6 Portland Cement Manufacturing)*

Table 8.8 PM_{10} Annual Average at Representative ASRs

ASR	Baseline Concentration (µg/m³)(1)	Baseline Classification	Air Quality Standard (AQS) (2)(3) (µg/m³)	Process Contribution(4)(5) (PC) (µg/m³)	PC/ AQS (%)	Predicted Environmental Concentration (PEC) (µg/m³)	PEC/AQS (%)	Impact Significance
AQ1	51.5	Degraded	20	0.310	1.6%	51.8	259%	Negligible
AQ2	51.5	Degraded	20	0.551	2.8%	52.1	260%	Negligible
AQ3	51.5	Degraded	20	0.0786	<1%	51.6	258%	Negligible
AQ4	51.5	Degraded	20	5.38	27%	56.9	284%	Major
AQ5a	51.5	Degraded	20	3.76	19%	55.3	276%	Moderate
AQ5b	51.5	Degraded	20	2.74	14%	54.2	271%	Minor
AQ6	51.5	Degraded	20	0.491	2.5%	52.0	260%	Negligible

(1) The highest measured PM_{10} 24-hour average concentration from the baseline assessment presented in *Section 5.3.1* was divided by 2 and used as an indication of the baseline conditions throughout the entire study areas as a worst case approach.

(2) *WBG General EHS Guidelines*, 2007

(3) *Myanmar National Environmental Quality (Emission) Guidelines*, 2015.

(4) PM results from fugitive sources were multiplied by a factor of 0.053 to derive the $PM_{2.5}$ fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 13.2.4 Aggregate Handling and Storage Piles)*

(5) PM results from point sources were multiplied by a factor of 0.18 to derive the $PM_{2.5}$ fraction for comparison to the air quality standard *(USEPA AP-42 Emission Factor Database Chapter 11.6 Portland Cement Manufacturing)*

Figure 8.1 *$PM_{2.5}$ 24-Hour Average (95^{th} Percentile) Contour Plot*

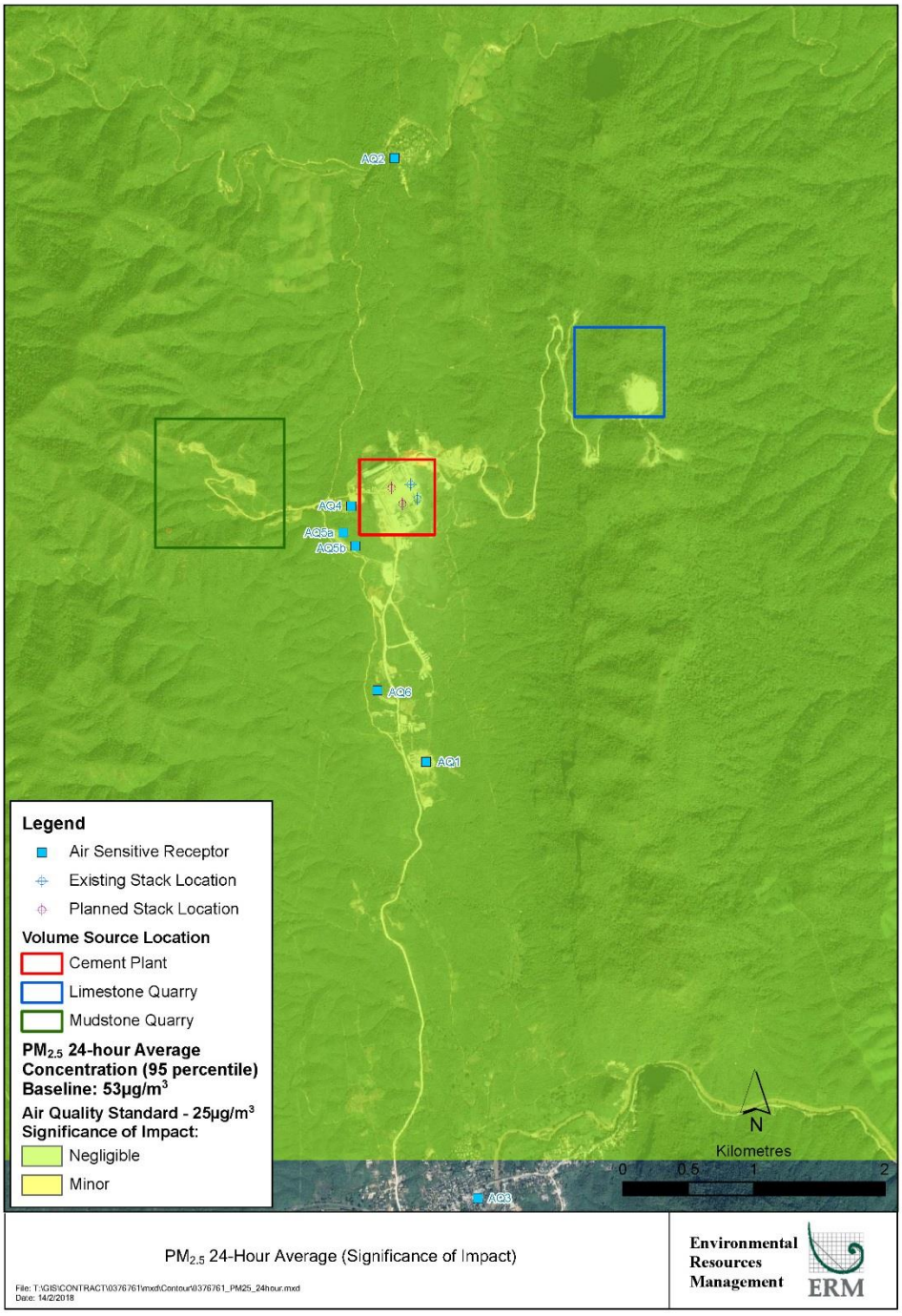


Figure 8.2 $PM_{2.5}$ Annual Average Contour Plot

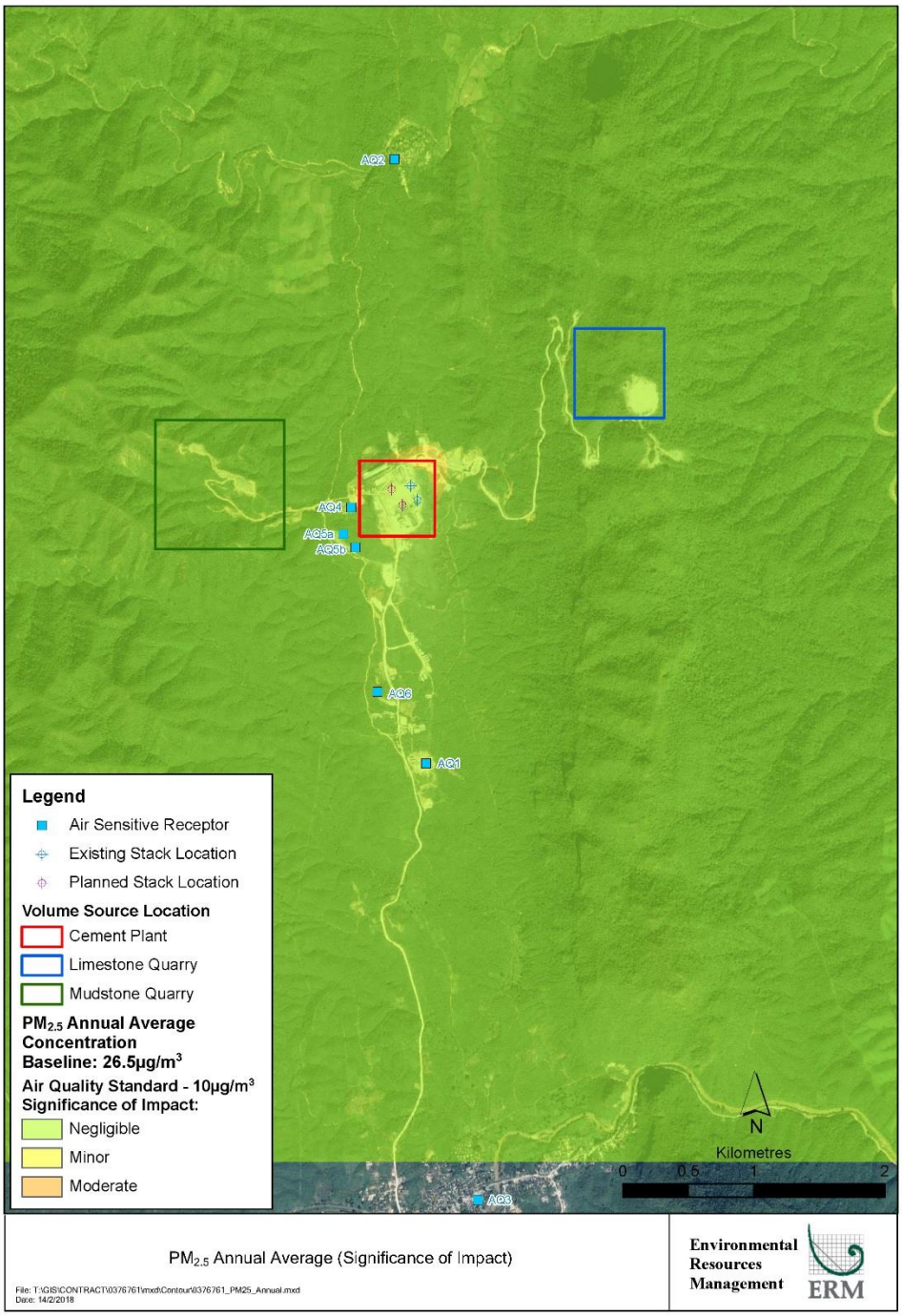


Figure 8.3 PM10 24-Hour Average (95th Percentile) Contour Plot

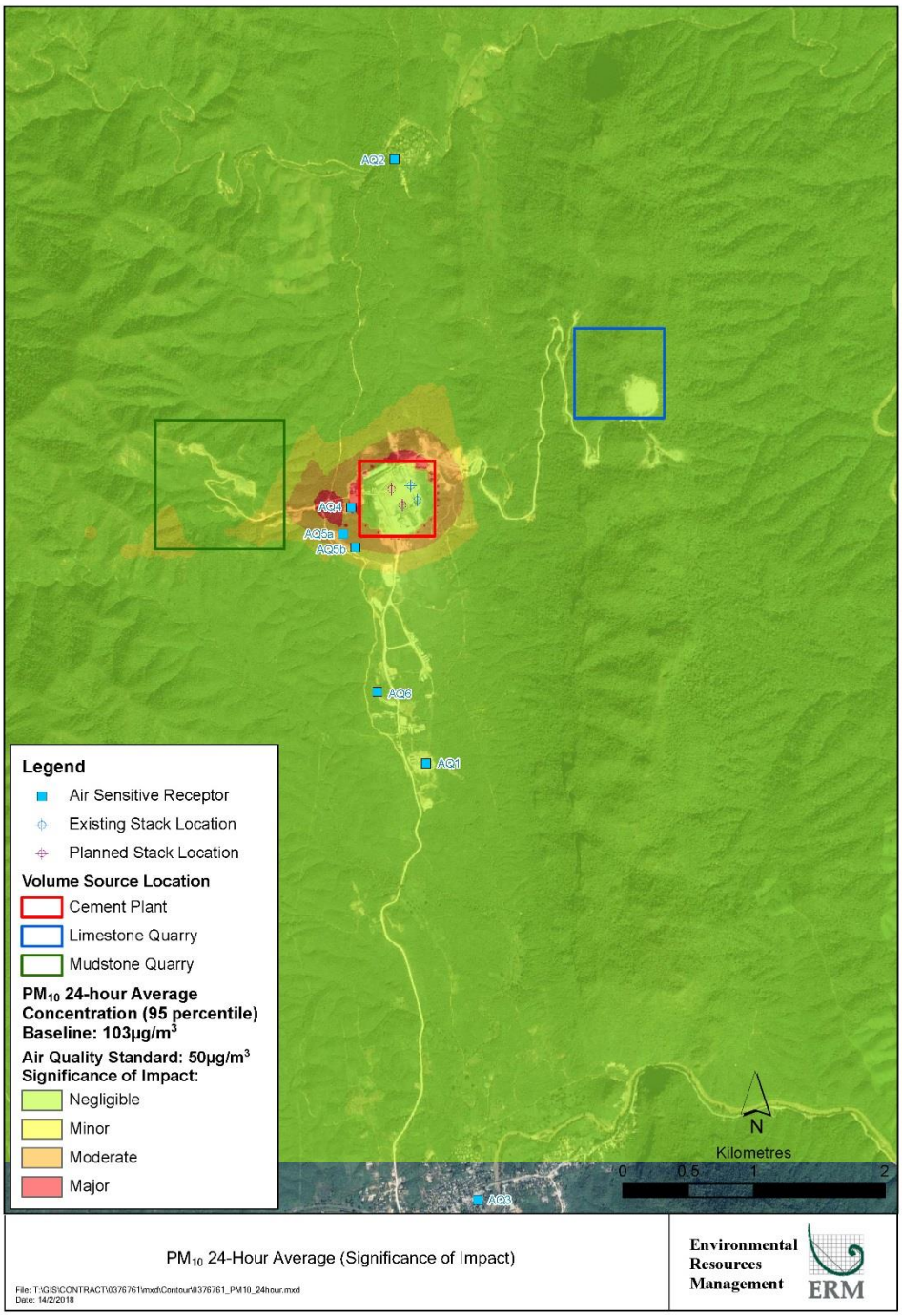
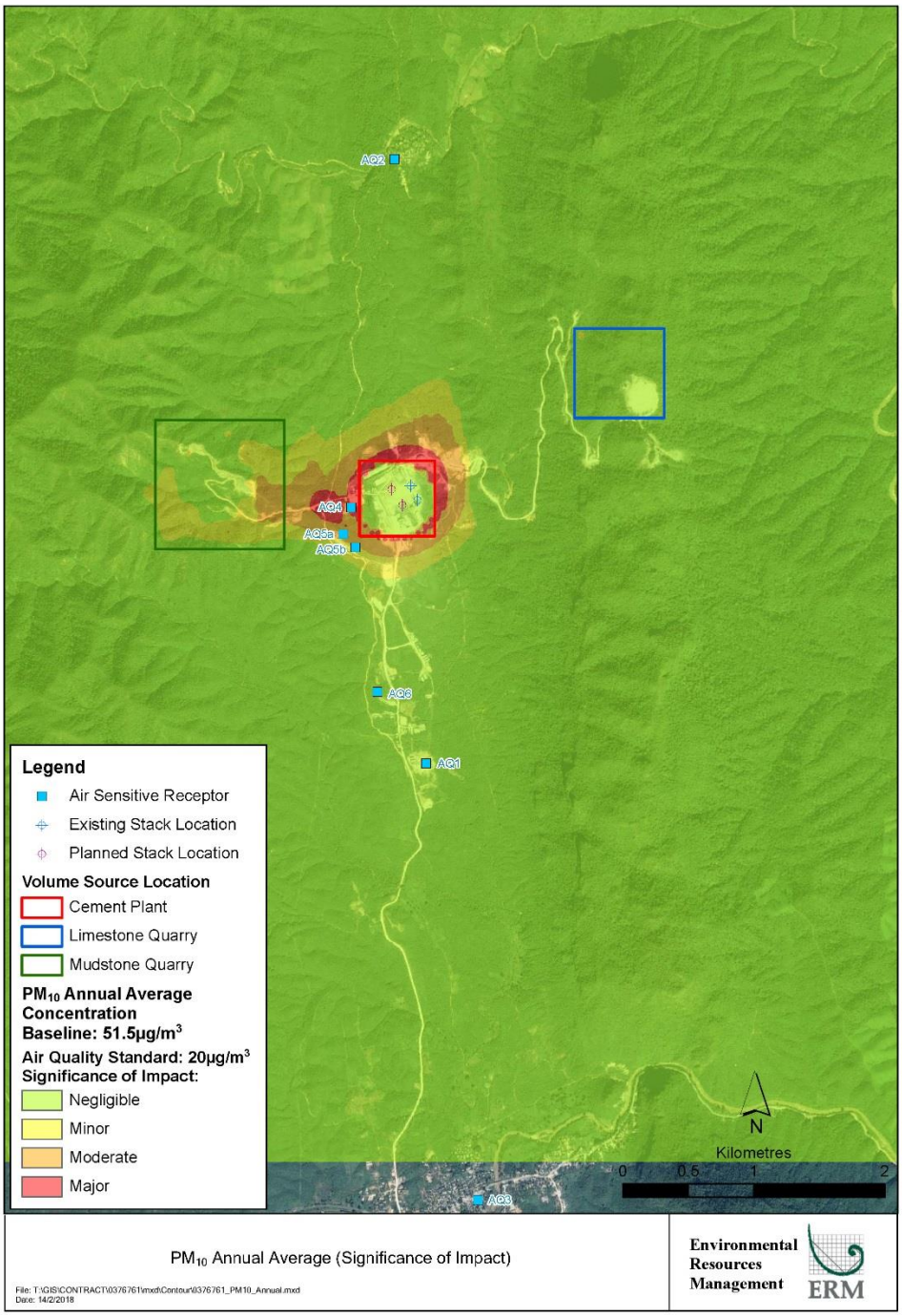


Figure 8.4 PM10 Annual Average Contour Plot



8.1.2 *Significance of the Impact*

Based on the emissions inventory presented in *Table 8.3* and the modelling approach outlined in *Annex C2*, the results from the modelling exercise indicates the following:

- Emissions of $PM_{2.5}$ from the Project will have a negligible impact on air quality at all of the air sensitive receptors identified in the study area (refer to *Table 8.5* and *Table 8.6*).

- Emissions of PM_{10} from the project result in major adverse impacts at the worker accommodation (AQ4) when considering both the predicted 24-hour and annual average contribution from the Project, which are predicted to represent >25% of background levels. At Kubyin Village and Pyin Nyaung Village, the main public residential areas to the north and south of the limestone quarry respectively, negligible impacts to air quality are predicted. With regard to the major adverse impact predicted at AQ4, the following observations are made:

    - the project contribution alone is not in exceedance of the relevant air quality standard. Instead, given the conservative assumption that the existing PM_{10} concentrations at AQ4 are in exceedance of the PM_{10} air quality standards in Myanmar, the impact is considered major when the contribution from the Project exceeds 25% of the applicable air quality standard [1]. The 24-hour average and annual average process contribution at AQ4 is predicted to be 12.6µg/m^3 and 5.38µg/m^3, 25% and 27% of the relevant air quality standards respectively;

    - AQ4 is located close to the western boundary of the volume source used in the AERMOD model to reflect the boundary of the cement plant. The major contributor to the ground level concentration at AQ4 are the fugitive sources from the cement manufacturing process. With reference to *Annex C2*, the fugitive sources were modelled to reflect a continuous emission of particulate matter across the entire cement plant area throughout the entire year as a worst case. In practice emissions are expected to be more intermittent and isolated to specific areas of the cement plant depending on different process occurring throughout the day and year; and

    - AQ4 is worker accommodation associated with the existing cement plant operations and this area shall be relocated further from the cement plant boundary to reduce potential exposure to PM_{10} from the cement manufacturing process. The modelling results indicate that relocating worker accommodation beyond a distance of 500m in any direction from the plant would achieve satisfactory air quality. Ideally, accommodation quarters should be located to the south of the cement plant, which is upwind of the prevailing wind direction. Modelling indicates that worker accommodation areas AQ5a and AQ5b to the south of the plant (upwind) are not exposed to unacceptable adverse air quality impacts as a result of the Project and therefore do not need to be relocated.

A summary of the impacts at the sensitive receptor locations is presented in *Table 8.9*.

[1] The IFC specify that emissions from projects do not contribute a significant portion to the attainment of relevant ambient air quality standards. As a general rule the guideline suggest 25% of the applicable standard to allow additional sustainable development in the same area. Within a degraded airshed, the impact assessment approach defines the significance of process contributions exceeding 25% of the relevant air quality standard as major adverse.

Table 8.9 Assessment of Impact at Sensitive Receptors Related to PM_{10} and $PM_{2.5}$ during Operation

Impact	Adverse impact to air quality from operational related activities at the limestone quarry.				
Impact Nature	**Negative**	Positive	Neutral		
	Elevated ambient concentrations of PM_{10} and $PM_{2.5}$ from operational related activities will have a **negative** impact on air quality.				
Impact Type	**Direct**	Indirect	Induced		
	Elevated ambient concentrations of PM_{10} and $PM_{2.5}$ from operational related activities will have a **direct** impact on air quality.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Potential impacts to air quality will occur throughout the operation phase and can therefore be described as **long term** in nature.				
Impact Extent	**Local**	Regional	International		
	Operational activities at the site have the potential to result in significant emissions of PM_{10} and $PM_{2.5}$ up to 5km from the project site boundary and can therefore be described as **local.**				
Impact Scale	The scale of the impact is likely to be up to 5km from the Project site boundary.				
Frequency	Impacts will arise continuously from operational related activities.				
Impact Significance	**Negligible**	Minor	**Moderate**	**Major**	Critical
	Emissions of $PM_{2.5}$ will have a **negligible** impact on air quality at all ASRs Emissions of PM_{10} will have a **negligible** impact on air quality at all ASRs except for AQ4 (**Major**) and AQ5 (**Moderate**)				

8.1.3 Mitigation

- Particulate matter associated with mining operations at the limestone and mudstone quarry should be controlled by the following good practice techniques:
  - Water suppression should be used on unpaved roads and work areas in dry and windy conditions;
  - Storage of dusty materials (i.e. stockpiles) should be enclosed or operated with efficient dust suppression measures;
  - Stockpile heights should be kept to a minimum; and
  - Drop heights during loading and transfer of materials should be minimized and shielded against the wind.
- Particulate matter associated with material handling and storage should be controlled by the following good practice techniques:
  - Reduce the number of material transfer points by simple, linear layout for material handling operations;
  - Use of enclosed belt conveyors for material transportation and emission controls at transfer points;

- Regular cleaning of conveyor belt systems; and
- Crushed and blended raw materials should be stored in covered or closed bays.

- Material handling processes including crushing operations should be undertaken in enclosed systems maintained under negative pressure by exhaust fans. Dust should be removed using cyclones and bag filters

- STC has agreed to relocate all worker accommodation beyond a distance of 500m from the plant in order to achieve satisfactory air quality. The permanent worker accommodation will be located to the south of the plant (upwind) at a distance of greater than 500m from the plant boundary.

8.1.4 Residual Impact Significance

Based on the proposed emission inventory for the operation of the limestone quarry site, the significance of the impacts to air quality at the ASRs in the vicinity of the plant will be **Minor** or below. The correct application of the above mentioned good practice measures will further support this outcome and reduce the likelihood of unacceptable impacts to air quality.

8.2 SURFACE WATER QUALITY

8.2.1 Potential Impacts

Impacts to surface water courses may arise from runoff from the working areas (including blasting area) and overburden dumps at the limestone quarry. Given that the storage and tranporation of explosive materials for blasting will be undertaken in strick compliance with the regulatory requirements as presented in *Section 4.1.2*, potential leakage and water quality impacts from storage and transporation of explosive materials are not expected to occur. Explosive materials used for blasting will be placed at the bottom of the drill hole and covered by soil on top. These materials are thus unlikely to be in direct contact with runoff when in use.

Stormwater from the limestone quarry flows west and south to the Myit Tha Stream and drains into STC's reservoirs. Water discharged from the reservoir is flowing to the Pyi Nyaung River as report by the STC.

STC is in the process of implementing in-place controls to manage impacts to surface water at the limestone quarry. During the stakeholder consultation in January 2017, residents in Kubyin expressed their concerns on the release of water from the reservoir of the cement plant upstream during the wet season. Adverse water quality impact was reported by the resident. It is, however, confirmed by STC that excess water from the reservoir will overflow from the overflow weir to the natural creek which is flowing to Pyi Nyaung to the south of the plant rather than Kubyin which is located north of the plant. As such, adverse water quality impact reported by residents in Kubyin is more likely to be caused by contaminated run-off or wastewater discharge from the plant, rather than reservoir overflow.

The magnitude of this impact is medium; the receptor sensitivity is high given that the Myit Tha Stream and Pyi Nyaung River are used as a drinking water supply. The overall impact significance is therefore **major**.

Table 8.10 Surface Water Quality Impact Assessment

Impact	Deterioration of surface water quality in the Pyi Nyaung River and Myit Tha Stream resulting from uncontrolled runoff from the Project.				
Impact Nature	**Negative**	Positive	Neutral		
	Pollutants entering surface water courses would create a negative impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact would be directly upon surface water resources and on the residents of nearby villages that depend on water supplied from the Pyi Nyaung River and Myit Tha Stream.				
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
	If not managed, the impact would occur over the life of STC's operations.				
Impact Extent	**Local**	Regional	International		
	The extent of the impact would be limited to the water courses adjacent to the site.				
Impact Scale	Moderate				
Frequency	Runoff from the quarries would occur routinely throughout the wet season.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is **Medium**.				
Receptor Sensitivity	Low	Medium	**High**		
	The receptor sensitivity is **High**, given the year round dependence by residents of nearby villages on water from the Pyi Nyaung River and Myit Tha Stream.				
Impact Significance	Negligible	Minor	Moderate	**Major**	Critical
	The significance is **Major** in the absence of mitigation.				

8.2.2 Mitigation

The following mitigation is being implemented by STC:

- Construction of a dedicated drainage network to intercept and divert runoff from the limestone quarry to an appropriately sized and maintained sedimentation pond to allow adequate retention time for suspended solids to settle;
- After passing through sediementation ponds, runoff from limestone quarry may be discharged to the wetland created by STC via a weir to remove suspended solids before entering the wetland;
- Baffles or other measures to reduce the velocity of runoff down hill slopes should be installed to minimise scouring; and
- Exposed areas and overburden dumps should be revegetated as quickly as possible.

8.2.3 Residual Impact Significance

The recommended mitigation measures will reduce the likelihood of runoff entering surface streams that ultimately drain to the Pyi Nyaung River and Myit Tha Stream such that the, residual impact significance would be *Minor* to *Moderate*. Routine surface water quality monitoring will be initiated to

monitor the effectiveness of the proposed mitigation measures which is discussed further in *Section 11- ESMP*.

8.3 BIODIVERSITY

8.3.1 Loss of Habitat

The areas of Natural Habitat and Modified Habitat impacted during operation of the limestone quarry are shown in *Table 8.11*. This assessment is based on an estimation of the size of impact within the Project area provided by STC.

Table 8.11 **Natural Habitat and Modified Habitat**

Project Area	Natural Habitat Area (ha)	Modified Habitat Area (ha)	Total (ha)
Limestone Quarry	235.58	118.79	354.37

The impacts from the loss of habitat within the concession during the operation phase will predominately be related to the operation of the limestone and mudstone quarries. With the exception of a small area (<0.8 ha) of additional vegetation clearance necessary to accommodate the new conveyor to the primary limestone crusher the area required for the second cement line has already been cleared and there is no need for additional clearance. The limestone quarry is located in Critical Habitat. It is therefore anticipated that impacts from these quarries may have a significant impact to biodiversity values.

Impacts from the limestone quarry include a loss of habitat for limestone dependent fauna, including endemic snail fauna. The limestone range is also likely to play host to endemic flora. Impacts due to limestone quarrying activities are the primary impact of concern.

The impact assessment summary for loss of habitat during the operation phase is outlined in *Table 8.12* and is defined as *critical*.

Table 8.12 ***Impact Assessment Summary – Permanent and Temporary Loss of Habitat***

Impact	Permanent and temporary loss of habitat including transition of habitats from one habitat type to another during operation				
Impact Nature	Negative	Positive	Neutral		
	The impact on the terrestrial and aquatic biodiversity is negative				
Impact Type	Direct	Indirect	Induced		
	Direct terrestrial habitat loss in the Project Footprint in areas to be developed. Induced effects on remnant/ isolated habitats.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	The impact will be ongoing during operations and is essentially a permanent change.				
Impact Extent	Local	Regional	International		
	The impact is expected to be local for habitats.				
Impact Scale	It is anticipated that the impact will be limited to the Limestone Quarry during operation, which occur in Critical Habitat. Induced clearing and illegal logging may have impacts on the nearby protected area.				
	Positive	Negligible	Small	Medium	Large

Impact	Permanent and temporary loss of habitat including transition of habitats from one habitat type to another during operation				
Impact Magnitude	The magnitude of impact may affect an entire population of a species and possibly threaten the long term viability of that population.				
Receptor Sensitivity	Low	Medium	High		
	Given that impacts could occur on endemic flora and fauna, the receptor sensitivity is considered to be High. Impacts to the nearby protected area from induced clearing and illegal logging are also considered to be High.				
Impact Significance	Negligible	Minor	Moderate	Major	Critical
	The significance of this impact is **Critical** and requires biodiversity offsets (see *Annex E*)				

Mitigation Measures

The following mitigation measures will be applied to the Project:

- Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring.

- All habitat clearance during quarrying/mining operations is to be clearly marked prior to excavation.

- A Wildlife clearance protocol (*Annex D4*) is to be applied during all operations that clear Critical Habitat and Natural Habitat.

- Education and awareness activities are to be undertaken with local people to provide information regarding illegal logging controls.

- Regular patrols (at least every month) of the Project boundary will be undertaken to identify any incursion by local people into the Project Area and surrounding forested area.

- Education of staff and workers of all rules, regulations and information concerning the restriction clearing outside of the Project footprint is to occur;

- Operation Contractor will schedule and implement routine inspection program throughout operation period to monitor clearing extent;

- Use of the access road should be restricted to operation vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and wood products; and

- Posters and signage are to be developed and placed at STC controlled properties stating the policy, including in local villages. These materials should be in Myanmar language.

Residual Impact Significance

Residual impacts remaining after mitigation include the permanent loss of 235.58 ha of limestone habitat from the limestone quarry. Biodiversity offsets are necessary to offset the permanent loss of habitats. Reference should be made to the Biodiversity Action Plan at *Annex E*. Ongoing impacts are likely regarding induced illegal logging and clearing. Monitoring of these impacts will be necessary to identify additional management measures that may be required.

8.3.2 Fragmentation and Edge Effects

It is anticipated that edge effect impacts during operation will continue to occur from the linear infrastructure such as the driving of vehicles along the access road and associated infrastructure (including the transmission line where vegetation will be suppressed under the strung wires). Additionally, edge effects will occur adjacent to all quarries. The edge impacts will be most significant within the limestone quarry areas which are Critical Habitat. The impacts will include dust, noise, vibration and light impacts on adjacent habitats. These edge effects will impact adjacent fauna and flora through disturbance and displacement and dust impacts on vegetation. It is likely that dust impacts will be limited to the dry season as rainfall will wash dust from vegetation during the wet season. Given that endemic flora exist adjacent to the limestone quarry, this is considered a sensitive receptor.

Impacts from fragmentation will occur within the limestone range as the quarry will reduce connectivity by removing a portion of the range. This will fragment currently joined habitats along the limestone range.

The impact assessment summary for impacts to habitats by edge effects during the operation phase is outlined in *Table 8.13*.

Table 8.13 Impact Assessment Summary – Fragmentation and Edge effects

Impact	Impact to flora and fauna from edge effects and fragmentation during operation of the access roads, Limestone Quarry and limestone quarry				
Impact Nature	Negative	Positive	Neutral		
	The impact on the terrestrial biodiversity is negative				
Impact Type	Direct	Indirect	Induced		
	Direct impact to terrestrial flora and fauna, including Critical Habitat adjacent to the limestone quarry. Dust impacts will continue on Modified Habitats adjacent to roads. Fragmentation will occur within limestone hills.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	The impacts will continue during operation and will be permanent.				
Impact Extent	Local	Regional	International		
	The impact is expected to be localised for habitats adjacent to quarries and alongside linear infrastructure components, including roads.				
Impact Scale	It is anticipated that the scale of impact will be limited to areas adjacent to quarries and along linear infrastructure components.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	The impacts to areas of Natural Habitats adjacent to the quarries are considered to be Medium. The impacts to Critical Habitats are considered to be Medium. Impacts to Modified Habitats beside linear infrastructure are considered to be Small.				

Impact	Impact to flora and fauna from edge effects and fragmentation during operation of the access roads, Limestone Quarry and limestone quarry				
Receptor Sensitivity	Low	Medium	High		
	Natural Habitats are considered to be High sensitivity as they play host to sensitive species of high biodiversity value.				
Impact Significance	Negligible	Minor	Moderate	Major	Critical
	The significance of this impact is **Moderate to Major**.				

Mitigation Measures

The following mitigation measures are recommended:

- Measures regarding managing dust, noise, vibration recommended in this EIA are to be applied during operations in Critical Habitat and Natural Habitat.

- Design of lighting will be directed away from vegetated areas and habitats. Upward lighting will be avoided and lights will not be left on after hours when not required.

Residual Impact Significance

Mitigation measures during operation will reduce the severity of impacts of the loss of terrestrial and aquatic habitats so as to reduce the impact to minor (Magnitude Minor).

8.3.3 Degradation of Habitats

A range of Project operation activities have the potential to lead to degradation of native flora and fauna habitats including excavation, land clearing, suppression of vegetation under transmission lines, movement of vehicles, drilling, refuelling, hazardous materials storage and maintenance. In general the impacts will cause: dust; runoff; and release of potential contaminants. Operation activities have been assessed for these impact types, including: quarrying activities, operation use of the access roads and operation of the conveyor belt. These impacts have been assessed as part of other relevant chapters of the EIA.

Invasive species (flora and fauna) have the potential to be introduced or spread throughout the Project area through increased movement of people, vehicles, machinery, vegetation and soil. An increase in the prevalence of weeds or other pests has the potential to reduce the quality of habitat for some native flora and fauna, including conservation significant species. Invasive flora species can rapidly germinate in disturbed areas whereby affecting the ability of native vegetation communities to re-establish.

Invasive species were detected within the Area of Influence of the Limestone Quarry. These species are outlined in *Table 8.14.*

Table 8.14 Invasive Species detected within the Limestone Quarry Area

S/N	Scientific Name	Family
1	*Ageratum conyzoides*	Asteraceae
2	*Bidens pilosa*	Asteraceae
3	*Caesalpinia decapetala*	Caesalpinaceae
4	*Chromolaena odorata*	Asteraceae
5	*Hiptage benghalensis*	Malpighiaceae
6	*Leucaena leucocephala*	Mimosaceae
7	*Mimosa pudica*	Mimosaceae
8	*Oroxylum indicum*	Bigoniaceae
9	*Paederia foetida*	Rubiaceae
10	*Ziziphus jujuba*	Rhamnaceae

Vehicle movement and activities which introduce a risk of invasion will be focused along access road and operation areas. The increase in human activity and movement across the landscape is also a consideration as well as the potential movement of weed seed and aquatic invasive species as a result of runoff. It is therefore likely that the primary transmission will be along existing roads and operation of the limestone conveyor belt.

The impact assessment summary for degradation of habitats during the operation phase is outlined in *Table 8.15.*

Table 8.15 Impact Assessment Summary – Degradation of Habitats

Impact	Impact to habitats from degradation including dust, runoff, release of contaminants and invasive species				
Impact Nature	Negative	Positive	Neutral		
	The impact on the terrestrial and aquatic biodiversity is negative.				
Impact Type	Direct	Indirect	Induced		
	Direct impact to terrestrial flora, mostly from dust impacts adjacent to roads.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Permanent and ongoing				
Impact Extent	Local	Regional	International		
	The impact is expected to be localised for habitats downstream or alongside linear infrastructure components and activities.				
Impact Scale	It is anticipated that the scale of impact will be limited to downstream areas and areas along linear infrastructure components. Impact will be restricted to Modified Habitats during Operation. Some impacts to Natural Habitat beside the conveyor belt operation may occur.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Considering the magnitude of impacts and that the majority of impact will be modified habitats, the overall magnitude of this impact is **Small**.				
Receptor Sensitivity	Low	Medium	High		
	Terrestrial habitats likely impacted will be predominately modified habitats, however some impacts to Natural Habitat will occur during operation of the conveyor belt.				
Impact Significance	Negligible	Minor	Moderate	Major	Critical
	The significance of this impact is **Moderate**.				

Mitigation Measures

The following additional mitigation measures will be applied during operation to reduce impacts from the degradation of habitats:

- Wheel wash bays will be installed at the guardhouse at the Limestone Quarry to remove dirt and plant material from vehicle wheels prior to entering and leaving the Project Area.

- Invasive species within Natural Habitats should be eradicated where possible. Appropriate use of herbicides may be used to control invasive species within the Project Area in accordance with the safe use and label directions of the herbicides.

- Monitoring of invasive species is to occur within the Project Area on an annual basis. New infestations identified are to be controlled.

Residual Impacts

Mitigation measures during operation will reduce the severity of impacts of the loss of terrestrial and aquatic habitats so as to reduce the impact to within the normal range of variation (Magnitude Negligible).

8.3.4 Impacts to Species during operation

Site Endemic Limestone Snails (NA)

No site endemic snails restricted to the project site occur. The species of snails detected within the concession are locally endemic and are currently only observed within the Limestone range within the DMU. The concession plays host to these species. The operation of the conveyor belt and limestone quarrying activities will impact the limestone habitat within the concession.

Site Endemic Limestone Flora (NA)

No site endemic flora restricted to the project site occur. The species of flora detected within the concession are locally endemic and are currently only observed within the limestone range within the DMU. The concession plays host to these species. The operation of the conveyor belt and limestone quarrying activities will impact the limestone habitat within the concession.

Site Endemic Limestone Reptiles (NA)

No site endemic reptiles restricted to the project site occur. The species of limestone reptiles detected within the concession are locally endemic and are currently only observed within the Limestone range within the DMU. The concession plays host to these species. The operation of the conveyor belt and limestone quarrying activities will impact the limestone habitat within the concession.

It should be noted that impacts to forested habitats at the limestone quarry and limestone dependent species during quarrying activities have been considered in the operational impact assessment.

It should be noted that impacts to forested habitats at the limestone quarry and limestone dependent species during quarrying activities have been considered in the operational impact assessment.

Table 8.16 Impact Assessment Summary – Species Impacts

Impact	Impact to species within the DMU and Project Area				
Impact Nature	Negative	Positive	Neutral		
	The impact on the terrestrial and aquatic biodiversity is negative				
Impact Type	Direct	Indirect	Induced		
	Direct impact to terrestrial an aquatic fauna and flora.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Permanent and ongoing				
Impact Extent	Local	Regional	International		
	The impact is expected to be localised for species.				
Impact Scale	It is anticipated that the scale of impact will be limited to areas within the Project Area and potentially in forested areas to the North of the Project Area, including the Panlaung-Pyadalin Wildlife Sanctuary				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Considering the magnitude of impacts and that the majority of impact will be modified habitats, the overall magnitude of this impact is **Negligible** to **Small**.				
Receptor Sensitivity	Low	Medium	High		
	Terrestrial and aquatic species likely impacted are considered to be a **High** sensitivity given the presence of Critical Habitat candidate species				
Impact Significance	Negligible	Minor	Moderate	Major	Critical
	The significance of this impact is **Moderate**.				

Mitigation Measures

The following additional mitigation measures will be applied during operation to reduce impacts to species:

- A Biodiversity Action Plan will be required for Critical Habitat triggers. This plan is to be prepared to outline measures to be applied to manage these species within the Project Area and Area of Influence. The management plan will address key threats to the species, including hunting, poaching, illegal logging, pollution and habitat destruction. Speed is to be limited to 40 km/hr for vehicles on company operated roads to minimise potential for fauna strike;

- Additional surveys for endemic reptiles and snails are to occur within the Concession and proposed offset areas to confirm presence and distribution

- Commitment will be made to raise awareness of values of important species and habitat areas to the work force and arrangements will be made for restriction of poaching and forest product collection by staff. Hunting wild animals will be strictly prohibited for all staff.

- Non-project related vehicles will not be permitted to enter company-operated roads during operation.

Residual Impacts

Mitigation measures during operation will reduce the severity of impacts to species so as to reduce the impact to within the normal range of variation (Magnitude Negligible). Permanent loss of limestone habitat will occur during operation of the conveyor belt that will result in minor impacts to limestone dependent flora and fauna.

8.4 WASTE MANAGEMENT

8.4.1 Potential Impacts

Waste streams generated are expected to include:

- General wastes from the operation of the limestone quarry (packaging for consumables, sites waste, office waste etc.);
- Hazardous wastes such as waste related to explosive materials, waste oil, lubricants and laboratory chemicals; and
- Spoil and overburden from the limestone quarry.

There are currently limited in place controls at the site for handling waste. A basic non-hazardous solid waste management facility has been newly created at the cement plant for non-hazardous wastes. This non-hazardous solid waste management facility is not lined with an impermeable layer and is therefore only suitable for inert (non-reactive) and non-hazardous waste. This non-hazardous solid waste management facility may lead to potential impacts to surface water quality if wastes from this non-hazardous solid waste management facility is not properly contained and enter watercourses.

The impact magnitude is considered to be *medium* and the receptor sensitivity is considered to be *medium*. As such the impact significance associated with wastes generated during operation are considered to be *moderate*.

Table 8.17 Assessment of Impact related to Waste Management during the Operation

Impact	Waste generated during the operation at the limestone quarry may have a direct impact on the surrounding environment and secondary effects on the environment, workers and the community if not managed appropriately.			
Impact Nature	**Negative**	Positive	Neutral	
	The generation of waste is a **negative** impact from the Project.			
Impact Type	**Direct**	Indirect	Induced	
	May impact directly on the environment and have secondary effects on workers and the community.			
Impact Duration	Temporary	Short-term	Long-term	**Permanent**
	Impacts from the use of a landfill at the site are essentially permanent.			
Impact Extent	**Local**	Regional	International	
	Impacts arising from waste management are likely to be local in nature.			
Impact Scale	Minor			

Frequency	Waste will be generated daily throughout the operational phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is expected to be **medium**				
Receptor Sensitivity	Low		**Medium**		High
	The receptors include the environment around areas used for waste disposal areas. Waste disposal areas include the basic landfill as well as rock and overburden storage areas at the quarries. The receptor sensitivity is considered to be **Medium**.				
Impact Significance	Negligible	Minor	**Moderate**	Major	Critical
	The impact significance without further mitigation is considered to be **moderate.**				

8.4.2 Mitigation

A comprehensive waste management plan (WMP) for the Project has been developed (*Annex F*).

The existing non-hazardous solid waste management facility is not lined and should be only used for inert (non-reactive) and non-hazardous waste only.

STC is in the processing of upgrading the waste management system. For hazardous waste, they will be transported and disposed at suitable facilities of Golden Dowa Eco-system Myanmar Co.Ltd, which is located at Thilawa SEZ of Yangon Region. It should be noted that the waste disposal facility in Yangon can also handle faecal and general wastes, if required. Non-hazardous wastes will be recycled and reused as far as possible or disposed in the non-hazardous solid waste management facility which will be lined with leachate collection facility.

8.4.3 Residual Impact Significance

By implementing the WMP (*Annex F*) throughout the operation phase the impact significance from waste generated can be reduced from *moderate* to *minor*.

8.5 OCCUPTIONAL HEALTH AND SAFETY

8.5.1 Potential Impacts

The Project will increase the number of on-site workers significantly. Workers are at risk of occupational health and safety incidents. Such incidents may be linked to the physical environment in which they operate, the procedures they have to abide by or the on-site health and safety culture (including the ongoing and efficient reporting of incidents and near-misses and how workers are empowered to learn from them to prevent them from happening again).

Shwe Taung has existing occupational health and safety policies and procedures in place at the limestone quarry and these will be applicable for the expansion project. These procedures include requirements in terms of operational safety (ladder, crane and forklift management, working at height, personal protective equipment use, lifting operation, emergency management, etc.). With the support of the IFC, STC has retained international consultants

to assist with the review, update and implementation of its occupational health and safety procedures.

For any works to be carried out in the quarry, relevant personal protective equipment for eye protection, fall protection, foot protection, hand protection, head protection, hearing protection and respiratory protection must be used. All basic PPE will be issued to all employees upon commencement of works. Special PPE (e.g. harnesses, welding shield) will be issued by the relevant department as a job requirement.

Training is provided to STC employees covering HSE induction, construction safety, firefighting, first aid, Occupational Safety and Health Management System (OSHMS), risk management and safe lifting induction. The HSSE Department is responsible for undertaking the training needs assessment and for organising the required training.

Before joining STC, workers will undertake a pre-employment medical check. For all workers, medical check will be undertaken every 36 months. For workers engaged in noisy works (e.g. blasting, hammering, grinding of raw materials), workers potentially exposed to radiation, welder and industrial vehicle drivers, medical check will be undertaken every 12 months.

The clinic at the cement plant is managed by one medical doctor. For emergency cases, treatment will be provided by the clinic doctor and if necessary, the medical doctor will decide to send the patient to a certain hospital. There are four public hospitals within Tharzi Township, located in Tharzi (50 beds), NyaungYan (16 beds), Yin Mar Pin (16 beds) and Hanzar (16 beds).

As presented in *Section 5.3.5*, Pyi Nyaung area is not situated in an area classified as most prone to flooding and cyclones in Myanmar. Records of natural disaster, namely earthquake, have been supplemented in *Section 5.3.5*. In case of earthquake, workers within the limestone quarry may potentially be affected. In order to achieve a safe design of the structures, based on the Probabilistic Seismic Hazard Analysis of earthquake data, seismic design parameters have been derived and adopted for the buildings/structures that are in the limestone quarry. As such, impacts related from earthquake are not expected to be significant.

The air quality modelling undertaken as part of this EIA indicate potential exceedances of applicable standards for ambient air quality (although it is noted that the impact assessment has been undertaken on the basis of conservative assumptions). Therefore STC have agreed that use of these accommodation facilities be discontinued as quickly as possible and workers housed at the new accommodation quarters to the south of the cement plant. Owing to the prevailing wind direction, the accommodation quarters west of the cement plant are more likely to be adversely affected by both air and noise impacts than those south of the plant.

Regarding the use of explosive materials, a permit to work system is currently adopted by STC which covers works of higher risk works activities including

blasting operation and excavation at the limestone quarry. Blasting is registered with the Military and approved based on detailed consideration of safety requirements. Transportation of the explosives to the storage will be in strict compliance with safety requirements and the storage is constructed in compliance with safety requirements of the Ministry of Defence. All explosives are stored as per required regulations. A security guard is posted at the explosives magazine 24 hours per day and the two main keys of the storage are kept and checked by heads of administration and mining departments of STC. The material in-out record is systemically recorded and must be carried out with strict material handling procedures.

The impact magnitude is considered to be *small*. The sensitivity of the receptor is considered to be *high* as it relates to human receptors and therefore the impact significance is considered to be *moderate*.

Table 8.18 Assessment of Impacts related to Health and Safety during the Operation

Impact	Health and safety (community and of workers) incidents during the operation phase at the limestone quarry.				
Impact Nature	**Negative**	Positive	Neutral		
	Health and safety (community and of workers) incidents are a negative impact from the Project.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct on workers and direct or indirect on communities. It is also directly impacted by the Project's Policies, Plans and Procedures.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration of Health and safety (community and of workers) incidents is the same as the Project duration (including operation and decommissioning).				
Impact Extent	**Local**	Regional	International		
	The impact will be on the workforce employed locally (though it may come from elsewhere) and on the communities around the Project.				
Impact Scale	Minor				
Frequency	Health and safety (community and of workers) incidents can occur at any time.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is expected to be **small.**				
Receptor Sensitivity	Low	Medium	**High**		
	The receptor sensitivity is considered to be **high** as the Health and safety (community and of workers) incidents can range in severity.				
Impact Significance	Negligible	Minor	**Moderate**	Major	Critical
	The impact significance is considered to be **moderate** without further mitigation.				

8.5.2 Mitigation

Mitigation measures include the review and update of STC's existing procedures and the design and implementation of additional procedures, such as:

- Incident Reporting Procedure;
- Contract Health and Safety Procedure (including Occupational, Environmental Health and Safety with co-benefits for the community health and safety);

- Emergency Response Procedure;
- Storage and Handling of Hazardous Material Procedure;
- Waste Management Procedure; and
- Worker Grievance Mechanism.

Such procedures should enable the Project Proponent to expand its own procedures to its Contractors. They should contribute to the Project's integration in its community by enabling dialogue (grievance lodging and communication). They should also reduce and prevent hazards and risks that may trigger occupational health and safety incidents on the Project's workforce and on the Project's communities.

During limestone extraction, chemicals should be used in accordance with the guidelines and management process of Materal Safety Data Sheet (MSDS).

The permit for approval of using explosive materials for blasting is appended in *Annex I*.

A permit to work system is currently adopted by STC which covers works of higher risk works activities including blasting operation and excavation at the limestone quarry. Blasting is registered with the Military and approved based on detailed consideration of safety requirements. Transportation of the explosives to the storage will be in strict compliance with safety requirements and the storage is constructed in compliance with safety requirements of the Ministry of Defence. All explosives are stored as per required regulations. A security guard is posted at the explosives magazine 24 hours per day and the two main keys of the storage are kept and checked by heads of administration and mining departments of STC. The material in-out record is systemically recorded and must be carried out with strict material handling procedures.

In addition, independent occupational health and safety (OHS) auditor and independent environmental and social specialist are engaged by STC to support the development, implementation, monitoring and review of the above procedures in order to improve STC performance on health, safety, social and environment.

It is also recommended that use of temporary accommodation facilities to the west of the cement plant be discontinued as quickly as possible and workers housed at the new accommodation quarters to the south of the cement plant.

8.5.3 Residual Impact Significance

By preparing suitable reviewed procedures and ensuring their implementation throughout the operation phase and relocating the worker housing area, the impact significance from occupational health and safety incidents during operation can be reduced from *moderate* to *minor.*

8.6 COMMUNITY HEALTH AND SAFETY

8.6.1 Potential Impacts

Residents in the two villages may be potentially affected by air quality, water quality and waste management impacts from the operation of the limestone quarry. The air quality modelling undertaken as part of this EIA do not indicate any potential exceedances of applicable standards for ambient air quality and noise at the Kubyin and Pyi Nyaung Villages, primarily due to the separation distance between the source and receptor and also the prevailing wind direction. In addition, STC is upgrading the wastewater and waste management system on site to reduce potential impacts from the limestone quarry.

Regarding the use of explosive materials, a permit to work system is currently adopted by STC which covers works of higher risk works activities including blasting operation and excavation at the limestone quarry. Blasting is registered with the Military and approved based on detailed consideration of safety requirements. Transportation of the explosives to the storage will be in strict compliance with safety requirements and the storage is constructed in compliance with safety requirements of the Ministry of Defence. All explosives are stored as per required regulations. A security guard is posted at the explosives magazine 24 hours per day and the two main keys of the storage are kept and checked by heads of administration and mining departments of STC. The material in-out record is systemically recorded and must be carried out with strict material handling procedures.

The impact magnitude is thus considered to be *small*. The sensitivity of the receptor is considered to be *high* as it relates to human receptors and therefore the impact significance is considered to be *moderate*.

Table 8.19 Assessment of Impacts related to Community Health and Safety during the Operation

Impact	Community health and safety during the operation phase at the limestone quarry.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential negative impact from the Project.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct or indirect on communities.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration of health and safety (community) is the same as the Project duration.				
Impact Extent	**Local**	Regional	International		
	The impact will be on the communities around the Project.				
Impact Scale	Minor				
Frequency	Impacts on health and safety (community) can occur at any time.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is expected to be **small.**				
Receptor Sensitivity	Low	Medium	**High**		
	The receptor sensitivity is considered to be **high** as the Health and safety (community) incidents can range in severity.				
	Negligible	Minor	**Moderate**	Major	Critical

Impact Significance	The impact significance is considered to be **moderate** without further mitigation.

8.6.2 Mitigation

Mitigation measures related to air quality, water quality and waste are presented in *Sections 8.1.3, 8.2.2* and *8.4.2.*

8.6.3 Residual Impact Significance

With proper implementation of mitigation measure, the impact significance on community health and safety can be reduced from *moderate* to *minor.*

8.7 LANDSCAPE AND VISUAL IMPACTS

8.7.1 Potential Impacts

Mining operation at the limestone quarry will change the nature of the existing landscape and visual amenity via clearance of vegetation to bare land and an overall lowering of the mountain range.

8.7.2 Landscape Impact

The landscape characters that may be affected by the Project elements are listed in *Table 8.20* with their sensitivity to change.

Table 8.20 Landscape Character Affected by Project Elements

Landscape Character	Description	Photo	Sensitivity to Change
Karst	This refers to the limestone outcrop ranging from the north to south of the AOI; a section of the outcrop falls within the project limestone concession. The limestone outcrop is part of the Shan plateau series of limestone ranges.		**High** since karst forest takes a long time to recover from disturbance. Any changes are essentially permanent in nature

Considering the sensitivity of the landscape character, potential impacts from different Project components are discussed as follows:

Limestone quarry – through the mining operation, karst vegetation will be cleared and the overallheight of the limestone range within the STC concession will be lowered. Potential impacts to the karst landscape will occur to the quarry life of around 37 years and cover an area of 354 ha. While

this is considered a relatively small portion of the karst landscape in the area which cover 500 km x 300 km, changes to this section will be permanent and noticeable from viewpoints to the west. Overall, the magnitude of change is considered small and impact significance considered **moderate** given the high sensitivity of this landscape.

8.7.3 Visual Impact

In addition to landscape impact as assessed above, operation of the Project will result in a change to the visual character of the landscape. Visually sensitive receivers (VSRs) that may be affected by the change included:

Inhabitants of villages - the residents of the villages, such as Kubyin and Pyi Nyaung villages, have a high level of association with the landscape, particularly the surrounding agricultural land and forest. The agricultural land and forest are accessible to these people, and it is likely that they place great value on these landscape due to the contribution they make to livelihoods in the area. Overall given that this is their home, as residential VSRs they are regarded as having high sensitivity to changes to the visual aspect of the area.

Travellers along the road and users of the forest –travellers passing along the access road to the cement plant and the bypass road to Kubyin village as well as users of the forest near the mudstone and limestone quarries may have transient views of the quarries. Travellers in Thazi Township may have transient views of the transmission line. Given the transient nature, their sensitivity is considered to be low.

For the limestone quarry, they are not expected to be visible to the inhabitants of Kubyin and Pyi Nyaung village with the hills between the villages and these Project elements. As such, no visual impact would occur for these VSRs from the quarry. For travellers and forest users, they may see the quarry during their travel along the road or their stay in the forest. The changes due to the mining of the quarry are considered small are discussed above. As such, potential visual impacts caused by the limestone quarry are considered of **negligible** significance.

Table 8.21 Impact Assessment Summary – Landscape and Visual Impact

Impact	Landscape and visual impacts from the limestone quarry during operation			
Impact Nature	Negative	Positive	Neutral	
	The impact on landscape character and visual amenity is considered negative			
Impact Type	Direct	Indirect	Induced	
	Potential impacts are likely to be direct impacts.			
Impact Duration	Temporary	Short-term	Long-term	Permanent
	The impact will be ongoing during operations and is a permanent change.			
Impact Extent	Local	Regional	International	
	The impact is expected to be local, limited to the Project footprint and VSRs in the vicinity.			
Impact Scale	Small considering small area affected in comparison to surrounding area in the vicinity.			

Impact	Landscape and visual impacts from the limestone quarry during operation				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	The magnitude of change is considered small.				
Receptor Sensitivity	Low		Medium		High
	Karst landscape – high Travellers along the road and users of the forest - low				
Impact Significance	Negligible	Minor	Moderate	Major	Critical
	The significance of this impact is not higher than **Moderate**.				

8.7.4 Mitigation Measures

The following mitigation measures will be applied to the Project:

- The design for earthworks and cut and fill should ensure that it is blended with the landscape as much as possible;
- Cut and fill slopes as well as areas disturbed by operation activity are to be suitably top soils and revegetated as soon as is possible after shaping;
- All existing large trees, if any, that fall outside the earthworks areas must be retained;
- Felled trees should be replaced where possible; and
- Laydown areas which will no longer be required for the operation stage are to be landscaped with suitable vegetation after the operation work is completed.
- Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring.
- All habitat clearance during quarrying/mining operations is to be clearly marked prior to excavation.

8.7.5 Residual Impact Significance

With implementation of the mitigation measures, residual landscape and visual impacts from the limestone quarry are expected to be of **negligible** to **minor** significance.

8.8 SOIL QUALITY

8.8.1 Potential Impacts

Impacts to soil quality in the vicinity of the limestone quarrry may arise from deposition of dust from the limestone quarry operation as well as soil erosion from limestone quarry.

For impacts to soil related to dust deposition, as presented in *Section 8.1* emissions of particulate matters from the Project will have a negligible impact at Kubyin Village and Pyin Nyaung Village which are the main public residential areas near the limestone quarry. As such, it is not expected that the emission will have any impacts to soil quality at these areas where the land may be used for cultivation. While it is noted that some residents have expressed concerns about dust deposition, the source of deposition within Kubyin and Pyi Nyuang Villages is very likely to be from within the villages themselves (eg vehicle movements, wood stoves and lime kilns in Pyi Nyuang village). Soil may be washed away by runoff from the limestone quarry. As presented in *Section 8.2*, STC is implementing control measures at the limestone quarry to divert runoff and reduce runoff from exposed earth. The overall impact significance resulting frm the project is considered to be **negligible**.

Table 8.22 Soil Quality Impact Assessment

Impact	Deterioration of soil quality due to dust deposition and soil erosion from limestone quarry.				
Impact Nature	**Negative**	Positive	Neutral		
	Pollutants entering soil would create a negative impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact would be directly upon soil resources and on the residents of Kubyin Village and Pyin Nyaung Village that use the land for cultivation.				
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
	If not managed, the impact would occur over the life of STC's operations.				
Impact Extent	**Local**	Regional	International		
	The extent of the impact would be limited to the land within and adjacent to the site.				
Impact Scale	Moderate				
Frequency	Dust deposition is expected to be throughout quarry operation.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is negligible from dust deposition.				
Receptor Sensitivity	Low	Medium	**High**		
	The receptor sensitivity is **High** at Kubyin Village and Pyin Nyaung Village where land is used for cultivation.				
Impact Significance	Negligible	Minor	Moderate	Major	Critical
	The significance is **negligible**.				

8.8.2 Mitigation Measures

Please refer to *Section 8.1* for relevant mitigation measures on dust deposition and *8.2* for runoff.

8.8.3 Residual Impact Significance

Residual impact to soil quality due to dust deposition is considered to be of **negligible** significance.

9 IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURES: LAND USE AND ACQUISITION REVIEW

This section describe the use of the site by local residents based on information provided by STC, observations on site and consultation with village leaders and a sample survey of 50 households.

STC's limestone quarry concession is 600 acres (25 years) occupying the ridgeline to the east of the cement plant. At present, the company has quarried one of four hills. The quarry will be expanded first to the south of the existing worked area, followed by the hill to the north. There was no physical resettlement at any of the sites currently occupied and none will be required for the expansion. All land occupied and to be occupied in the future was leased from the Forest Department (now part of MONREC). STC has applied to the Forest Department to offset the loss of forest cover with an area equal to 20% of the limestone concession that is required. This land has not yet been allocated.

The quarry area itself was previously inaccessible and hence operations of the limestone quarry did not result in impacts to the livelihoods of local residents.

10 CUMULATIVE IMPACT ASSESSMENT

10.1 METHODOLOGY AND APPROACH

Cumulative impacts encompass impacts that result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted. The IFC (2012) defines cumulative impacts as those generally recognised as important on the basis of scientific concerns and or concerns from affected communities[1].

Cumulative impacts in this section refer to the additional impacts that may be generated by other developments or activities in the vicinity of the Project site, that when added to the impacts of the operation of the proposed Project combine to cause a greater impact. Such impacts may arise due to spatial overlap (e.g. overlap in spatial extent of air quality changes) or temporal overlap (e.g. noise impacts caused by operation activities at the same time from different sources).

10.2 CUMULATIVE IMPACT ASSESSMENT

The Project is part of a series of limestone-extraction development projects scattered around Pyi Nyaung village, including projects led by YCDC Companies, Asia World and Htoo south of Pyi Nyaung village. These companies, along with the Project company, have sponsored the upgrading of the Yebauzong substation. The Forest Department and other relevant authorities are in charge of granting forest land and operational leases for each project.

The development of this Project is at the most advanced stage of any of the planned neighbouring projects, being the only one in operations in the valley leading to Kubyin village. At this time, there is limited information on the other planned projects for the area and, as such, the cumulative impacts from subsequent projects should be considered as and when their development is confirmed. Any cumulative impacts discussed at this stage would be speculative and based on hearsay of projects that are yet to be confirmed by the relevant authorities. Such impacts might be expected to be similar in nature as the ones discussed in this Environmental and Social Impact Assessment report, in particular on air quality and biodiversity. Likewise, the mitigation measures, including the planned environmental and social management procedures associated with the Project, are expected to contribute to mitigating the Project's contribution to potential cumulative impacts. In particular, the Project is in the process of defining operational stakeholder engagement activities which will include an information centre and suggestion boxes, to enable ongoing communication with the local communities. The Project company has also already collaborated with the

[1] IFC Performance Standards on Environmental and Social Sustainability, January 2012, International Finance Corporation, World Bank Group

neighbouring companies in sponsoring the upgrading of the Yebauzong substation. It is recommended that such communication between neighbouring development projects be maintained.

In addition to the above, it should be noted that cumulative impact caused by the limestone quarry expansion Project and the nearby STC cement plant and mudstone quarry have been considered as appropriate in the assessment presented in *Section 8.1* and *Section 8.3* (e.g. for air quality impacts as well as biodiversity for which a BAP was developed to mitigate the cumulative biodiversity impacts caused by the cement plant and quarries).

STC is committed to undertake the cumulative impact assessment should information of nearby projects become publicly available.

11 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Through a systematic assessment, the EIA has identified a number of significant environmental and social impacts that are predicted to result from the operation of the Project. In order to manage and mitigate these impacts, a range of measures have been developed to reduce the overall residual impacts to acceptable levels and as low as reasonably practicable. These measures are contained within this Environmental and Social Management Plan (ESMP) that will be used by STC to implement and track the effect of these management and mitigation measures included in the EIA.

11.1 OBJECTIVES

The key objectives of this ESMP are to:

- Collate the various mitigation and management measures developed throughout the EIA into a single point;
- Identify all of the detailed management plans which will need to be developed for implementation throughout the operation phase of the Project;
- Define monitoring requirements to determine the efficiency of all mitigation and management measures; and
- Provide clarity to all stakeholders as to what impacts have been identified, how they will be mitigated and managed, and through what means.

11.2 SCOPE OF THIS ESMP

The scope of this ESMP covers operation phase of the Project, which have the potential to affect, positively or negatively, the environment and communities in which the Project will operate.

As required by this ESMP, various management plans will be developed and implemented for each specific phase of the Project. The responsibility for the implementation of these plans will lay variously with the STC and contractors. It is noted that this is only a framework ESMP into which the full range of management and monitoring activities will eventually fit into.

11.3 SUMMARY OF IMPACTS AND MITIGATION MANAGEMENT MEASURES

A summary of mitigation measures identified for the operation phase of the Project is presented in *Table 11.1*. This also identifies lead responsibility for implementing the mitigation measures. Many of the mitigation measures are associated with good operation and/or housekeeping practices.

STC will be responsible for ensuring that the mitigation measures in the ESMP are implemented throughout the life span of the Project.

It is estimated that the overall annual budget for implementing the EMP is between USD $150,000 and $200,000.

11.4 DETAILED MANAGEMENT PLAN

Based upon the outcomes of the EIA, detailed management plans are required to guide STC and its contractors in the implementation of all mitigation and management measures. This is essential to ensure that the key outcomes of the impact assessment process are put in place throughout the life of the Project, and their overall efficacy tracked. These detailed management plans will be used by contractors to develop their own management plans.

As identified with the summary of impacts and mitigation and management measures, the following detailed management plans are considered necessary to effectively implement the outcomes of the EIA throughout the life of the Project:

- Contractor Management Plan;
- Biodiversity Action Plan;
- Spill Response Plan;
- Waste Management Plan;
- Mine and Quarry Rehabilitation Plan;
- Environmental and Social Monitoring Plan;
- Stakeholder Engagement Activities and Grievance Mechanisms;
- Hazardous Material Management Plan;
- Incident Reporting and Investigation Procedure;
- Stormwater Management Plan;
- Sewage Management Plan;
- Air Pollution Abatement and Control Plan;
- Occuptional Health and Safety Plan;
- Community Health and Safety Plan;
- Emergency Response Plan; and
- Community Development Plan.

Since mid-2017, STC has engaged third party consultants to provide environmental and social support for the operation of the Project. This includes support on the development, implementation and monitoring of the Environmental, Occupational Health and Safety and Social Management System and the above management plans for the Project, which are prepared and will be updated on a regular basis considering any changes in circumstances.

Table 11.1 Environmental and Social Management Plan of the Project

Item No.	Affected Aspect	Affected Area	Potential Impacts	Proposed Mitigation Measures	Implementation Schedule	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements
B	**Operation Phase**							
1	Air Quality	Limestone Quarry	Dust impacts	• AQ4 is worker accommodation associated with the existing cement plant operations and this area shall be relocated further from the cement plant boundary to reduce potential exposure to PM10 from the cement manufacturing process. The modelling results indicate that relocating worker accommodation beyond a distance of 500m in any direction from the plant would achieve satisfactory air quality. Ideally, accommodation quarters should be located to the south of the cement plant, which is upwind of the prevailing wind direction. Modelling indicates that worker accommodation areas AQ5a and AQ5b to the south of the plant (upwind) are not exposed to unacceptable adverse air quality impacts as a result of the Project and therefore do not need to be relocated. • Water suppression should be used on unpaved roads and work areas in dry and windy conditions; • Storage of dusty materials (i.e. stockpiles) should be enclosed or operated with efficient dust suppression measures; • Stockpile heights should be kept to a minimum; and • Drop heights during loading and transfer of materials should be minimized and shielded against the wind.	Operation	STC Environmental Manager	STC HSSE Department Head	Monthly Report
2	Waste Management	Limestone Quarry	Waste Management	• A comprehensive waste management plan (WMP) for the Project has been developed (Annex F). • The existing landfill is not lined and should be only used for inert (non-reactive) and non-hazardous waste only.	Operation	STC Environmental Manager	STC HSSE Department Head	Monthly Report WMP
3	Biodiversity	Limestone Quarry	Permanent and temporary loss of habitat and fragmentation and edge effect	The following mitigation is required for permanent and temporary loss of habitat • Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species as appropriate. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring. • All habitat clearance during quarrying/mining operations is to be clearly marked prior to excavation. • A Wildlife clearance protocol (Annex D4) is to be applied during all operations that clear Critical Habitat and Natural Habitat. • Education and awareness activities are to be undertaken with local people to provide information regarding illegal logging controls. • Regular patrols (at least every month) of the Project boundary will be undertaken to identify any incursion by local people into the Project Area and surrounding forested area. • Education of staff and workers of all rules, regulations and information concerning the restriction clearing outside of the Project footprint is to occur; • Operation Contractor will schedule and implement routine inspection program throughout operation period to monitor clearing extent; • Use of the access road should be restricted to operation vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and wood products. The following mitigation is required for fragmentation and edge effects: • Measures regarding managing dust, noise, vibration recommended in this EIA are to be applied during operations in Critical Habitat and Natural Habitat.	Operation	STC Environmental Manager	STC HSSE Department Head	Monthly Report

Item No.	Affected Aspect	Affected Area	Potential Impacts	Proposed Mitigation Measures	Implementation Schedule	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements
				• Design of lighting will be directed away from vegetated areas and habitats. Upward lighting will be avoided and lights will not be left on after hours when not required. The following additional mitigation measures will be applied during operation to reduce impacts from the degradation of habitats: • Wheel wash bays will be installed at the guardhouse at the Limestone Quarry to remove dirt and plant material from vehicle wheels prior to entering and leaving the Project Area. • Invasive species within Natural Habitats should be eradicated where possible. Appropriate use of herbicides may be used to control invasive species within the Project Area in accordance with the safe use and label directions of the herbicides. • Monitoring of invasive species is to occur within the Project Area on an annual basis. New infestations identified are to be controlled. The following additional mitigation measures will be /is applied during operation to reduce impacts to species: • A Biodiversity Action Plan (*Annex E*) is required for Critical Habitat triggers. This plan is prepared to outline measures to be applied to manage these species within the Project Area and Area of Influence. The management plan will address key threats to the species, including hunting, poaching, illegal logging, pollution and habitat destruction. Speed is to be limited to 40 km/hr for vehicles on company operated roads to minimise potential for fauna strike; • Commitment will be made to raise awareness of values of important species and habitat areas to the work force and arrangements will be made for restriction of poaching and forest product collection by staff. Hunting wild animals will be strictly prohibited for all staff. • Non-project related vehicles will not be permitted to enter company-operated roads during operation.				
4	Surface Water Quality	Limestone Quarry	Surface runoff	• Construction of a dedicated drainage network to intercept and divert runoff from the limestone quarry to an appropriately sized and maintained sedimentation pond to allow adequate retention time for suspended solids to settle; • After passing through sediementation ponds, runoff from limestone quarry may be discharged to the wetland created by STC via a weir to remove suspended solids before entering the wetland; • Baffles or other measures to reduce the velocity of runoff down hill slopes should be installed to minimise scouring; and • Exposed areas and overburden dumps should be revegetated as quickly as possible.	Operation	STC Environmental Manager	STC HSSE Department Head	Monthly Report
5	Landscape and Visual Amenity	Limestone Quarry	Landscape and Visual	• The design for earthworks and cut and fill should ensure that it is blended with the landscape as much as possible. • Cut and fill slopes as well as areas disturbed by operation activity are to be suitably top soils and revegetated as soon as is possible after shaping. • All existing large trees, if any, that fall outside the earthworks areas must be retained; • Felled trees should be replaced where possible. • Laydown areas which will no longer be required for the operation stage are to be landscaped with suitable vegetation after the operation work is completed. • Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring. • All habitat clearance during quarrying/mining operations is to be clearly marked prior to excavation.	Operation	STC H&S Manager	STC HSSE Department Head	Monthly Report Monitoring Report

Item No.	Affected Aspect	Affected Area	Potential Impacts	Proposed Mitigation Measures	Implementation Schedule	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements
6	Occputional Health and Safety	Limestone Quarry	OHS impacts to works hired by the Project Proponent and contractors	• Review and update of the Project Proponent's existing procedures and the design and implementation of additional procedures related to OHS. • Independent occupational health and safety (OHS) auditor and independent environmental and social specialist are engaged by STC to support the development, implementation, monitoring and review of the above procedures in order to improve STC performance on health, safety, social and environment. • Safety officer from STC will also supervise the safety performance of the Contractors.	Operation	STC H&S Manager	STC HSSE Department Head	• Incident Reporting Procedure; • Contract Health and Safety Procedure (including Occupational, Environmental Health and Safety with co-benefits for the community health and safety); • Emergency Response Procedure; • Storage and Handling of Hazardous Material Procedure; • Waste Management Procedure; and • Worker Grievance Mechanism.
7	Soil Quality	Limestone Quarry	Soil Quality	• Please refer to Item 1 of operation phase control for air quality to prevent soil contamination caused by dust deposition. • Please refer to Item 4 of operaiotin phase control for runoff from limestone quarry.				
C	**Decommissioning Phase**							
1	As per Operation Phase	As per Operation Phase	As per Operation Phase	• As per Operation Phase	End of Operation Phase	STC Environmental Manager, Social Manager and H&S Manager	STC HSSE Department Head	To be determined

11.5 ENVIRONMENTAL AND SOCIAL MONITORING PROGRAMME

Monitoring is a means of verifying the effectiveness of the management and mitigation measures contained within the management plans listed above. Key objectives of the monitoring process are to:

- Confirm effectiveness of management and mitigation measures;
- Ensure compliance with Applicable Standards (i.e. IFC Performance Standards, IFC EHS Guidelines and Myanmar National Environmental Quality (Emissions) Guidelines);
- Monitoring the status of, and impacts on, identified sensitive receptors;
- Provide an early warning that any of the control measures or practices are failing to achieve their desired performance and ensure changes can be implemented to remedy these practices;
- Determine whether environmental and social changes are attributable to Project activities, or as a result of other activities or natural variation; and
- Provide a basis for continual review and improvements to Project design and execution.

11.5.1 Performance Indicators and Monitoring Schedule

Physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator has been prepared for all phases of the Project and is presented in *Table 11.2*.

This includes the tentative parameters to be measured, methods to be utilised, sampling locations, frequency of measurements, detection limits and responsibilities for implementation and supervision.

It is to be noted that the detailed and specific monitoring measures will be developed and included within the Environmental Monitoring Plan. The monitoring components will be refined and finalised during plan development.

Impact monitoring will be undertaken during the life of the Project to verify the predicted levels of residual impacts from the Project and the effectiveness of the various management plans and mitigation measures.

STC will prepare an Environmental Monitoring Report and submit to the Ministry of Natural Resources and Environmental Conservation (MONREC) in every six months as per the EIA Procedure requirements. Information related to the Project will be reported to the community on a biannual basis.

Table 11.2 Environmental and Social Monitoring Programme (Operation Phase)

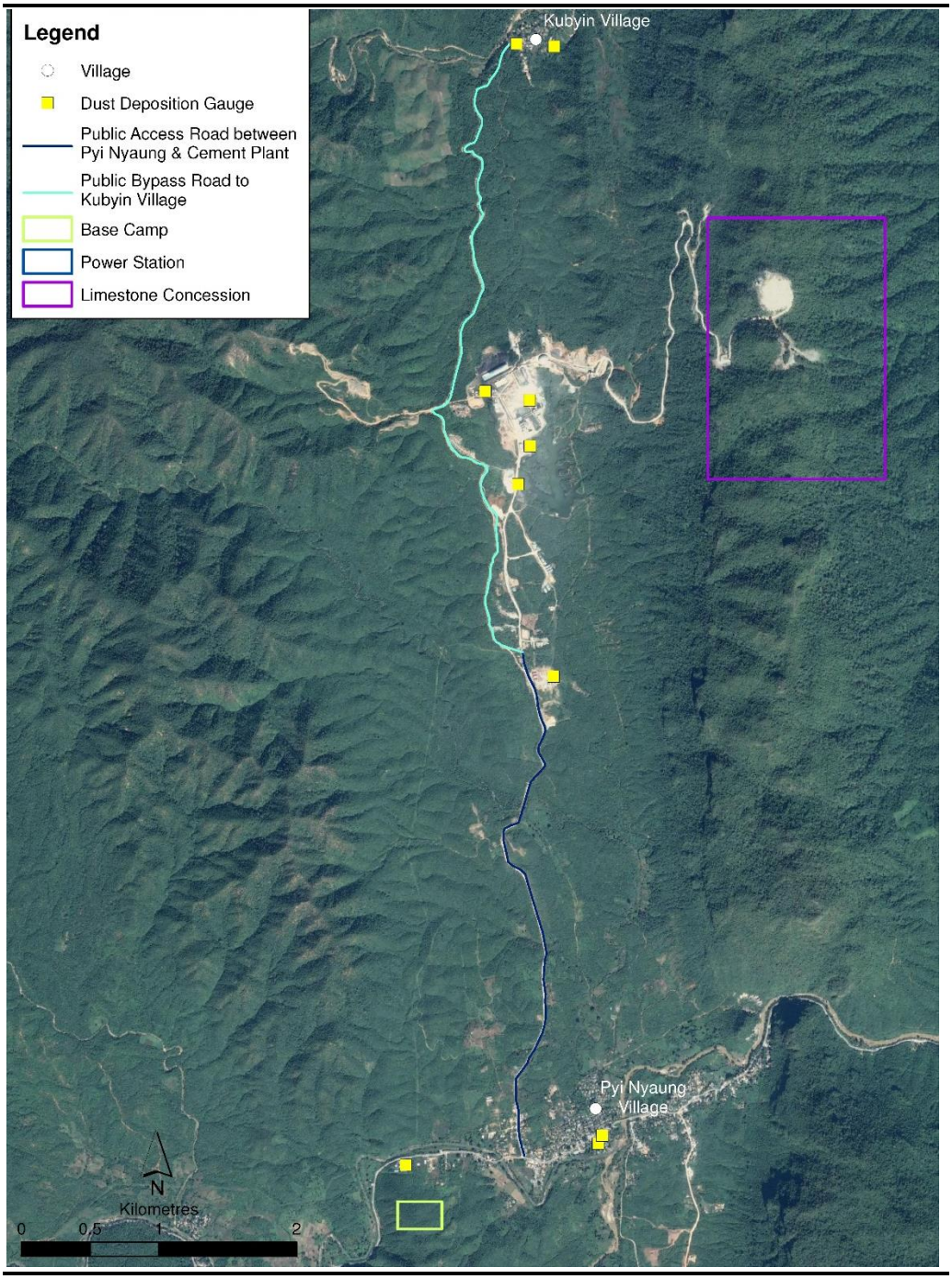
Project Stage/ Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Operation / Limestone Quarry	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP.	Project activity areas	Visual inspection of all active work areas and inspection of records	Weekly	HSE Team of Appointed Contractor and STC HSSE Department Head and Environmental Manager
Operation / Limestone Quarry	Dust impacts	Dust deposition	Cement Plant, Kubyin and Pyi Nyaung Villages (*Figure 11.1*)	Dust deposition gauge	Monthly	STC HSSE Department Head and Environmental Manager
Operation / Limestone Quarry	Air Quality Impacts at ASR	Check compliance with levels specified in Myanmar National Environmental Quality (Emission) Guidelines (2015) for NO_2, SO_2, $PM_{2.5}$, and PM_{10}.	AQ1 (worker accommodation), Kubyini Village and Pyi Nyaung Village (*Figure 5.1*)	Standard analytical methods	Every 6 months, once during dry and once during wet season.	STC HSSE Department Head and Environmental Manager
Operation / Cement Plant	Discharge of treated wastewater and runoff.	Check compliance with Myanmar National Environmental Quality (Emissions) Guidelines for Construction Materials Extraction (for BOD, COD,	Sampling at: 1. Kubyin River 2. Reservoir 3. Myit Tha Stream 4. Pyi Nyaung River	Standard analytical methods	Monthly	STC HSSE Department Head and Environmental Manager

Project Stage/ Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
		TSS, oil and grease, pH, total coliform bacteria, total nitrogen, total phosphorus)	5. Two selected treatemnet water discharge points from the limestone quarry.			
Operation / Cement Plant	Waste Management	1. Volumes of waste (per waste stream – i.e. hazardous and non-hazardous) disposed of at non-hazardous solid waste management facility (on-site / off-site) and/or incinerated and not reused, recycled or reclaimed; 2. Volume of waste (per waste stream – i.e. hazardous and non-hazardous) reused, recycled or reclaimed; 3. Percent change of volume of waste (per waste stream – i.e. hazardous and nonhazardous) produced compared to previous year; 4. Percent change of volume of waste reused, recycled, reclaimed and disposed of	Cement Plant / Limestone Quarry	Waste volume records	Quaterly	STC HSSE Department Head and Environmental Manager

Project Stage/ Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
		compared to the previous year; 5. Volume of contaminated soils generated and treated on-site; 6. Description of implementation of segregation of waste streams (recyclables, general waste and hazardous waste): excellent / good / not good; 7. Reports of hazardous waste being mixed with general waste and vice versa: number; and 8. Reports of illegal dumping of wastes: number.				
Operation / Cement Plant	Occupational Health and Safety	Monitor medical check data of staffs Monitor incident related to: 1. Blasting 2. Air quality 3. Heat 4. Noise and Vibration 5. Physical Impact 6. Chemical Usage 7. Natural Diaster	Limestone Quarry	Medical check Review of incident statistics	Before joining STC, workers will undertake a pre-employment medical check. For all workers, medical check will be undertaken every 36 months. For workers engaged in noisy works (e.g.	STC Medical Doctor STC HSSE Department Head

Project Stage/ Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
					hammering, grinding of raw materials), workers potentially exposed to radiation, welder and industrial vehicle drivers, medical check will be undertaken every 12 months. Quarterly review of incident statistics related to blasting, air quality, heat, noise and vibration, physical impact, chemical usage and natural disaster.	
Construction and Operation / Cement Plant	Biodiversity	Please refer to *Table 8.1* and *Table 8.2* of *Annex E.*	Please refer to *Table 8.1* and *Table 8.2* of *Annex E.*	Please refer to *Table 8.1* and *Table 8.2* of *Annex E.*	Please refer to *Table 8.1* and *Table 8.2* of *Annex E.*	Please refer to *Table 8.1* and *Table 8.2* of *Annex E.*

Figure 11.1 Locations of Dust Deposition Gauges



11.5.2 Reporting Mechanism for Environmental and Social Monitoring Programme

A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will provide a mechanism to ensure that the measures proposed in the Project's ESMP are implemented.

STC will finalise the format and frequency for reporting on the status and progress of environmental and social monitoring. The format will be designed to meet all the compliance conditions associated with the local and international requirements. The contractor will be required to submit the duly completed reporting form on the agreed frequency to STC.

As per the EIA procedure (Notification No (616/2015) Chapter 9 Section 108), the Project Proponent shall submit monitoring reports to the Ministry on a frequency prescribed by the Ministry (at least every six (6) months).

11.6 INSTITUTIONAL SETTING AND IMPLEMENTATION ARRANGEMENTS

11.6.1 Environmental Management Organisation

STC is committed to providing resources essential to the implementation and control of the ESMP. Resources include the appropriate human resources and specialised skills. The structure for the organisation responsible for environmental and social management and implementation of the ESMP is depicted in *Table 11.3*.

Table 11.3 Environmental Management Organisation Roles and Responsibilities

Position	Responsibility
STC	
General Manager (Cement Plant)	Oversee and coordinate all activities pertaining to the Project; ultimately responsible for environmental and social issues. Ensure delivery by the asset of its environmental, social and operational targets. Ensure effective communication with all stakeholders.
HSSE Department Head supported by Environmental Manager, Social Manager and Health and Safety Manager	Technical aspects of the Project including supervision during operation. Ensuring that the Project and contractors operate in accordance with applicable regulatory environmental and social requirements and plans. Monitor implementation of environmental and social protection measures.
Community Liaison Officer	Liaise with local communities and government regulators on the project's behalf. Implement environmental and social awareness and education programmes with communities.
Contractor	
Project Manager	Responsible for subcontractor technical performance and compliance.

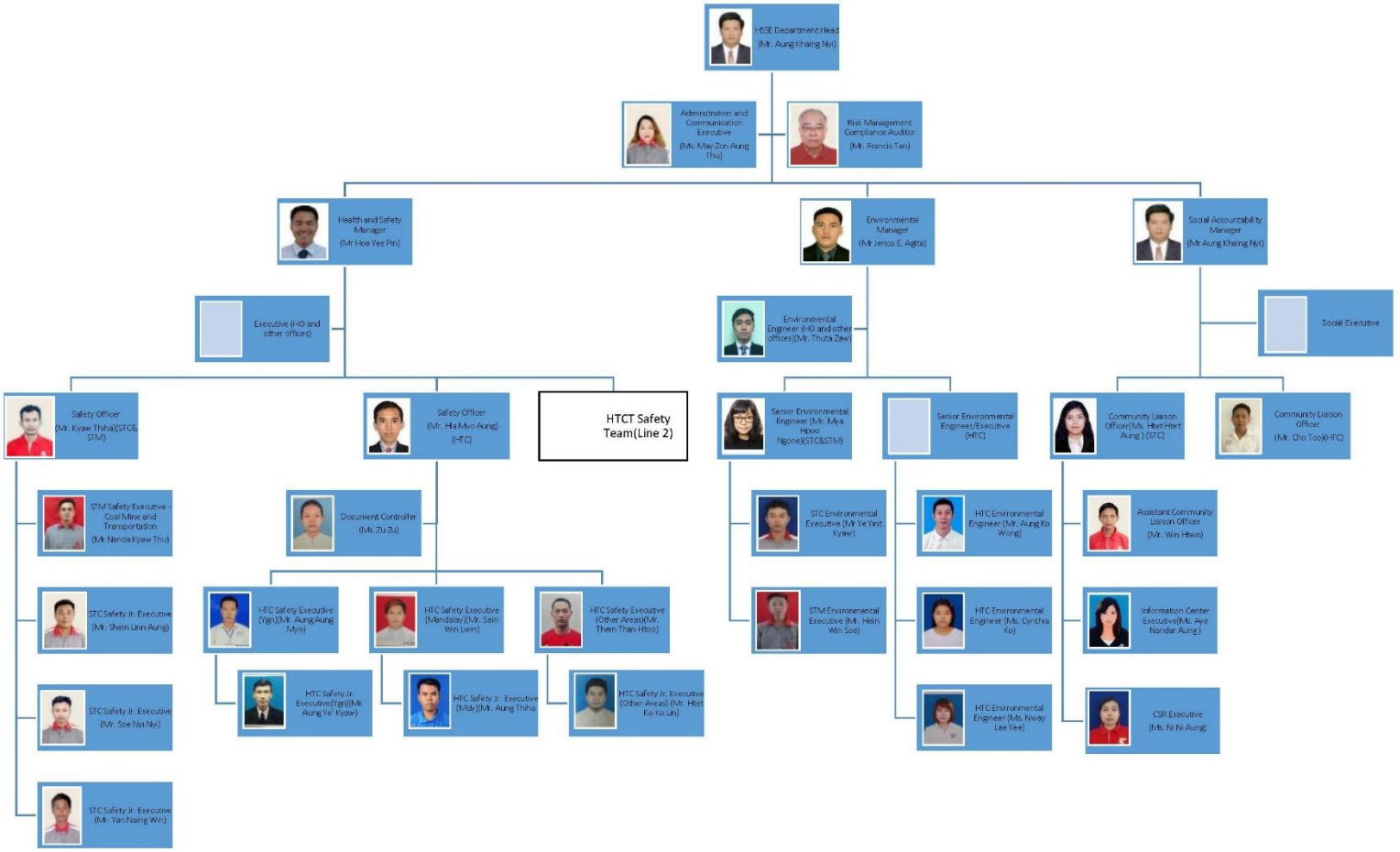
HSE Manager	Ensure that environment and social regulatory requirements are met and that ESMP requirements are properly implemented.

11.6.2 Operation Phase

The operation team of STC will be responsible for implementation of the associated mitigation measures during the operation phase. STC's staff, specifically the HSSE Department Head, will monitor the implementation of these mitigation measures. This will be achieved through implementation reviews conducted by the HSSE Department Head by means including operation meetings, review of operation log book, monthly and other operation reports etc. Records of these minutes of the meeting, monthly reports and special reports on implementation of the mitigating measures will also be maintained and available for review by the Project management. It is suggested to identify documents and records that require templates and accordingly suitable templates should be developed, which should include but not limited to policies, procedures and work instructions, meeting minutes, monitoring results, training attendance records, emergency contract lists, action plans etc. Further, all templates should be communicated to all potential users. All these records will be archived at the Project office and will be maintained by the HSSE Department Head. All documents and records shall be archived with a unique identifier so that they can be distinguished from any other material and can be easily retrieved.

The following highlights STC's current organisation chart of its health, safety, social and environmental department:

Figure 11.2 STC HSSE Organisation Chart (February 2018)



11.7 TRAINING

Suitably qualified in-house/external environmental expert will be engaged by STC to develop and deliver the relevant training programmes on operation phase environmental and social monitoring and reporting. The training will include the following topics:

- Environment, Health and Safety Policy of the contractor;
- Environment and fundamentals of environmental pollution in relation to the Project;
- HSE management plans prepared by the Contractor;
- Do's and Don'ts for the workers;
- Safety procedures and guidelines;
- Internal reporting and response system;
- Hazardous chemicals and waste handling;
- Environmental conservation and awareness; and
- Limestone extraction (including but not limited to: management of explosive; emergency response related to accidental explosion; incident related to limestone crushing etc.)

In addition, specific training will be provided to the team involved in environmental and social monitoring and reporting, which will include:

- Applicable environmental and social guidelines and standards;
- Sampling site selection guidelines in line with environmental monitoring plan;
- Sample collection, storage, transportation and analysis procedures;
- Solid and hazardous waste management;
- Quality assurance and quality control; and
- Environmental monitoring report preparation.

The training will help in capacity building and implementation of the ESMP during the operation phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project and STC will set aside a dedicated budget.

11.8 UPDATE OF THE ESMP

This ESMP will be updated, revised and reviewed internally on a regular basis to ensure its effectiveness in monitoring the environmental and social performance of the Project. The ESMP of the Project will be reviewed on an annual basis.

Furthermore, in the event of an unanticipated impact and design change with respect to the Project standards (including Myanmar Government and IFC requirements), the ESMP would be updated as necessary.

12 STAKEHOLDER ENGAGEMENT

As a part of the EIA process, consultation was carried out with the indirectly and directly affected population in six villages within the Project's Area of Influence (AOI), Non-Governmental Organisations (NGOs) and Civil Society Organisations (CSOs) working in areas of interest to the Project and Myanmar Government representatives.

ERM undertook EIA scoping visits and preliminary consultation with Village Tract leaders in November 2016 and used the results to guide the consultation activities for the remainder of the EIA.

ERM visited the Project Site in January 2017 to consult with stakeholders, explaining the project and administering questionnaires to individuals and groups. The consultation served the dual purpose of informing the public about the potential impacts of the Project and seeking community views on issues. Following the consultation, the Draft EIA was prepared taking into account views of the community collected in January 2017 and was disclosed to the public in April 2017 [1].

In July to November 2017, further consultation on the Draft EIA was undertaken. The opinions collected informed the finalization of this EIA Report.

This section summarises the stakeholder engagement as briefly described above and explains how stakeholder views' were used to inform the EIA.

12.1 OBJECTIVES OF THE STAKEHOLDER ENGAGEMENT

The objectives of stakeholder engagement during the EIA were to:

- Identify stakeholders and communities potentially affected by Project activities;
- Update stakeholders about the expansion Project; and
- Engage with potentially affected groups and individuals to understand their views, concerns and perceptions in order to inform the EIA.

12.2 OVERVIEW OF CONSULTATION UNDERTAKEN

In summary, the following consultation was undertaken for the Draft EIA:

- Consultation with village leaders in Pyi Nyaung and Kubyin during Scoping in November 2016.
- Community briefings in Pyi Nyaung and Kubyin villages in January 2017.

[1] Shwe Taung Cement Company APACHE Website Disclosure page (accessed at https://www.apachecement.com/category/activities/disclosure/ on 1 February 2018)

- 50 Household surveys in Pyi Nyaung and Kubyin villages in January 2017.

- Focus Group Discussions with women and farmers in Pyi Nyaung and Kubyin villages in January 2017.

- Consultation with Flora and Fauna International and Wildlife Conservation Society concerning the establishment of biodiversity offsets in January 2017.

- Consultation with MONREC and representatives of the Forest Department responsible for management of the two candidate Biodiversity Offset Sites.

Concerns raised by stakeholders were incorporated into the Draft EIA Report as appropriate to assess the Project impacts and to propose mitigation measures.

Disclosure of the Draft EIA Report was undertaken to obtain stakeholder views on finding of the Draft EIA. This disclosure included:

- Posting on the Draft EIA on STC website and IFC's disclosure portal in April 2017;

- A public forum held on 18 July 2017 at the Novotel hotel in Yangon attended by about 85 representatives of the Government, the public, CSOs, businesses, and other groups. This was followed by a closed-door meeting with several community and CSO representatives to further discuss Project related issues in detail;

- A meeting in Thazi Township with local communities held on 21 July 2017; and

- A meeting in Pyi Nyaung Village with local communities held on 22 July 2017.

Regarding the Biodiversity Action Plan (BAP) prepared to accompany this EIA, government agencies and NGOs were consulted.

ERM conducted consultation with Myanmar Government officials and NGOs in Myanmar in June 2017, including:

- Flora and Fauna International (FFI), Myanmar;

- Wildlife Conservation Society (WCS), Myanmar;

- International Union for the Conservation of Nature (IUCN) (Bangkok Office);

- Myanmar Ministry of Environmental Conservation and Forestry (MONREC);

- Mahamyaing Wildlife Sanctuary Forest Office; and
- Panlaung-Pyadalin Cave Sanctuary Forest Office.

Additional public consultation occurred in November 2017 with the following NGO parties:

- Flora and Fauna International Myanmar Office (face-to-face);
- World Wildlife Fund (WWF) (by email);
- Wildlife Conservation Society (WCS) (by email);
- International Union for the Conservation of Nature (IUCN) (by email); and
- Myanmar Centre for Responsible Business (MCRB) (face-to-face).

Written comments on the BAP were received from FFI, WWF and WCS.

Consultation in November 2017 also occurred with the following Myanmar Government representatives:

- Nature and Wildlife Conservation Division of MONREC (NWCD);
- Ministry of Mines; and
- Forestry Department of MONREC.

Stakeholder feedback obtained on the Draft EIA Report of the Project was taken into account in finalising the Final EIA Report. The Final EIA Report will be disclosed both on STC website and a summary in Myanmar language will be made available to local communities at the community centre in Pyi Nyaung.

12.3 DISCLOSURE AND STAKEHOLDER CONSULTATION OF THE PROJECT FROM NOVEMBER 2016 TO JANUARY 2017

In November 2016, an EIA scoping site visit was undertaken at the Project Area in Mandalay. The purpose of the visit was to identify potential stakeholders of the Project to inform the subsequent disclosure and stakeholder consultation plan of the Project which were conducted in January 2017.

In January 2017, community meetings were arranged by STC in collaboration with the Township General Administration Department Authorities and Village leaders. The purpose of these briefings was for STC to provide an update on the Project and for ERM to describe the processes for consultation and baseline studies. The community briefings included a question and answer session for the communities to express their views on the Project and associated environmental and social impacts.

Socio-economic data was collected through community meetings, household surveys and face to face discussions with stakeholders. The data was used to understand current socio-economic conditions in the Area of Influence of the Project, historical impacts associated with the construction of the limestone quarry as well as potential issues associated with the ongoing operation of the Project. Special attention was given to potentially vulnerable groups such as women.

12.3.1 Household Surveys

Household (HH) survey questionnaires were used to gather data and solicit views about the Project from the communities around the Project Area to inform the EIA.

Prior to conducting HH surveys, an introductory meeting was convened in the host community to introduce the purpose of the consultation. Each community consultation event consisted of an update of the project by Shwe Taung followed by a survey of households (selected at random) in the vicinity of the Project footprint.

A total of 50 useable household surveys, 2 surveys of Village leaders, and 6 group discussions were completed across 2 villages that were deemed potentially most impacted by the Project. The surveys and discussions bore particular focus on the livelihoods of women and farmers. The details of the surveys conducted are in *Table 12.1* and photos of the community meetings are presented in *Figure 12.1* and *Figure 12.2*.

The information collected is reflected in the Socio-economic Baseline in *Section 6* of this EIA.

Table 12.1 Details of the surveys and group discussions conducted in the Project area

Date	Village	Village Tract	Township	Region	No. of HH Consulted by Village Tract
17-1-17	Kubyin & Pyi Nyaung	Pyi Nyaung	Tharzi	Mandalay	Meeting with Village leaders and 2 Socio-economic Surveys
18-1-17	Kubyin	Pyi Nyaung	Tharzi	Mandalay	25 HH Survey
19-1-17	Pyi Nyaung	Pyi Nyaung	Tharzi	Mandalay	25 HH Survey
20-1-17	Kubyin & Pyi Nyaung	Pyi Nyaung	Tharzi	Mandalay	2 Townhall Meetings, 6 Groups Discussion
Total Surveys			**50 HH Surveys, 2 Socio-economic survey and 6 Groups discussion**		

Source: ERM, 2017

12.3.2 Key Findings from Consultation with Affected Communities, January 2017

Representative photos taken during the consultation are shown in *Figure 12.1* and *Figure 12.2*. Key findings of consultation are presented below.

Pyi Nyaung Village

- All the surveyed respondents were aware of the proposed overall expansion Project including the STC cement plant, limestone quarry and mudstone quarry .
- All respondents described the overall expansion Project as important for the community.
- Positive impacts of the STC development include: i) the upgrading of the road from Pyi Nyaung to the Cement Plant in the vicinity of limestone quarry that provides improved access for firewood collection; and ii) the renovation and upgrade of a 17 bed clinic in the village increasing staffing and treatment capabilities.
- The majority of respondents (80%) expect the overall expansion Project to create job opportunities, thus increasing income, and a further 16% mentioned improved transportation. One respondent mentioned a new school.
- The community noted increased water and air pollution as a concern and attributed this to the overall expansion Project. The respondents anticipate that the overall expansion Project will generate air pollution (80% mentioned it) and one raised concerns about increased noise.
- All the respondents are concerned about outside people coming to the village to work on the cement plant expansion Project.

Kubyin Village

- All the respondents described the overall expansion Project as important for the community.
- While residents all appreciate the improved access from the upgraded road to Pyi Naung, concerns were raised about the road encouraging an influx of outsiders for logging, exerting pressure on their own livelihoods.
- Concerns were raised that the STC cement plant has led to pollution and sedimentation of the Kubyin River. They attributed an increase to skin disease in children to this issue.
- Residents of Kubyin also claimed that dust pollution is created on a twice weekly basis from the Project Area.
- All the surveyed respondents were aware of the proposed Project.

- The majority of respondents (52%) expect the Project to create job opportunities and a further 32% mentioned improved transportation. Four respondents did not mention anything.

- The respondents overwhelmingly anticipate that the overall expansion Project will generate air pollution (80% mentioned it), increase noise (52% mentioned it) and 8% raised concerns over failed crop harvest.

- All the respondents are concerned about outside people coming to the village to work on the cement plant expansion Project.

- One respondent raised concerns about the health and agricultural situation of his community and enquired over the drinking water (supply) in relation to the overall expansion Project.

12.3.3 Incorporation of Stakeholders' View in the Draft EIA

Consultation outcomes have been incorporated into the design of mitigation measures for Project and are contained in the Draft EIA Report. These include:

- Relocation of worker accommodation to a location 500m south of plant boundary;

- Routine air and water monitoring to be undertaken in communities closest to the STC Project Area. Dust deposition gauges have been installed in Kubyin and Pyi Nyaung Villages and STC has committed to communicating the results of this air monitoring to local residents;

- Engineering controls to prevent erosion and runoff from entering surface streams at the limestone quarry;

- A code of conduct will be developed for incoming workers during the operation phase of the project; and

- Development of a formal grievance procedure for use by local residents (*Annex J*).

During the EIA disclosure period, STC committed to briefing those communities consulted as part of the EIA process to provide feedback on how the concerns raised are being addressed. This was undertaken by STC and their EIA consultants prior to submission of the final EIA report from April to November 2017 with details provided in *Section 12.4* below.

Figure 12.1 Consultation at Pyi Nyaung Village in January 2017

Figure 12.2 Consultation at Kubyin Village in January 2017

12.4 DISCLOSURE AND STAKEHOLDER CONSULTATION FOR THE DRAFT EIA IN JULY- NOVEMBER 2017

Following disclosure of the Draft EIA in April 2017, a series of public consultation meetings were undertaken from July to September 2017 to collect stakeholder feedback of the Draft EIA for consideration in the Final EIA. Photos of the community meetings are presented in *Figure 12.1* to *Figure 12.5*.

Summaries of the method of invitation of these meeting, key stakeholder views collected as well as how they are taken into account to finalise this EIA, are presented in *Table 12.2*. Meeting minutes are appended in *Annex H* of this report and are disclosed on STC website (https://www.apachecement.com/category/news/).

In relation to biodiversity, consultation was undertaken with Government agencies (Nature and Wildlife Conservation Division of MONREC, Ministry of Mines, Forestry Department of MONREC) and with NGO parties (FFI, WCS, International Union for the Conservation of Nature (IUCN) (Bangkok Office), Myanmar Centre for Responsible Business (MCRB)) in June 2017 and on 17 November 2017 specifically on the draft BAP. Comments received were incorporated to finalise the BAP.

Figure 12.3 Public Forum in Yangon in July 2017

Figure 12.4 Thazi Township Meeting in July 2017

Figure 12.5 Consultation at Pyi Naung in July 2017

Table 12.2 Summary of Comments Received on Draft EIA

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
Public Forum in Yangon	18th July 2017 – 14:00 to 18:00	Novotel Hotel, Yangon	1. Announcement on two newspapers (one in Myanmar language and one in English). 2. Invitation through email and phone to NGOs and CSOs	1. General Public 2. NGOs 3. CSOs 4. Government officials 5. Local Community 6. Media 7. Industrial and Engineering Sector	Impacts of the Project on the livelihoods of local people, including negative impacts due to land acquisition of the existing and future operation.	ERM undertook a socio-economic survey through discussions with village leaders; focus group discussions with women and famers and through a direct survey of 50 households sampled at random in January 2017. Concerns from the community were taken into account to prepare the Draft EIA and presented in the report. In general, it is considered that the livelihood of local communities has benefitted from the improved access to the area created by the Project. STC has acknowledged issues related to land acquisition since the Project will / has acquired land that the community used for agricultural activities. STC adopted a process to receive and respond to claims for compensation for Project land use.
					Waste management issues of the Project	A Waste Management Plan has been developed for the Project taking into account local constraints and will be updated on a regular basis.
					Water shortage issues of the community	The Water Supply Study is completed and results are summarised in the Final EIA. This included assessment of the water requirements of the Project, option assessment of water supply considering potential impacts to water availability to local community, as well as measures to safeguard water supply to community. Water for the expansion project will not be drawn from Kubyin River.

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						STC has committed to a CSR project that will provide water supply to the community in Pyi Nyuang Village in parallel with the water supply for the second line.
					Employment of local community by the STC	Priority to employ local employee is described in the Final EIA. It should also be noted that STC encourages graduates to further their education instead of working for the Project immediately after graduation. The higher education level will benefit the local community. This is done through scholarship as part of the CSR programme.
					Biodiversity impact of the Project	Biodiversity impact and mitigation are assessed and included in the Final EIA according to IFC PS 6 under *Sub-section 8.3* for the operation phase. The Biodiversity Action Plan (BAP) is developed.
					Air quality impact of the Project	Air quality impact and mitigation are assessed and included in the Final EIA under *Sub-section 8.1* for the Operation phase. Further baseline air surveys were undertaken in response to concerns raised by ECD and by CSOs and the results are presented in the report.
					Noise impact of the Project	Notable noise impact is not expected due to large separation distance between the quarries and the community. Noise impact from the cement plant expansion project is included in the separate EIA Report for the cement plant expansion Project.
					Health issue from the Project	Concerns regarding skin disease of a child in Kubyin was raised and the STC clinic doctor followed up on the case. According to the doctor, the skin disease was related to poor sanitation.

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						STC did not draw water from the Kubyin River in 2017.
					CSR activities (e.g. power and water supply, road improvement, provision of fire services etc)	With regard to the community residing around STC's Project site, STC is committed to contributing to the community health and safety through the implementation of various corporate social responsibility (CSR) programs in education promotion, environment protection, infrastructure improvement, health, natural disaster relief and general social matters, with a financial focus on education facilities and medical support, as well as on the provision of water treatment systems and of electricity. STC has also been providing reconstruction support for post-emergency events such as fire or flooding.
					Grievance receipt channel	A community grievance mechanism will be set up and updated on a regular basis (*Annex J*).
					Improve the invitation channel for stakeholder consultation meeting	Invitation channel on further consultation improved and include invitation notice at public places of the communities (e.g. school, wells where the community obtained drinking water.
Thazi Township Meeting *	21st July 2017 – 09:00 to 11:00	GAD Office Meeting Room (Thazi Township)	1. Invitation through Township GAD. 2. Invitation through phone to CSOs	1. CSOs/Government officials 2. Local Community	Blasting materials storage	Blasting is registered with the Military and approved based on detailed consideration of safety requirements. Transportation of the explosives to the storage will be in strict compliance with safety requirements and the storage is constructed in compliance with safety requirements of the Ministry of Defence. All explosives are stored as per required regulations. A security guard is posted at the explosives magazine 24 hours per day and the two main keys of the storage are kept and

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						checked by heads of administration and mining departments of STC. The material in-out record is systemically recorded and must be carried out with strict material handling procedures.
					Environmental monitoring of the Project	Environmental monitoring requirements and data disclosure requirements included in the Final EIA. These include visual inspection of works areas and HSE records during operation of the Project, monitoring of stack missions and dust impacts from the operation and treated wastewater and runoff monitoring for operation of the cement plant and quarries.
					Case of malaria in the area	Malaria is now rare is the area after the Malaria combat program of Thazi Township Health Department. STC has a plan to implement a Malaria prevention programme in communities as part of the CSR activity. This is included in the Final EIA.
					Employee welfare	A Worker Grievance Mechanism will be developed and updated on a regular basis (*Annex J*).
					Replantation programme after quarry / mine closure	Replantation requirements are recommended as part of the biodiversity impact assessment and in the Biodiversity Action Plan. Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring.
Pyin Naung Village Meeting *	22nd July 2017 – 14:45 to 17:30	Aung Theintdi Monastery	1. Invitation through Township GAD. 2. Invitation through village tract leaders. 3. Invitation notice at public places of the communities (e.g. school, wells where the community obtained drinking water.	Pyi Nyuang Village Community	Request to provide information centre for the community	An information centre was established in Pyi Nyaung Village in December 2017 with a Community Liaison Officer hired from Pyi Nyuang Village.
Letter received by EIA Consultant from EarthRights International, MATA and IFI Watch Myanmar	11 October 2017	N/A	N/A	N/A	1. Form and content of the Draft EIA does not align with the Myanmar EIA Procedure (2015) 2. No Assessment of alternatives 3. Greenhouse gas assessment not undertaken	1. The Final EIA has been updated to align with the Myanmar EIA Procedures (2015) and in response to ECD comments. Its structure has also been reorganized to align with the local recommendations. 2. Discussion of potential alternative use is included in the Final EIA under *Sub-section 4.2 Project Alternatives*. This includes alternative to use the conveyor belt to transfer the limestone to reduce fuel consumption. For the cement plant expansion project, STC has committed to undertaking a study of the economic and technical feasibility of using

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
					4. Cumulative Impact Assessment not included 5. Monitoring Plan not included 6. ESMP Budget not specified 7. Concerns on the air, water, noise, land and biodiversity impact assessments 8. Concerns related to the assessment of Indigenous Peoples 9. Concerns on inadequate stakeholder engagement. 10. Concerns on land acquisition. 11. Project Closure 12. Increased traffic due to the Project.	biomass waste (rice husk) in the cement kiln. Based on current understanding, it is envisaged that this could substitute up to 10% of the fuel coal. This is included in the in the separate EIA Report for the cement plant expansion Project. 3. Greenhouse gas assessment is included in the in the separate EIA Report for the cement plant expansion Project and is based on IFC estimates. According to IFC estimates, the CO2 specific emissions per tonne of cement produced will reduce by 17% between the first line and the second line with the waste heat recovery cogeneration system. This is driven by a planned reduction in power specific consumption of 38% for each tonne of cement produced and a planned reduction in fuel specific consumption of 17% for each tonne of clinker produced. 4. Cumulative Impact Assessment is included under *Section 10* of the Final EIA. Note that additional air quality baseline sampling has been undertaken and the revised assessment now includes an assessment of project contribution plus "baseline conditions" that include other sources of air emissions at the time this report was produced. 5. Additional environmental monitoring requirements and data disclosure requirements have been added to the ESMP under *Section 11* of the Final EIA. These include visual inspection of works areas and HSE records during operation of the Project, monitoring of

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						stack missions and dust impacts from operation and treated wastewater and runoff monitoring for operation of cement plant annd quarries. 6. It is not possible to provide an overall budget for ESMP implementation at this stage, however, STC committed to deploy sufficient resources to undertake all required mitigation and monitoring measures. 7. Elements of these impact assessments have been reviewed and redone and revisited where necessary. Air, water, noise and biodiversity impact assessments include additional detail on the basis of feedback from stakeholder feedback and from ECD. For air quality, additional baseline survey was done on PM2.5 and PM10 in January 2018. Air quality modelling was updated with the survey results which confirmed significance of the impacts to air quality at the ASRs in the vicinity of the plant will be Minor or below. An air monitoring programme is required as part of ESMP. Within the cement plant, worker accommodation (AQ4) located immediately to the west of the second line will be relocated to a distance of 500m from the boundary of the plant to avoid adverse air quality impacts on workers. Ideally, accommodation quarters should be located to the south of the cement plant, which is upwind of the prevailing wind direction.

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						Notable noise impact is not expected due to large separation distance between the quarries and the community. For noise assessment of the cement plant expansion project, noise model SoundPLAN was used for the operational noise impact assessment in accordance with the Acoustics -- Attenuation of sound during propagation outdoors -- Part 1: Calculation of the absorption of sound by the atmosphere (ISO 9613-1:1993) and Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation (ISO 9613-2:1996) for the cement plant expansion Project. Note that multiple noise sources of similar sound power level are additive on a log scale which explains why adding more pieces of equipment of a similar sound power level has little effect on the noise experienced at the receptor.. The output noise contour confirmed that predicted noise levels due to operation of the Project comply with the assessment noise criteria. As such, no adverse operational noise impact is expected at the nearest village. Within the cement plant in the vicinity of Limestone Quarry, worker accommodation (N2 and N3) located immediately to the west of the second line will be relocated to a distance of 500m from the boundary of the plant to avoid adverse noise impacts on workers. This is included in the in the separate EIA Report for the cement plant expansion Project.

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						On water quality, control measures on site-runoff. This includes installation of a wastewater treatment plant(s) to treat all contaminated sources of wastewater such that only uncontaminated runoff is dischared form the site. The Water Supply Study is completed for the cement plant expansion and results are summarised in the Final EIA. This included assessment of the water requirements of the Project, option assessment of water supply considering potential impacts to water availability to local community, as well as measures to safeguard water supply to community. Water for the expansion project will not be drawn from Kubyin River. STC has committed to a CSR project that will provide water supply to the community in Pyi Nyuang Village in parallel with the water supply for the second line. On biodiversity, results of further surveys including reptile survey and karst flora survey for cement plant as well as flora survey for transmission line have been incorporated to the assessment. This confirmed that with proper implementation of the recommended mitigation measures, the residual biodiversity impacts causing by the operation of the Project would be of no larger than moderate significance, except for the loss of habitat due to operation of the quarries and coal mine which are of critical significance and required to be offset. The Biodiversity Action Plan is also included in the Final EIA Report (*Annex E*) to detail the offset requirements.

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						8. STC has appointed an independent specialist to assess Indigenous Peoples issues for the project. This is being undertaken separately to the EIA process. 9. Extensive stakeholder consultations have been undertaken for the preparation of the Draft and Final EIA as well as the Biodiversity Action Plan. These included consultations with the potentially affected people, CSOs and NGOs (FFI, WWF, WCS, IUCN, MCRB, ERI, MATA, IFI Watch Myanmar etc), government departments including Nature and Wildlife Conservation Division of MONREC, Ministry of Mines; and Forestry Department of MONREC. Stakeholder feedback obtained on the Draft EIA Report of the Project was taken into account in finalising the Final EIA Report. The Final EIA Report will be disclosed both on STC website and a summary in Myanmar language will be made available to local communities at the community centres in Pyi Nyaung and in Paluzawa. Please refer to *sub-Section 12.2* for further details. 10. STC has adopted a process to receive and respond to claims for compensation for Project land use. 11. There is no current plan of closure for the cement plant or quarries. It is, however, expected that issues of closure activities would be similar to those of construction / operation activities and similar mitigation measures will be applied as necessary. For the quarries and mine, rehabilitation of habitat will occur within

Meeting	Date	Venue	Invitation	Attendants	Key Comments / Concerns Received	Consideration for EIA
						the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring. 12. For impacts related to increased traffic due to the cement plant expansion, it is assessed and confirmed to be of minor significance. This is included in the in the separate EIA Report for the cement plant expansion Project.

Note: * Similar issues raised to the previous consultation meetings are not repeated.

13 CONCLUSION AND RECOMMANDATIONS

13.1 SUMMARY OF FINDINGS

The Project consists an expansion of a limestone quarry, at STC's existing limestone concession in Pyi Nyaung Village, Thazi Township in the Mandalay region of Myanmar.

An EIA has been conducted for Project in accordance with relevant environmental and social guidelines of the Myanmar and International Finance Corporation with an overall objective to ensure acceptable environmental and social performance of the Project. The EIA identified potential impacts through a systematic scoping process whereby the activities (both planned and unplanned) associated with the Project have been considered with respect to their potential to interact with environmental and social resources or receptors. Interactions which may generate potentially significant environmental and social impacts have been further assessed in this document, with appropriate mitigation and enhancement measures recommended for alleviating potential negative impacts or enhancing potential positive impacts from the Project. It is concluded in the EIA that with proper implementation of the recommended mitigation measures, the residual environmental and social impacts caused by the operation of the Project would be of no larger than moderate significance with the exception of impacts as a result of the loss of Critical Habitat within the limestone concession. The loss of habitat due to operation of the limestone quarry is of critical significance and required to be offset as per the Biodiversity Action Plan (*Annex E*).

To ensure proper delivery of the committed mitigation measures identified in this document, an Environmental and Social Management Plan has been prepared for the Project which provides the procedures and processes to be applied to the Project activities in order to check and monitor compliance and effectiveness of the mitigation measures during the operation of the Project. In addition, this ESMP will be used to ensure compliance with statutory requirements and corporate safety and environmental policies. Overall, it is expected that the Project will be constructed and operated with acceptable environmental and social performance under proper implementation of the ESMP.

Table 13.1 Summary of Impact Assessment for Operation of the Project

Issue	Impact Summary	**Impact Significance** *(prior to implementation of Mitigation and Management Measures)*	**Residual Impact Significance** *(after implementation of Additional Mitigation and Management Measures)*
Air Quality	$PM_{2.5}$ and PM_{10} due to Project emission	Major (Worker Acommodation) Minor to Negligible (Kubyin and Pyi Nyuang Villages)	Minor to Negligible
Surface Water Quality	Impacts to surface water quality due to wastewater and runoff during operation.	Major	Minor to Moderate
Waste Management	Impacts from waste management during operation	Moderate	Minor
Biodiversity	Degradation of habitats due to operation.	Moderate	Negligible
	Impacts to species during operation	Moderate	Negligible
	Permanent and Temporary loss of habitat due to operation.	Critical	Critical
	Fragmentation and edge effects due to operation.	Moderate to Major	Minor
Occputional Health and Safety	Impacts to health and safety of workers due to operation of the Project.	Moderate	Minor
Occputional Health and Safety	Impacts to health and safety of community due to operation of the Project.	Moderate	Minor
Landscape and Visual Impacts	Impacts to landscape and visual amenity of Project area	Moderate	Negligible to Minor
Soil	Impacts to soil from dust deposition and runoff.	Negligible	Negligible

Annex A

ESIA Terms of Reference

1 ESIA SCOPE OF WORK

1.1 AIR

1.1.1 Potential Impacts

The construction and operation of the proposed cement manufacturing facility, the associated quarry, and the coal mine has the potential to result in significant impacts on air quality both at human and ecological receptors.

Coal Mine

Strip mine operations will involve the removal of overburden, extraction of ore, crushing and screening of ore, stockpiling and loading onto trucks. In addition, the movement of coal trucks to/from site may give rise to dust impacts. Key sources of emissions will be:

- Mining activities: Stripping, extraction, overburden placement and hauling of coal/overburden may all result in emissions of dust, PM_{10} (and $PM_{2.5}$).

- Excavators, trucks and potentially diesel power generation onsite would generate emissions to air of NO_2, NO_x, SO_2, PM_{10}, $PM_{2.5}$.

Cement Manufacturing and Associated Quarries

Potential construction phase impacts include land clearance, construction of infrastructure, transport of materials to site, etc. Key construction phase emissions will be PM_{10} and dust as a result of dust raised by vehicles moving over open surfaces and disturbance of surface materials.

During the operational phase, the primary emissions from the manufacture of Portland cement include:

- Quarries: dust and particulate matter (PM_{10} and $PM_{2.5}$) generated from quarrying (blasting and extraction) and crushing.

- Kilns: nitrogen oxides (NO_x) and sulphur dioxide (SO_2), carbon monoxide (CO) and PM_{10} and $PM_{2.5}$ from coal combustion. Potentially also volatile organic compounds (VOC), ammonia (NH_3), chlorine, and hydrogen chloride (HCl) may also be emitted. Possible emissions of metal compounds from cement kilns (partitioning of these in the gas/solid phases is a function of kiln operating conditions).

1.1.2 Baseline and Assessment Methodology

Cement Manufacturing and Associated Quarries

- ERM will assist STC to install 10 dust deposition gauges at locations around the plant and at the nearest sensitive receptor in Kubyin Village, 3km from the plant. Materials to construct these deposition gauges will be

sourced locally by STC. Deposition gauges will be used to collect dust samples on a monthly basis (analysis can likely be done at the onsite laboratory). The intention is that these would form part of a long term monitoring programme that would continue beyond the EIA and be managed by STC. ERM proposes to analyse one set of samples for a typical suite of metals over the duration of the baseline sampling programme.

- Three locations will be sampled for NO_x, NO_2, SO_2 using diffusion tubes for a period of one week in locations around the plant.

Coal Mine

- No baseline air sampling will be conducted

Assessment Methodology

The potential impacts of the construction activities will be assessed in a qualitative manner and standard mitigation measures developed. Emissions of site based vehicles and plant during construction is expected to make a negligible contribution to air quality impacts and will not be assessed.

An emissions inventory for both the cement manufacturing plant and coal mine will be developed. These inventories will primarily be developed from guidance set out in NPI produced by the Australian Government and USEPA AP-42 emissions database. Key input data will include the tonnages of coal produced, vehicle specifications, distances travelled by vehicles, and fuel specifications and use.

On the basis of the emissions inventory, dispersion modelling will be utilised to quantify the magnitude of impacts arising from the key sources of emissions at both the cement manufacturing plant and coal mine. This approach is utilised to ensure robust quantification of impacts and ascertain the effectiveness of mitigation and emissions controls. The USEPA AERMOD dispersion model will be utilised; this model is widely recognised as being appropriate for this type of scheme by several agencies including the IFC, USEPA and UK Environment Agency. In addition to consideration of emissions, the model also considers local meteorology (using MM5 simulation), local topography, and the locations of nearby receptors.
ERM will model the following:

- **Coal Mine:** Particulate matter modelled as an area source from the mine.

- **Cement Plant and Quarries:** Particulate matter, NOx and SO_2. ERM will model one set of operating conditions for both point and area sources at the cement plant. Particulate matter from the quarries will be modelled as an area source.

1.2 BIODIVERSITY AND ECOSYSTEM SERVICES

1.2.1 *Potential Impacts*

ERM notes that species of conservation significance were recorded at the Cement Plant/Quarry and Coal Mine area, including: Chinese pangolin, *Manis pentadactyla* (CR); and *Dalbergia oliera* (Plant) (EN). Records indicate that the area may contain species of primate, including Hoolock Gibbon (*Hoolock hoolock*). Forest areas are also likely to contain species of *Dipterocarps* that may also be listed on the IUCN Red List as Endangered. It is also reported that part of the quarry is located within a forest reserve area.

Limestone karst dependent fauna are also likely present, including potentially new-to-science of reptile and snail species recently detected in the vicinity by Flora and Fauna International (FFI). The FFI surveys however did not target invertebrates and flora.

Given the methodology used for baseline surveys in the EIAs, it is considered likely that other fauna of conservation significance are present within the Area of Influence (AOI) of the Project Areas.

The primary impacts from the Project will be loss of habitat as a result of mining and quarrying activities and the associated disturbance and displacement impacts on flora and fauna species.

Preliminary information is available within the EIAs on potential impacts to Ecosystem Services from the Project. Further scoping and screening is necessary to determine whether further assessment is required.

1.2.2 *Baseline and Impact Assessment Methodology*

Scoping Phase- Task 1

ERM propose to undertake the following during Scoping:

- Literature review of existing studies, scientific literature or any other type of pre-existing biodiversity assessments available for the project area; national or regional plans; existing conservation programs or initiatives in the area and its surroundings.

- Stakeholder consultation with NGOs and Government representatives to collect relevant data for the project site. The exercise will:

    - Carry out interviews with relevant government representatives, universities and conservation organisations (in particular FFI, but also WCS, WWF, Biodiversity and Nature Conservation Association of Myanmar (Birdlife International representative) and Myanmar

Environment Rehabilitation-conservation Network and Government of Myanmar Ministry of Natural Resources and Conservation). The purpose of the consultation will be to fill data gaps, understand the regional context of the project AOI in terms of its importance to biodiversity conservation (e.g., ecosystems, threatened species, endemic species and/or migratory species) as well as occurrence of invasive species;

- Undertake a scoping and screening exercise and coordinate with social impact assessment efforts (if necessary) to determine if there are any biodiversity in terms cultural or human use value to local communities (ecosystem services).

- Use existing data (e.g., collected as part of local EIA assessments, IUCN Red List of Threatened Species, Global Invasive Species Database, IUCN Species Action Plans and nationally protected species lists and that gained through consultation), to identify if there are any known or potentially occurring threatened species (CR and EN listed species), endemic species (such as invertebrates, reptiles, flora and cave dwelling bats) and/or migratory species associated within the project study area;

- Use existing data to identify any potential invasive species in the project AOI and the surrounding landscape;

- confirm and map the boundary of any habitats of conservation significance, including World Heritage Areas; Protected Areas; local forest designations, Key Biodiversity Areas (Important Plant Areas, Important Bird Areas and Alliance for Zero Extinction sites) in relation to the Project area;

Habitat Characterisation and Classification- Task 2

Based on the information obtained during Scoping, ERM will prepare an analysis of the distribution of land classes and Natural and Modified Habitats within the Project Area and AOI. A Discrete Management Unit (DMU) will be determined for Critical Habitat candidate species.

Biodiversity Field Surveys – Task 3

The purpose of biodiversity field surveys would be to obtain further information on existing known biodiversity values, focusing on values that may trigger Critical Habitat thresholds in the project study area and to further refine maps of Modified and/or Natural Habitat, as required.

Targeted biodiversity surveys will be conducted in early December or March to June to capture potential seasonality constraints (particularly for invertebrates and flora).

<u>Limestone Hill Surveys</u>

Surveys are to be conducted of the limestone hills within the concession to determine the presence of site endemic invertebrates, molluscs, reptiles, mammals and flora.

At least 3 suitable reference locations along the same limestone range are also to be surveyed to determine the likely distribution of any species detected.

Surveys will focus on: caves and fissures within the limestone hills; varying microclimate conditions including: varying aspects, soil conditions, slopes and depositional areas; and downslope areas below cliffs.

Soil samples should be taken in depositional areas, caves and fissures to detect molluscs. Inspections of caves and fissures should be conducted to detect invertebrates and reptiles. Surveys are to be conducted at dawn and dusk to detect crepuscular species at entrances to caves and fissures. Flora transects should be conducted in accessible areas in varying micro-habitat conditions.

Surveys should be conducted in dry conditions over a period of 5-7 days.

Forested Habitats

The following surveys will occur in forested areas at both Project sites:

- Interviews are to be undertaken with local people (hunters, NTFP collectors) to determine contemporary sightings (within the last 12 months) of fauna of conservation significance likely to occur within the Project Area (CR, EN and VU species). Data should be provided on: species; number of sightings; location of siting; condition of individual.

- Diurnal and nocturnal transects are to be undertaken for a minimum of 2 hours in the morning and evening for a period of 5 days per Project area. The transects will cover a range of forest cover types aspects and slope. These inspections will target birds, herpetofauna and arboreal mammals/primates and ground dwelling mammals. Inspections of any habitat features (nests, roosts and dens) are to occur if detected. Tracks and traces are to be noted, photographed and GPS reference point taken.

- A flora survey will occur along transects within the Project area to determine the distribution and abundance of species of conservation significance (CR, EN and VU listed flora) and invasive species. A minimum of 1 transect per hectare will be applied. The distribution of records will be marked on a map and GPS referenced.

- Vegetation class mapping will be undertaken to show the type, condition and distribution of vegetation classes within the Project area. This mapping may occur through satellite image/aerial photograph interpretation and a series of inspections to confirm vegetation distribution.

The following surveys will occur at the coal mine site only:

- A targeted survey for fauna will be undertaken using infra-red camera traps. These traps will be placed based on likely fauna movement pathways and key attractants (water bodies, salt licks). The traps will remain in place for at least 10 days. A minimum of 10 camera traps will be placed per 2 hectares (this may be varied based on the terrain).

- A targeted listening survey will be conducted at dawn and dusk for gibbons. Listening posts will be set up near to potential/confirmed habitat for at least 2 hours at dawn and dusk. The calls will be recorded for future reference (if possible), the direction and approximate distance of individuals will be recorded.

All fauna and flora surveys will be completed within a maximum period of 15 days. Two teams may be used to cover both sites.

Critical Habitat Determination- Task 4

A Critical Habitat (CH) Screening Assessment is to be undertaken in relation to any CH triggers identified during Tasks 1-3. The assessment will determine the presence or not of biodiversity values that meet CH thresholds. The CH assessment will be peer reviewed by local, regional and species experts to ensure the accuracy of the findings are validated.

Mitigation and Management Measures- Task 5

An impact assessment will be conducted to determine the impacts to biodiversity values and recommend mitigation or management measures to reduce overall impacts to biodiversity values. The approach will involve using the mitigation hierarchy: avoid, minimize, mitigate and offset. Avoidance, mitigation and management measures will be made that explicitly address project risks and impacts to biodiversity values that are known or likely to occur at the project study area. Mitigation will take a precautionary approach given the need for assessment to provide final confirmation or refinement.

The consultant will work with the client to identify sensitive biodiversity receptors that should be avoided through changes in footprint or design, of possible. Further measures will be recommended to input into the design processes to mitigate impacts through practical design measures.

Development of a Biodiversity Offset Strategy – Task 6

A Biodiversity Offset Strategy will be prepared to determine the potential biodiversity offset size, candidate locations, costs and implementation/management mechanisms required.

A Biodiversity Action Plan and Biodiversity Offset Plan for the selected biodiversity offset site would need to be undertaken as a commitment to meet IFC standards and have not been included in the scope of the Phase 2 ESIA.

1.3 TRAFFIC AND TRANSPORT

1.3.1 Potential Impacts

During operations, transportation of coal, clay and other raw materials to the cement plant and transportation of Portland cement product to market will involve the use of a large number of heavy vehicles.

Vehicle movements may give rise to dust and pose a risk to other road users and communities through which they pass, such as Pyi Nyaung Village, located approximately 6 km south of the cement facility. Both road dust and road safety associated with the movement of coal trucks were raised by concerns of local residents in relation to the coal mine according to the Regulatory EIA submission.

Similarly construction activities will require the use of trucks to transport plant and equipment to site. Impacts during the construction phase are not expected to differ significantly with operational phase impacts and will be assessed in parallel.

1.3.2 Baseline and Assessment Methodology

ERM will make an inventory of existing road traffic related to the project and the future projected traffic once the expanded facility comes into operation. The adequacy of existing infrastructure (roads, staging areas, "pinch-points") to accommodate the projected increase in road traffic will be assessed qualitatively.

A Traffic and Transportation Management Plan will be developed that will include measures to minimize dust, safety, traffic congestion and ensuring drivers have access to adequate facilities (e.g., ablutions) as well as any other issues that are raised during engagement with external parties.

1.4 WATER

1.4.1 Potential Impacts

Cement Plant/Quarry

It is understood that water for dust suppression and to supply the workforce/families (approximately 500-600 people) is drawn from a small reservoir onsite and passed through an RO treatment plant. A dry manufacturing process is used and hence the operational water need is not anticipated to be significant.

Runoff from quarrying operations, coal storage areas and waste stockpiles may become contaminated and enter surface streams and/or groundwater and flow downstream to Kubyin Village which uses the stream as a drinking water supply. The bulk storage of fuel at the also poses a risk to surface and

groundwater contamination.

Coal Mine

It is understood that the coal seam mined is shallow and there is no need for dewatering. Water for the mine employees and for dust suppression is drawn from the South Paluzawa stream. This stream is also the water source for local residents who have stated that there is a lack of water for three months during the dry season and hence the potential for competition for water supply needs to be assessed.

Runoff from coal staging areas and overburden dumps may become contaminated and enter surface streams and/or groundwater. The bulk storage of fuel at the base camp and barging area in Paluzawa also poses a risk to surface and groundwater contamination.

1.4.2 *Baseline and Assessment Methodology*

Cement Plant/Quarry

ERM will verify the volume of water currently used (for consumption, dust suppression and process use) and assess the capacity of the existing reservoir to supply the projected future water demand of the expanded facility (predicted to be approximately 700,000 tpa in the Regulatory EIA). Given the relatively low volume of water expected to be used an operational water balance is not proposed.

ERM will review STC's plans for runoff control at the quarry and plant. Particular attention will be paid to the lower reaches of hill slopes and around stockpiles, staging and disposal areas. Where necessary, ERM will make recommendations to improve stormwater management at the quarry and cement plant aligned with accepted industry practice. While sources of waste water are limited e.g., related to sewerage, waste water from canteens and vehicle washing areas, recommendations to ensure good practice is applied to such aspects will also be provided.

Four water samples (at the Mudstone Quarry area, at two surface water drainage locations downgradient from the coal storage area and at the Kubyin Stream at Kubyin Village) will be taken and analysed for typical inorganic compounds and metals.

Coal Mine

ERM will assess the volume of water abstracted from the South Paluzawa stream by the mining operations as a proportion of total flow to assess the potential for competition for water with local communities. Three water samples (one upstream of the mine highwall, one downstream of the mine and upstream of the base camp and one at Chuanzong Village) will be taken and analysed for typical inorganic compounds and metals.

STC's plans for runoff control at the mine and coal stock pile areas adjacent to the river will be reviewed. Particular attention will be paid to the overburden dumps which may contaminate surface streams or groundwater.

Where necessary, ERM will make recommendations to improve stormwater management at the coal mine and coal stockpiling areas to ensure alignment with accepted industry practice Similarly, the approach to the management of sewerage / other ounces of waste water will also be considered to ensure this is aligned with good practice.

1.5 NOISE

1.5.1 *Potential Impacts*

During the construction of the Project, the key noise sources will be from blasting (if any), excavation work, site formation, the use of mobile machinery and construction plant items.

During the operational phase, noise emissions will be generated from the operation of the proposed coal mine, including clearing of vegetation, excavation of coal, loading, and transportation of coal to stock yard. For the operation of the proposed cement plant, noise will be generated from the unloading hopper, crushing of limestone, material transportation use pf wheel loaders and conveyors, material blending station, ball mill, preheater, coal burner and cement kiln.

1.5.2 *Baseline and Assessment Methodology*

Noise monitoring will be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed facility and whether or not workers or nearby residents are affected by current noise levels. Baseline noise monitoring is proposed to be conducted in a minimum of 3 monitoring locations in the vicinity of the cement plant (at the existing and newly constructed accommodation quarters and at the guard house). Baseline noise measurements will not be undertaken at the coal mine given that the distance to the nearest residents in several kilometres. Noise monitoring will be carried out using a Type 1 or 2 sound level meter.

An operational noise impact assessment will be carried out for the cement plant based on project information provided by STC and the results of baseline sampling. The noise assessment will be undertaken based on standard acoustics principles, in accordance with the British Standard, BS5228: Part 1: 2009 *Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control*. The procedures of the assessment are summarised as follows:

- identify representative Noise Sensitive Receivers (NSRs) that may be affected by the works;
- assign Sound Power Level (SWL) to each plant item proposed and calculate the overall SWL associated with the proposed plant inventory;
- determine the distance between the approximate geometric centre of the works site;
- apply the correction factors based on the distance and façade correction as appropriate, in accordance with BS5228: Part 1: 2009; and
- predict the construction and operational noise levels on the basis of the plant activity and any in built design controls, if any.

The sensitivity of NSRs will be determined as high, medium and low based on the effects of noise on health in consideration of annoyance, speech intelligibility, communication interference, disturbance of information extraction, sleep disturbance, and hearing impairment.

The magnitude and significance of the construction and operational noise impacts will be determined in consideration of the sensitivity of the NSRs and the levels of predicted noise impacts below or above the assessment noise criteria. Appropriate noise mitigation measures will be recommended if results indicate noise exceedance over the assessment noise criteria.

1.6 SOCIAL IMPACT ASSESSMENT

1.6.1 Potential Impacts

Cement Plant & Quarries

Expansion of the cement plant is likely to bring about both benefits in terms of employment and spending in local communities and negative impacts such as environmental nuisance, increased traffic and possible influx. The Area of influence would include:

- Pyi Nyaung Village Tract: 6km south of the cement plant (200 households).
- Kubyin Village: approximately 4km north of the cement facility (approximately 60 households).

Previous consultation was undertaken in March 2014 and December 2015 for the regulatory EIAs. The only specific concern raised was that that the operations do not affect the rearing of livestock in forest areas. Residents in Kubyin also expressed a desire for assistance with potable water supply and electricity.

In addition to environmental nuisance and traffic/road safety, it is possible that expansion of the cement plant may result in an influx of people, resulting in fenceline communities that would be at greater risk of environmental nuisance from the mine and that couple pose an operational and/or safety risk. It is noted that Kubyin Village was only formerly recognised in 2014 after an initially small number of households relocated from the larger settlement of Pyi Nyaung as early as 1978 due to overcrowding..

Coal Mine

The base camp is located approximately 1 km form Chaungzon village (Paluzawa area), Ywar Thar village Tract, Kalaywa Township, 6 km west of the Chindwin River. The company has also a base camp at Paluzawa village 2 miles east on the Kalaywa-Maw Lite Road. Chaungzon village has 19 households and a population of 80. It is noteworthy that the mine does not employ any residents of Chaungzon village, whose residents appear dependent on subsistence cropping and logging.

Previous consultation undertaken was undertaken for the Regulatory EIA in November 2015. Issues raised include:

- Water availability during the dry season. South Paluzawa stream is the water source for both employees at the mine and the village. Local

residents have stated that there is a lack of water for three months during the dry season and hence the potential for competition for water supply needs to be addressed.

- Dust from the movement of coal trucks;
  Road safety and concerns about driver conduct.

1.6.2 *Social Impact Assessment Methodology*

ERM expects that consultation and baseline socio-economic surveys would be undertaken at Pyi Nyaung Village Tract and Kuybin Village for the cement plant and at Paluzawa, Chaungzon and Namwake Village at the coal mine. During the surveys, ERM will seek to identify those that may be particularly vulnerable to the proposed developments, especially through restriction of access to forests, waterways or other communal resources.

Based on the results of the consultation (see ***Task 5, Section*** *Error! Reference source not found.*) and household surveys, ERM will undertake an assessment of the likely social impacts from the project. This will include both those arising from planned events (eg dust from traffic movements) and unplanned but predictable events (eg in-migration). Where necessary, recommendations to minimize adverse social impacts will be recommended. This will include the preparation of a Grievance Procedure for STC.

An important part of this process will be developing measures to maximize local economic benefits, for example through employment and the procurement of goods and services.

Once the draft EIA is prepared, there will be a second townhall meeting to share feedback with those who provided input to the process prior to disclosure of the ESIA, ESMP and LRP.

1.7 CONTRACTOR MANAGEMENT

1.7.1 *Potential Impacts*

Construction of the expanded manufacturing facility will involve a range of local and international contractors, as well as local labour. While the project will provide local employment opportunities, it is anticipated that the majority of the contractor workforce would be drawn from larger cities in Myanmar.

Potential impacts form large groups of imported labour include cultural differences, communicable diseases, and hygiene and security issues from contractor camps, workshops and lay down areas. Similarly, the potential impacts from contractors' EHS, labour and social management practices could significantly impact the project's performance.

1.7.2 *Baseline and Assessment Methodology*

Contractor Management Capacity Assessment

It is important that the company has a robust system in place for contractor selection, management and performance evaluation. Contractors' environmental, health and safety management capacity and labour practices could potentially could have significant impacts on the project's EHS and social impacts.

A capacity assessment will be carried out to assess the company's process and procedure and personnel in place for contractor management during construction and operational phases. Through interviews with relevant personnel and document review, the company's current contractor management practices will be evaluated. ERM will identify gaps with reference standards and recommend actions to be undertaken to bridge the gaps.

ERM anticipates preparing a contractor management procedure as part of the overarching ESMP to be implemented at both the cement plant and the coal mine.

1.8 WASTE MANAGEMENT

1.8.1 *Potential Impacts*

Waste sources will include:
Coal Mine

- Hazardous Wastes (oils, hydraulic fluids, etc);
- Construction waste (off cuts, spoilage, packaging);
- Waste from Construction/Worker Camps;
- Vegetation from surface stripping;
- Overburden; and
- Coal dust.

Cement Plant/Quarries

- Cement kiln dust and clinker waste;
- Office wastes;
- Domestic waste (460 employees / families);
- Hazardous waste (oils, hydraulic fluids, etc);
- Construction waste (off cuts, spoilage, packaging); and
- Waste from Construction/Worker Camps.

1.8.2 *Baseline and Assessment Methodology*

Waste Inventory
A waste inventory will be created for both the cement plant and the coal mine and will include estimates of all waste types, quantities and sources based on the information available from any feasibility studies, the EIA and benchmarks for the cement manufacturing / coal mining industry at similar scales to the proposed facilities.

Waste Capacity Assessment

A capacity assessment will be carried out to identify the waste management facilities available to the cement plant and the coal mine. The capacity assessment will aim to identify all waste facilities that could be practicably

used for waste disposal at a local, regional and national level for the identified waste streams.

Waste Management Plan
ERM will review STC's existing waste management plans for the cement plant and coal mine and propose recommendations for improvement, where necessary.

Materials handing at the cement plant (eg raw material and coal stockpiles) will be reviewed and recommendations made in line with good international industry practice to minimise the risks of air and water quality impacts.

1.9 CUMULATIVE IMPACT ASSESSMENT

It is understood that there are other cement plants owned by Htoo, Max Myanmar, YIG and Asia World within the vicinity of the STC plant. Where applicable, cumulative impacts arising from the combination of the expansion of the STC plant with other developments in the vicinity will be assessed. The most likely aspects that could be subject to cumulative impacts include: air quality, traffic and transport, pressure on communal resources (eg areas to rear livestock) in-migration and biodiversity.

Based on ERM's previous experience, information may not be shared among operators in Myanmar and as such the cumulative impact assessment will likely be qualitative in nature.

1.10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLANS

ERM will prepare an Environmental and Social Management Plan(s) (ESMP) to address the key risks and impacts identified by the ESIA. The format of these will be agreed with STC and may be either standalone documents or component parts of an integrated ESMP for the various project components. It is envisaged that the following issues would be addressed through the ESMPs:

- Biodiversity;
- Waste management (based on STC's existing Management Plan)
- Traffic and Transport;
- Air;
- Noise;
- Influx;
- Contractor management;
- Runoff; and
- Grievance redress.

1.11 LAND ACQUISITION REVIEW

The objectives of the Land Acquisition Review are as follows:

1. Assess the processes and outcomes of historical (or ongoing) land acquisition for the purpose of setting up (or expanding) all direct project components, against requirements of IFC PS5 and relevant parts of PS1. This will include looking at PS5 impacts arising from involuntary restrictions on land use and access to natural resources (e.g. forests).

2. Identify gaps and propose corrective actions to bring the Project in line with the Applicable Standards.

3. Screen for the presence of Indigenous Peoples communities at the project sites which can be expected to be adversely impacted by the project, and propose corrective actions to meet PS7 requirements. ERM understands that it is IFC's preliminary assessment that while Indigenous Peoples may be present, the affected land is not subject to customary use nor do affected areas include areas of indigenous cultural heritage significance. However this needs to be further screened by ERM and we assume that securing FPIC is not required as part of this scope.

4. Screen project sites to identify potential cultural heritage as defined in paragraph 3 of IFC PS8, and if identified, assess whether the project meets PS8 requirements and propose appropriate mitigations.

5. Screen for potential human rights (HR) risks, impacts, and violations associated with the project against relevant national and international HR principles, and propose appropriate mitigations as needed.

ERM has presented preliminary findings of the land acquisition review in the scoping report. These findings are based on a brief scoping visit in November 12016 and will need to be confirmed through the Household Surveys and further Consultation that will be undertaken as part of the ESIA.

It is understood that a small portion of Shwe Taung's total lease holding at the coal mine (in Nanmawke Village and possibly at Chuangzon and Paluzawa Villages) was previously used for shifting cultivation. It is understood that this may have affected less than 10 households that did not hold land use certificates. ERM will undertake consultation with each of these households during baseline studies to assess the adequacy of compensation payments. The Land Acquisition Review will be updated for the ESIA Report.

1.12 LIVELIHOOD RESTORATION PLAN (LRP)

Based on the results of ERM's Scoping Study, we do not consider that there have been significant adverse impacts to the livelihoods of local residents based on the project to date. Furthermore, it is understood that no physical or economic displacement is required for the expansion of the project. As such, we do not consider that a Livelihood Restoration Plan will be necessary for the project and this has been excluded from our scope of work. Shoul this be necessary based on the results of the baseline social surveys undertaken for the ESIA, this would be agreed separately with Shwe Taung.

Annex B

Impact Assessment Methodology

1 IMPACT ASSESSMENT METHODOLOGY

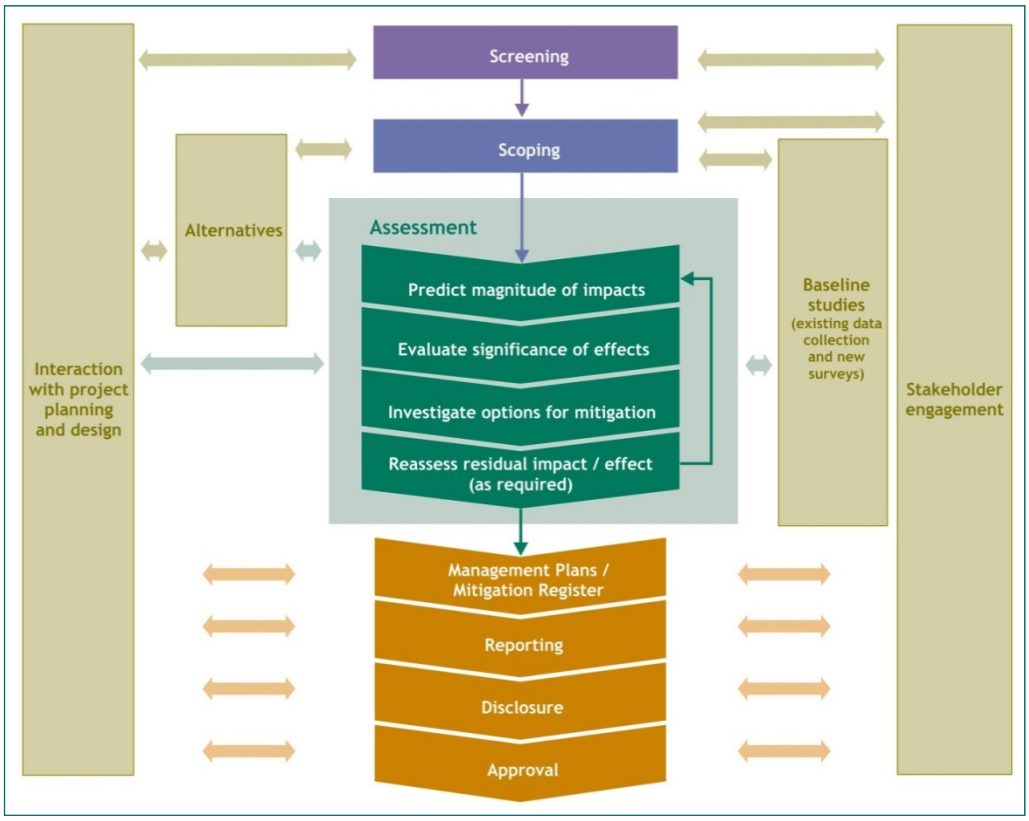
1.1 INTRODUCTION

This section of the EIA presents the methodology used to conduct the impact assessment. This methodology has been developed by ERM and is based on international best practice. The following approach is considered applicable to meet both Myanmar national and IFC requirements on environmental and social performance of the Project.

1.2 IMPACT ASSESSMENT METHODOLOGY

The impact assessment (IA) methodology follows the overall approach illustrated in *Figure B1.* The IA has been undertaken following a systematic process that predicts and evaluates the impacts the Project could have on aspects of the physical, biological, and social/ socio-economic environment, and identifies measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. The stages of the IA process are described below and further explained in the subsequent sections.

Figure B1 Impact Assessment Process



1.2.1 Scoping

Scoping has been undertaken to identify the potential Area of Influence (AOI) for the Project (and thus the appropriate Study Area), to identify interactions between the Project and resources/receptors in the AOI and the impacts that could result from these interactions, and to prioritize these impacts in terms of potential significance.

This phase is intended to ensure that the IA focuses on those issues that are most important for design, decision-making and stakeholder interest.

Scoping also has the benefit of identifying those impacts which are not likely to be significant and hence which warrant little or no further consideration or associated data gathering.

A scoping exercise was undertaken as part of EIA of the Project and the results are presented in *Section 4* of the EIA Report. The scoping of impacts indicates that the majority of identified potential impacts are not expected to be significant (i.e. those scoped out above). For activities predicted to have no significant impact (i.e. those in white in the Matrix), no detailed quantification or further assessment will be conducted in this EIA Report. For activities where possible significant effects could occur, these interactions will be assessed in more detail in *Sections 8-9* of this EIA Report

1.2.2 Project Description

The Project Description sets out the scope of the Project features and activities, with particular reference to the aspects which can impact on the environment. Details of the Project facilities' design characteristics, as well as Project activities, are provided in *Section 2* of this EIA Report.

1.2.3 Stakeholder Engagement

An effective IA Process requires engagement with relevant stakeholders throughout the key stages. This assists in informing stakeholders about the Project, understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

Details of the stakeholder engagement activities undertaken for this Project are presented in *Section 5* of this EIA report

1.2.4 Baseline Environment

To provide a context within which the impacts of the Project can be assessed, a description of physical, biological and social/socio-economic conditions that would be expected to prevail in the absence of the Project is characterized. The baseline includes information on all resources/receptors that were identified during scoping as having the potential to be affected by the Project.

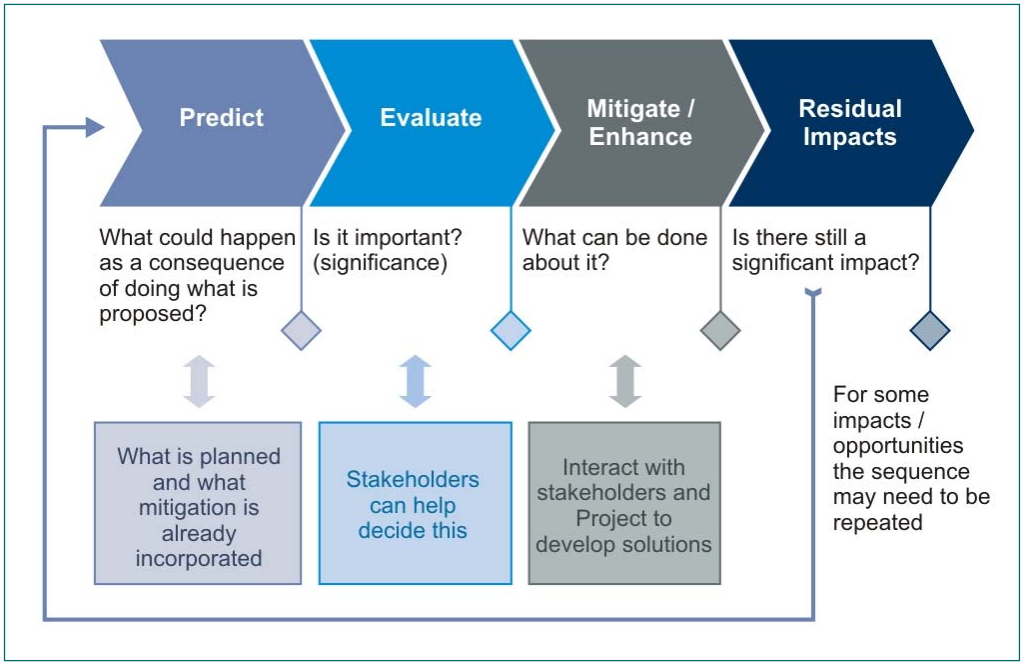
The baseline environment characterization is reported in *Sections 6-7* of this EIA Report.

1.2.5 *Impact Assessment*

Impact identification and assessment starts with scoping and continues through the remainder of the IA Process. The principal IA steps are summarized in *Figure B2* and comprise:

- Impact prediction: to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities.
- Impact evaluation: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- Mitigation and enhancement: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- Residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure B2 *Impact Assessment Workflow*



Prediction of Impacts

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the Project and its associated activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the Project and the baseline environment are identified. In the impact assessment stage,

these potential interactions are updated based on additional Project and baseline information. From these potential interactions, the potential impacts to the various resources/receptors are identified, and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques.

Evaluation of Impacts

Once the prediction of impacts is complete, each impact is described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is shown in *Table B1*.

Table B1 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The "reach" of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

The definitions for the *type* designations are shown in *Table B2*. Definitions for the other designations are resource/receptor-specific, and are discussed in the resource/receptor-specific sections.

Table B2 Impact Type Definitions

Designations (Type)	Definition
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is

likelihood. The *likelihood* of an unplanned event occurring is designated using a qualitative scale, as described in *Table B3*.

Table B3 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Once an impact's characteristics are defined, the next step in the impact assessment phase is to assign each impact a 'magnitude'. Magnitude is a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency

Additionally, for unplanned events only, magnitude incorporates the 'likelihood' factor discussed above.

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. As discussed above, the magnitude designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor-by-resource/receptor basis, as further discussed in each of the resource/receptor-specific sections. The universal magnitude designations are:

- Positive
- Negligible
- Small
- Medium
- Large

In the case of a *positive* impact, no magnitude designation (aside from 'positive') is assigned. It is considered sufficient for the purpose of the IA to indicate that the Project is expected to result in a *positive* impact, without characterising the exact degree of positive change likely to occur.

In the case of impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilised, but the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterising the magnitude of impact, the other principal impact evaluation step is definition of the sensitivity / vulnerability / importance of the impacted resource/receptor. There are a range of factors

to be taken into account when defining the sensitivity / vulnerability / importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors may also be considered when characterising sensitivity/vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis. The universal sensitivity/vulnerability/importance designations are:

- Low
- Medium
- High

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact. Impact significance is designated using the matrix shown in *Figure B3.*

Figure B3 Impact Significances

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Critical

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/ importance designations that enter into the matrix.

Box B1 provides a context for what the various impact significance ratings signify.

It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the IA Process). An example of an embedded control is a standard acoustic enclosure that is designed to be installed around a piece of major equipment. The avoids the situation where an impact is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

Identification of Mitigation and Enhancement Measures

Once the significance of an impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM has adopted the following Mitigation Hierarchy:

- **Avoid at Source; Reduce at Source**: avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).

- **Abate on Site**: add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping).

- **Abate at Receptor**: if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site).

- **Repair or Remedy**: some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.

- **Compensate in Kind; Compensate Through Other Means**: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Box B1 ***Context of Impact Significances***

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the IA Process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

Management and Monitoring

The final stage in the IA Process is definition of the management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

An ESMP, which contains a summary of all actions which the Project Proponents have committed to executing with respect to environmental/social/health performance for the Project, is also included as part of the EIA Report. The ESMP includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

Annex C

Air Quality Impact Assessment (AQIA) Technical Inputs

Annex C1

AQIA Criteria

1 AIR QUALITY IMPACT ASSESSMENT CRITERIA

1.1 OVERVIEW

With regard to air quality, there is no project specific approach for determining magnitude and significance of impacts. There is, therefore, a need to make specific consideration of the guidance set out by the IFC when defining the magnitude and significance of impacts.

The significance criteria to be used for the air quality impact assessment are therefore discussed in this section, as these significance criteria were applied for assessing impacts to air quality in the ESIA.

1.2 AIR QUALITY ASSESSMENT SIGNIFICANCE CRITERIA

The *magnitude* of impacts during the operational phase was quantified using predictive techniques based on detailed dispersion modelling. The magnitude of the impact was ascertained by means of comparison to air quality standards (AQS) and guidelines and is based upon whether or not the impacts result in air quality standards being exceeded or contribute a substantial proportion of airborne pollutants in the local airshed. Magnitude is based on both the 'Project Contribution (PC)'; this is the impact arising solely from project related emissions, and the Predicted Environmental Concentration (PEC); this is the PC added to the existing baseline.

In order to determine the *significance* of those impacts, consideration is then required to the sensitivity of the area in question, based on sensitivity of human health within the general population. There are a small number of specific cases where the sensitivity may be defined as 'High'; these include hospitals where there are intensive care units or high dependency wards. In general, the approach used in this assessment assumes that sensitivity within the general human population is 'Medium'. Under no circumstances is the sensitivity for human health described as 'Low'.

The IFC make a differentiation in the significance of impacts, based upon the existing baseline. Essentially, this is whether air quality standards are exceeded or not due to baseline concentrations.

The IFC General EHS Guidelines state:

> *"Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:*
>
> - *Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognized sources.*

- *Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed [i.e. in an undegraded airshed]".*

And:

> *"An airshed should be considered as having poor air quality [degraded] if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly".*

The IFC guidelines further state:

> *"Facilities or projects located within poor quality airsheds, and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment."*

The significance of impacts is therefore defined in terms of the magnitude of impacts (i.e. the PEC), the sensitivity of the receptors, and whether the baseline pollution concentrations are above or below the air quality standards. Using this approach, the significance criteria for air quality have been defined. Based upon these considerations the magnitude and significance of impacts for un-degraded and degraded airsheds has been derived and presented in *Table 1.1* and

Table 1.2 respectively.

Table 1.1 Magnitude Criteria for Assessment of Air Pollutants

Magnitude of impact	Undegraded airshed (i.e. baseline < AQS)	Degraded airshed (i.e. baseline > AQS)
Negligible	PC <25% of AQS	PC <10% of AQS
Small	PC between 25% and 50% of AQS and PEC <100% of AQS	PC between 10% and 30% of AQS
Medium	PC between 50% and 100% of AQS, and PEC <100% AQS; or PC between 25% and 50% of AQS, and PEC >100% of AQS	PC between 30% and 50% of AQS
Large	PC > 100% of AQS; or PC > 50% of AQS, and PEC >100% of AQS	PC > 50% of AQS

PC: Process Contribution
PEC: Predicted Environmental Concentration
AQS: Air Quality Standard

Table 1.2 Determination of Significance

Magnitude	Sensitivity		
	Low	*Medium*	*High*
Negligible	Negligible	Negligible	Negligible
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

Box 1.1 provides a context for what the various impact significance ratings signify.

Box 1.1 Context of Impact Significances

An impact of ***negligible*** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of ***minor*** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of ***moderate*** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of ***major*** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

With regard to dust deposition there is no clear consensus as to the level of dust deposition that is likely to result in nuisance issues. However, on the basis of pragmatic consideration of the various guidelines used internationally, the following magnitude criteria have been developed relating to dust deposition:

- Negligible: <120mg/m^2/day;
- Small: 120 – 200 mg/m^2/day;
- Medium: 200 – 350 mg/m^2/day; and
- Large: >350mg/m^2/day.

Significance is defined on the basis of the matrix set out in *Table 1.1*. However, for dust 'high sensitivity' receptors for dust include: hospitals, schools, and sensitive commercial properties; 'medium sensitivity' receptors include residential properties, recreational areas, public open spaces and markets and shopping areas; 'low sensitivity' receptors represent other locations, in particular agriculture and industrial areas. Furthermore, the significance of impacts associated with dust deposition is assessed in terms of the PC only. Impacts associated with deposition of dust relate to the potential to cause nuisance issues, with this being related to dust deposition over and above that which already exists. Therefore the guidelines refer to increased deposition only; this is in contrast to other pollutants where the total concentration is considered, as impacts are assessed against an absolute health based standard.

Annex C2

AQIA Detailed Methodology

1 OPERATIONAL PHASE AIR QUALITY IMPACT ASSESSMENT METHODOLOGY

1.1 CEMENT PLANT & ASSOCIATED LIMESTONE AND MUDSTONE QUARRY

1.1.1 Overview

The Project will emit a number of pollutants during normal operation which could potentially lead to significant impacts on air quality at sensitive receptors. These are primarily nitrogen dioxide (NO_2), sulphur dioxide (SO_2), and particulate matter (PM_{10} and $PM_{2.5}$) from the cement manufacturing process [(1)] including quarrying and mining [(2)]. Potential impacts to air quality during this phase of the Project were quantified using detailed dispersion modelling.

The process of deriving emissions from the proposed activities and equipment, and subsequently informing the dispersion model, is highly complex. The overarching approach is set out here, and the detailed calculations are set out in *Annex C3.*

1.1.2 Assumptions and Limitations

A number of assumptions have been made for determining impacts to air quality during the operational phase of the Project and include:

- The USEPA [(1)] state that only small quantities of volatile organic compounds (VOC), ammonia (NH_3), chlorine and hydrogen chloride (HCl) may be emitted from the cement manufacturing process and trace amounts of heavy metals may be emitted as a particulate or vapor. On this basis these substances have been screened out of the assessment and have not been considered further.

- The baseline surveys were undertaken during a period at the time when the existing 1,500 tonnes per day (tpd) cement plant was operational. The results, therefore, are expected to reflect a measure of the concentrations associated to the existing operation. As a conservative approach, the baseline results were treated as indicative of the baseline and all modelled concentrations cumulatively added to derive the predicted environmental concentration (PEC). This is considered a worst case approach as some double counting of species concentrations is likely.

- The daily operation of the cement plant will generate some additional traffic on the local road network; however, the number of vehicle

(1) The United States Environmental Protection Agency (USEPA) AP-42: Compilation of Air Emission Factors, Chapter 11.6 Portland Cement Manufacturing (1995) [Online] Available at: https://www3.epa.gov/ttn/chief/ap42/ch11/index.html [Accessed 18 December 2017]

(2) Australian Government (2012) National Pollution Inventory Emission Estimation Technique Manual [online] Available from: http://www.npi.gov.au/reporting/industry-reporting-materials/emission-estimation-technique-manuals [Accessed 01 March 2017]

movements is anticipated to be sufficiently small to not result in a significant impact on air quality.

- Fugitive emissions from the cement plant and quarry sites have been modelled as three (3) individual and spatially separate volume sources. This approach incorporates emissions from all identified activities within the cement plant and quarries into one consolidated source and assumes a continuous emission throughout the year. In practice, emissions will be more isolated to specific process areas, such as crushers and grinding mills, for example, or spatially variable and transient in the case of quarries where processing of raw materials would be undertaken in different parts of the quarry throughout the year. This approach, therefore, has some inherent inaccuracy depending on where receptors are spatially located relative to the volume source. Predicted concentrations at receptors close to the volume source are likely to be over or underestimated depending on the specific processes being undertaken and its relative distance from the receptor. The approach, however, is considered acceptable given the information type available, the scale of the operation, and the relative distance of receptors to the fugitive sources. The exception is the worker accommodation identified within 500m of the cement plant. Pollutant plumes would merge with distance from the volume source, therefore the accuracy of the model findings would increase with increasing distance from the source.

1.1.3 Proposed Project Activities

The main sources of atmospheric emissions from the cement plant and quarries during operations are presented in *Table 1.1.*

Table 1.1 Project Activities

Project Component	Activity	Pollutants of Interest
Cement Plant	• the kiln systems and clinker coolers; • material transfers and handling including loading and loading crushers and stockpiles; • the crushing, milling and grinding of auxiliary materials and cement; and • the onsite storage of auxiliary material and clinker.	NO_x, NO_2, SO_2, Dust, PM_{10} and $PM_{2.5}$
Limestone Quarry	• clearing and excavating of surface materials; • bulldozing surface materials; • drilling; • blasting; • loading and unloading haul trucks with limestone and waste rock; • vehicle movements over unpaved surfaces; • wind erosion from limestone and waste rock stockpiles.	Dust, PM_{10} and $PM_{2.5}$

Project Component	Activity	Pollutants of Interest
Mudstone Quarry	• clearing and excavating of surface materials; • bulldozing surface materials; • drilling; • blasting; • loading and unloading haul trucks with mudstone and waste rock; • vehicle movements over unpaved surfaces; • wind erosion from mudstone and waste rock stockpiles.	Dust, PM_{10} and $PM_{2.5}$

1.1.4 Impact Assessment Methodology

Detailed Modelling

The model used in the assessment is the USEPA AERMOD dispersion model. AERMOD is a state of the art detailed dispersion model that can be used to represent complex multiple emission sources and predicting air quality at receptor locations taking into account meteorology. The model is widely recognised for use in this type of application, including by the IFC, US Environmental Protection Agency, UK Environment Agency and Australian Environmental Protection Agency.

Detailed dispersion modelling has been used to predict concentrations of pollutants at ground level locations outside the site boundaries of the project and at sensitive human receptors. Five years of hourly sequential meteorological data have been used, so that inter annual variability is incorporated in the model. The results of the assessment are based upon the highest ground level concentration converted to the 95 percentile result for any of the five meteorological years used for each of the receptors considered.

Mitigation

The dispersion modelling has considered a number of basic mitigation measures for fugitive dust emissions from the cement plant (see *Annex C3 Table 2.2* and *Table 3.2*) such as fabric filters for crushing, storing and handling process materials including limestone and coal.

The point source emissions from the preheater and grate cooler stack have been modelled at the relevant emission limit for each substance of interest and can be considered a worst case scenario. It is likely that with the implementation of good practice mitigation (refer to *the ESMP* of ESIA) these concentrations will be reduced further.

The emissions of fugitive dust from the limestone and mudstone quarry, as well as the coal mine have been modelled assuming no mitigation and is therefore considered a worst case scenario. With the implementation of good practice mitigation (refer to *the ESMP* of ESIA) throughout the operational lifetime of the quarries and coal mine the impacts to air quality will be further reduced.

Assessment Scenario

The potential impacts from the cement plant and quarries were based on emission associated with the cement plant operating at 5,500tpd capacity.

The modelling scenario was developed to reflect net emissions from all the sources operating simultaneously over one entire year which comprises of 365 days for modelling purposes.

Defining Sources

The representation of emission sources in AERMOD has been based upon the nature of the source being considered and takes into account the fact that pollutant emissions are generated by different mechanisms:

- Emissions of dust (total suspended particulates - TSP) and PM_{10}/$PM_{2.5}$ generated from mechanical sources such as ore handling and processing, waste handling, and cement manufacturing, for example, were modelled and treated as volume sources within the dispersion model. The volume source is defined as a three-dimensional source of diffuse air pollutant emissions where there is an initial emission height. The volume sources have been used to represent activities in the cement manufacturing area and the limestone and mudstone quarry areas where emissions are subject to an initial lift from mechanical processes such as the transferring of raw materials used for the cement production process. The dimensions of the volume sources were assumed based on the expected size of the pit required to generate an additional 2.2 million tons per annum (mtpa) of limestone and 262,260 tons per annum (tpa) of mudstone. See *Annex C3* for more information regarding these assumptions.

- Emissions of NO_x, SO_2 PM_{10} and $PM_{2.5}$ occur from the operation of kiln systems and clinker coolers. These emissions are distinctly different from emissions of fugitive dust described previously in that they occur at elevated temperature and therefore have thermal buoyancy and have an upward momentum provided by the flow of gases from the stack. Therefore, these sources were treated in the model as point sources, in which stack parameters such height of emission, temperature and exit velocity are defined.

The use of these different approaches ensures that the different emission sources are suitably reflected in the modelling approach.

Defining Emissions

Emissions arising from the activities during the lifetime of the proposed Project have been defined based on a detailed review of the proposed Project activities. Where necessary, emissions have been derived using the following sources of information:

- the National Pollution Inventory (NPi) emission estimation technique manuals [1] produced by the Australian Government, which includes typical emissions from mining and cement manufacturing activities, and other relevant sources referenced in this report; and

- the USEPA AP-42 emission factor database for Portland Cement Manufacturing [2] and Aggregate Handling and Storage Piles [3].

NPi and AP42 provide the most recently published consolidation of suitable emissions data, and although derived from Australia and US sources, is considered to be robust and suitable for use in this assessment. The NPi takes into consideration local meteorological effects and provides opportunity to take into consideration site specific factors such as silt content and distances travelled on roads. Where it is appropriate to take into account local conditions in the estimation of emissions careful consideration has been given to the climate and geology of Myanmar.

The NPi and AP-42 guidance documents have been used as the basis for the following:

- scoping significant emission sources;

- estimating emissions from the identified significant sources; and

- identifying the reductions in emissions achievable with mitigation measures, where necessary.

The emission rates applied to both point and volume sources are summarised and presented in *Table 1.2*. The detailed emission inventory including source paramaters, emission factors and methodology to estimated emission rates from each source type are presented in more detail in *Annex C3.*

Table 1.2 Applied Emission Rates

Project Component	Source Type	Source Description	Pollutant Type	Emission Rate (g/s)
Cement Plant	Volume	Fugitive emission from 5,500tpd process	PM	3.28
	Point	Preheater stack (1,500tpd)	NO_x	40.7
			SO_2	0.881
			PM	6.78

(1) Australian Government (2012) National Pollution Inventory Emission Estimation Technique Manual [online] Available from: http://www.npi.gov.au/reporting/industry-reporting-materials/emission-estimation-technique-manuals [Accessed 01 March 2017]

(2) United States Environmental Protection Agency (USEPA) (1995) Fifth Edition, Volume 1, Chapter 11.6: Portland Cement Manufacturing [Online] Available from: https://www3.epa.gov/ttn/chief/ap42/ch11/index.html [Accessed 01 March 2017]

(3) United States Environmental Protection Agency (USEPA) (1995) Fifth Edition, Volume 1, Chapter 13.2.4: Aggregate Handling And Storage Piles [Online] Available from: https://www3.epa.gov/ttn/chief/ap42/ch13/index.html

Project Component	Source Type	Source Description	Pollutant Type	Emission Rate (g/s)
	Point	Grate cooler stack (1,500tpd)	PM	1.56
	Point	Preheater stack (4,000tpd)	NO_x	70.0
			SO_2	46.6
			PM	3.50
	Point	Grate cooler stack (4,000tpd)	PM	3.62
Limestone Quarry	Volume	Fugitive emission from 5,500tpd process	PM	2.06
Mudstone Quarry	Volume	Fugitive emission from 5,500tpd process	PM	1.05

Land Use and Terrain

The land use and terrain around the Project will affect dispersion. Airflow over the ground is disturbed by protuberances into the air, for example buildings, trees and vegetation. The surface roughness length is a representation of the disruption of airflow close to the ground due to these obstructions. In this case, the land use type is primarily characterised by forest. The albedo, bowen ratio and surface roughness used in AERMOD to characterise the above-mentioned environment is presented below in *Table 1.3.*

Table 1.3 Land Use Characteristics

Land Use Type	Albedo	Bowen Ratio	Surface Roughness
Deciduous forest	0.215	0.875	0.9

Hills, mountains and valleys can affect dispersion by directing the plume. The terrain pre-processor AERMAP using the Shuttle Radar Topographic Mission (SRTM) 90 x 90m imagery was run to provide information on the a) base elevation of each receptor and source defined in the model; and b) the terrain height that has the greatest influence on dispersion for each individual receptor, otherwise known as the hill height scale. Both the base elevation and hill height scale were incorporated into AERMOD.

Receptor Grid

The dispersion model uses a nested cartesian grid centred on cement plant and extending up to 5km in each direction to determine the maximum PC and the PC arising at sensitive receptors and in each receptor classification. The receptor spacing varies with distance from the cement plant in order to provide sufficiently dense receptors close to the site, and suitable spatial coverage further afield. The spacing of receptors is as follows:

- 50 meter spacing from 0 to 500 meters;
- 100 meter spacing from 500-1000 meters;
- 150 meter spacing from 1000 meters to 2000 meters; and

- 300 meter spacing from 2,000 meters to 5,000 meters.

Meteorological Data

The meteorological data used in the model must be reflective of the local conditions. There is very little meteorological data available for Myanmar, and that which was identified was not considered robust due to missing and incomplete data. Therefore five years of meteorological data were modelled using a 12km x 12km grid resolution using the Weather Research and Forecasting Model (WRF) [1]. The WRF model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. The model is extensively validated using actual observations to ensure the best possible accuracy and precision.

Conversion of NO_x to NO_2

Emissions from the Project contain oxides of nitrogen, occurring as both nitric oxide (NO) and NO_2. The ratio of these two gases in the exhaust gases from combustion processes varies, but is typically in the ratio of 90-95% NO to 5–10% NO_2. With regard to the assessment of impact on human health NO_2 is the pollutant of interest as NO has little effect on human health at concentrations typically encountered in ambient air.

Within the atmosphere various processes oxidise NO to create NO_2 but these processes will not occur quickly or completely before the plume reaches ground level. Therefore it is overly pessimistic to assume 100% conversion from NO to NO_2, and it is necessary to use a factor to estimate ground level concentrations of NO_2 based upon total NO_x emitted.

A number of international agencies have developed guidelines for including in assessments the conversion of NO to NO_2. A summary of selected guidelines are set out below in *Table 1.4* which indicates that a wide range of ratios to convert NO to NO_2 are recommended by a variety of agencies.

Table 1.4 Recommended NO to NO_2 Conversion Ratio

Country	Averaging period	Recommended NO to NO_2 conversion ratio
United States	1 hour	80%
	Annual	75%
Germany	24 hour	60%
	Annual	60%
United Kingdom	Short term (1 hour)	35%
	Annual	70%
Hong Kong	24 hour	20%
	Annual	20%
Ontario, Canada	24 hour	52%
	Annual	68%

[1] Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, M. G Duda, X.-Y. Huang, W. Wang, and J. G. Powers, 2008: A Description of the Advanced Research WRF Version 3. NCAR Tech. Note NCAR/TN-475+STR, 113 pp.

On the basis of those factors identified, the worst cases are those derived by the USEPA. On this basis, an 80% conversion rate was used for short term and a 75% conversion rate was used for long term. These conversion factors have been applied in the results interpretation.

It should be noted that the USEPA discusses NO_x to NO_2 conversion approaches in detail in a March 2011 memorandum [1]. According to this memorandum, the approaches can be characterised in terms of tiers that correspond to decreasingly conservative, but increasingly accurate and scientifically justifiable, methods. Tier 1 assumes 100% conversion to NO_2. Tier 2 applies an Ambient Ratio Method (ARM) of 80% (1-hour) and 75% (annual) conversion, and Tier 3 uses the NO_x to NO_2 conversion algorithms built into AERMOD. The Tier 3 methods built into AERMOD include the Ozone Limiting Method (OLM) and Plume Volume Molar Ratio Method (PVMRM). Both OLM and PVMRM require the user to specify ozone concentrations that can vary in several different ways, ranging from a single value to hourly concentrations that need to be developed and processed for model input. According to EPA, the use of OLM or PVMRM must be justified on a case-by-case basis but these techniques are considered to be generally accurate and justifiable. The selection of a Tier 2 approach for this study (near-field and far-field) provides a conservative assessment.

Buildings

When air flow passes over buildings, a phenomenon known as building downwash occurs where the air is entrained in the lee of the building and drawn down to ground level. This effect can bring the plume from the stack down to ground level quicker than would otherwise be the case, and therefore increase the ground level concentration relative to a case where there are no buildings. Building effects are typically a consideration where the buildings are greater than one third the height of the stacks.

No detailed information regarding the dimensions of buildings was available therefore no buildings were included within the model setup.

1.2 COAL MINE AND ASSOCIATED COAL STOCKPILING AREA

1.2.1 Overview

The Project will emit a number of pollutants during normal operation which could potentially lead to significant impacts on air quality at sensitive receptors. At the coal mine site, these are primarily dust, PM_{10} and $PM_{2.5}$ from the mining of coal and the associated activities including the transportation and handling of ore and waste materials and stockpiling.

[1] USEPA, 2011. Memorandum - Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. United States Environmental Protection Agency, March 01 2011.

The process of deriving emissions from the proposed activities and equipment, and subsequently informing the dispersion model, is highly complex. The overarching approach is set out here, and the detailed calculations are set out in *Annex C3.*

1.2.2 Assumptions and Limitations

A number of assumptions have been made for determining impacts to air quality during the operational phase of the coal mine and include:

- the daily operation of the mine will generate some additional traffic on the local road network; however, the number of vehicle movements is anticipated to be sufficiently small to not result in a significant impact on air quality.

- fugitive emissions from the coal mine and stockpile areas have been modelled as two (2) individual and spatially separate volume sources. This approach incorporates emissions from all identified activities within the coal mine and stockpiling area into one consolidated source and assumes a continuous emission throughout the year. In practice, emissions will be more isolated to specific processing areas or spatially variable and transient in the case of the coal mine where processing of raw materials would be undertaken in different parts of the mine footprint throughout the year. This approach, therefore, has some inherent inaccuracy depending on where receptors are spatially located relative to the volume source. Predicted concentrations at receptors close to the volume source are likely to be over or underestimated depending on the specific processes being undertaken and its relative distance from the receptor. The approach, however, is considered acceptable given the information type available, the scale of the operation, and the relative distance of receptors to the volume sources. The exception is Paluzawa identified within 50m of the coal stockpiling areas at the closest point. Pollutant plumes would merge with distance from the volume source, therefore the accuracy of the model findings would increase with increasing distance from the source.

1.2.3 Proposed Project Activities

The main sources of atmospheric emissions from the coal mine and stockpiling area during operation have been identified and are presented below in *Table 1.5.*

Table 1.5 Project Activities

Project Component	Activity	Pollutants of Interest
Coal Mine	• clearing and excavating of surface materials; • bulldozing surface materials; • loading and unloading haul trucks with coal and waste rock; • wind erosion from waste rock stockpiles; • vehicle movements over unpaved surfaces.	Dust, PM_{10} and $PM_{2.5}$

Project Component	Activity	Pollutants of Interest
Coal Stockpiling Area	• unloading haul trucks with coal; • loading ships with coal; • vehicle movements over unpaved surfaces; • wind erosion from coal stockpiles.	Dust, PM_{10} and $PM_{2.5}$

1.2.4 Impact Assessment Methodology

Detailed Modelling

The detailed modelling approach is the same as that used for estimating emissions from the cement plant and associated quarry sites, however the results of the assessment are based upon the worst case result for any of the five meteorological years used for each of the receptors considered, as opposed to the 95 percentile applied at the cement plant. Refer to *Section 1.1.4* for further information.

Assessment Scenario

The potential impacts from the coal mine and stockpiling area were based on emissions associated with the coal mine producing 100,000tpa of coal.

The modelling scenario was developed to reflect net emissions from all the sources operating simultaneously over one entire year which comprises of 365 days for modelling purposes. It is noted that the coal mine is only active for six months of the year from December through May therefore this scenario is considered a worst case approach.

Defining Sources

The representation of emission sources in AERMOD has been based upon the nature of the source being considered and takes into account the fact that pollutant emissions are generated by different mechanisms:

- Emissions of dust (total suspended particulates - TSP) and $PM_{10}/PM_{2.5}$ generated from mechanical sources such as ore handling and processing and waste handling, for example, were modelled and treated as volume sources within the dispersion model. The volume source is defined as a three-dimensional source of diffuse air pollutant emissions where there is an initial emission height. The volume sources have been used to represent activities in the coal mine and stockpiling area where emissions are subject to an initial lift from mechanical processes such as the transfer and stockpiling of materials. The dimensions of the volume sources were based on the current size of the coal mine and the stockpile area. See *Annex C3* for further more detailed information regarding source type and characteristics.

Defining Emissions

Emissions arising from the activities during the lifetime of the proposed Project have been defined based on a detailed review of the proposed Project

activities. Where necessary, emissions have been derived using the following sources of information:

- the National Pollution Inventory (NPi) emission estimation technique manual for mining [1] produced by the Australian Government, which includes typical emissions from mining activities.

The NPi provide the most recently published consolidation of suitable emissions data, and although derived from Australia sources, is considered to be robust and suitable for use in this assessment. The NPi takes into consideration local meteorological effects and provides opportunity to take into consideration site specific factors such as silt content and distances travelled on roads. Where it is appropriate to take into account local conditions in the estimation of emissions careful consideration has been given to the climate and geology of Myanmar.

The NPi guidance document has been used as the basis for the following:

- scoping significant emission sources;
- estimating emissions from the identified significant sources; and
- identifying the reductions in emissions achievable with mitigation measures, where necessary.

The emission rates applied to the volume sources are summarised and presented in *Table 1.6.* The detailed emission inventory including source parameters, emission factors and methodology to estimated emission rates are presented in more detail in *Annex C3.*

Table 1.6 Applied Emission Rates

Project Component	Source Type	Source Description	Pollutant Type	Emission Rate (g/s)
Coal Mine	Volume	Fugitive emission from 100,000tpa coal production	PM	5.03
Coal Stockpiling Area	Volume	Fugitive emission from stockpiling 100,000tpa of coal	PM	1.60

Land Use and Terrain

The land use and terrain around the Project will affect dispersion. Airflow over the ground is disturbed by protuberances into the air, for example buildings, trees and vegetation. The surface roughness length is a representation of the disruption of airflow close to the ground due to these obstructions. In this case, the land use type is primarily characterised by

[1] Australian Government (2012) National Pollution Inventory Emission Estimation Technique Manual [online] Available from: http://www.npi.gov.au/reporting/industry-reporting-materials/emission-estimation-technique-manuals [Accessed 01 March 2017]

forest. The albedo, bowen ratio and surface roughness used in AERMOD to characterise the above-mentioned environment is presented below in *Table 1.7.*

Table 1.7 Land Use Characteristics

Land Use Type	Albedo	Bowen Ratio	Surface Roughness
Deciduous forest	0.215	0.875	0.9

Hills, mountains and valleys can affect dispersion by directing the plume. The terrain pre-processor AERMAP using the Shuttle Radar Topographic Mission (SRTM) 90 x 90m imagery was run to provide information on the a) base elevation of each receptor and source defined in the model; and b) the terrain height that has the greatest influence on dispersion for each individual receptor, otherwise known as the hill height scale. Both the base elevation and hill height scale were incorporated into AERMOD.

Receptor Grid

A 10km by 10km grid with a 150m resolution was applied across the study area to capture impacts from the coal mine and stockpiling areas. Furthermore, specific receptor points were included in the model to reflect the locations of the representative sensitive receptors.

Meteorological Data

The meteorological data used in the model must be reflective of the local conditions. There is very little meteorological data available for Myanmar, and that which was identified was not considered robust due to missing and incomplete data. Therefore five years of meteorological data were modelled using a 12km x 12km grid resolution using the Weather Research and Forecasting Model (WRF) [1]. The WRF model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. The model is extensively validated using actual observations to ensure the best possible accuracy and precision.

Buildings

When air flow passes over buildings, a phenomenon known as building downwash occurs where the air is entrained in the lee of the building and drawn down to ground level. This effect can bring the plume from the stack down to ground level quicker than would otherwise be the case, and therefore increase the ground level concentration relative to a case where there are no buildings. Building effects are typically a consideration where the buildings are greater than one third the height of the stacks.

No detailed information regarding the dimensions of buildings was available therefore no buildings were included within the model setup.

[1] Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, M. G Duda, X.-Y. Huang, W. Wang, and J. G. Powers, 2008: A Description of the Advanced Research WRF Version 3. NCAR Tech. Note NCAR/TN-475+STR, 113 pp.

Annex C3

Emission Factors and AERMOD Emission Inventory

1 *EMISISON FACTORS AND AERMOD EMISSION INVENTORY*

This Annex details the emission factors used to estimate emission rates for the project, and includes the detailed emission inventory for each source type identified.

The final section of this annex includes summary tables detailing the AERMOD inputs for the cement plant, limestone quarry, mudstone quarry and coal mine.

2 EMISSION FACTORS

2.1 OVERVIEW

Emission factors from AP-42 and Npi were used to determine emission rates for a number of processes leading to fugitive dust emissions at the cement plant, limestone quarry, mudstone quarry and coal mine.

The primary sources of information include:

- National Pollution Inventory (NPi) Emission Estimation Technique Manual for Mining, Version 3.1[1];
- United States Environmental Protection Agency (USEPA) Air Pollutant Emission factors (AP-42) for Aggregate Handling And Storage Piles [2] ; and
- United States Environmental Protection Agency (USEPA) Air Pollutant Emission factors (AP-42) for Portland Cement Manufacturing [3].

2.1.1 *Emission factors for Portland Cement manufacturing*

The emission factors used to generate emission rates for operations at the cement plant are set out in *Table 2.1.*

[1] Australian Government (2012) National Pollution Inventory Emission Estimation Technique Manual for Mining, Version 3.1 [Online] Available at : http://www.npi.gov.au/system/files/resources/7e04163a-12ba-6864-d19a-f57d960aae58/files/mining.pdf [Accessed 11th March 2017]

[2] Unites States Environmental Protection Agency (USEPA) Air Pollutant Emission Factors (AP-42) Chapter 13.2.4 Aggregate Handling and Storage Piles [Online] Available at: https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf [Accessed 11th March 2017]

[3] Unites States Environmental Protection Agency (USEPA) Air Pollutant Emission Factors (AP-42) Chapter 11.6 Portland Cement Manufacturing [Online] Available at: https://www3.epa.gov/ttn/chief/ap42/ch11/final/c11s06.pdf [Accessed 11th March 2017]

Table 2.1 Emission Factors for Portland Cement Manufacturing

Process	Emission Factor	Unit
Particulate Matter (PM) from Kilns and Clinker Coolers		
Preheater/precalciner process kiln with fabric filter	0.100	kg/ton of clinker
Clinker cooler with ESP	0.0480	kg/ton of clinker
Particulate Matter (PM) from Manufacturing Raw Material and Product Processing and Handling		
Raw mill with fabric filter	6.20×10^{-3}	kg/ton of material process
Raw mill feed belt with fabric filter	1.60×10^{-3}	kg/ton of material process
Raw mill weigh hopper with fabric filter	0.0100	kg/ton of material process
Raw mill air separator with fabric filter	0.0160	kg/ton of material process
Finish grinding mill with fabric filter	4.20×10^{-3}	kg/ton of material process
Finish grinding mill feed belt with fabric filter	1.20×10^{-3}	kg/ton of material process
Finish grinding mill weigh hopper with fabric filter	4.70×10^{-3}	kg/ton of material process
Finish grinding mill air separator with fabric filter	0.0140	kg/ton of material process
Primary limestone crushing with fabric filter	5.00×10^{-4}	kg/ton of material process
Primary limestone screening with fabric filter	1.10×10^{-4}	kg/ton of material process
Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process
Secondary limestone screening and crushing with fabric filter	1.60×10^{-4}	kg/ton of material process

Source: USEPA AP-42 Emission Factor database – Chapter 11.6 Portland Cement Manufacturing

2.1.2 *Emission Factors for Aggregate Handling and Storage Piles*

Overview

The approach set out in AP-42 and Npi was used to estimate the emissions of particulate matter from aggregate handling and storage piles at the cement plant, limestone quarry and mudstone quarry. Formulae are given to calculate emissions based upon source characteristics and other considerations such as local meteorological conditions.

Calculation of Emissions from Aggregate Handling and Storage Piles

Emission equations have been used to calculate emissions from material handling for the following processes:

- loading crushers;
- clearing and excavating; and
- loading and unloading haul trucks;

The emission factor equation used to estimate the emissions is as follows:

- E = 0.0016 x [((u/2.2)^1.3)/((m/2)^1.4)] (kg/ton of material) *(Equation 1)*
  - Where:
    - E = emission factor
    - u = mean wind speed
    - m = material moisture content

2.1.3 *Emission Factors for Mining*

Overview

The approach set out in Npi was used to estimate the emissions of particulate matter from mining processes at the coal mine, limestone quarry and mudstone quarry. Formulae are given to calculate emissions based upon source characteristics and other considerations such as local meteorological conditions.

Calculation of Emissions from Mining Operations

Emission equations have been used to calculate emissions from the following processes at the coal mine, mudstone quarry and limestone quarry:

- bulldozing;
- drilling;
- blasting;

- vehicle movements over unpaved surfaces;
- wind erosion form active stockpiles;
- excavators/shovels/front-end loaders; and
- wind erosion from active stockpiles.

The emission factor equation used to estimate the emissions from each of the above mentioned processes is as follows:

Bulldozers on Coal

- EF TSP = 35.6*s^1.2(%)/M^1.4(%) *(Equation 2)*
  - Where:
    - EF = emission Factor
    - S = silt content (%)
    - M= moisture content (%)

Bulldozers on Material other than Coal

- EF TSP = 2.6*s^1.2(%)/M^1.3(%) (*Equation 3)*
  - Where:
    - EF = Emission Factor
    - S = silt content (%)
    - M= moisture content (%)

Drilling

- TSP = 0.59 kg/hole (*Equation 4)*

Blasting

- EF TSP (kg/blast) = 0.00022 x A^1.5 (m2) (*Equation 5)*
  - Where:
    - EF = emission factor
    - A = area blasted (m^2)

Wheel Generated Dust from Unpaved Roads

- EF TSP (kgVKT) = (0.4536/1.6039)*4.9*(S(%)/12)^0.7)*(W(t)/3)^0.45 (*Equation 6)*

- Where:
  - EF = emission factor
  - S = silt content (%)
  - W(t) = vehicle mass

Wind Erosion from Active Stockpiles

- EF TSP = 1.9 x (S(%)/1.5)*365*(365-p/235)*(F(%)/15) (*Equation 7)*
  - Where:
    - EF = emission factor
    - S = silt content (%)
    - p = number of days rainfall >0.25mm
    - F = % of time wind speed >5.4m/s

The information used to calculate the emission rates for input into the AERMOD model are presented below in *Table 3.1.* The emission inventory and is presented in *Table 3.2, Table 3.3* and *Table 3.4.*

The emissions inventory has been developed based on the maximum amount of clinker produced in one full operational year.

Table 3.1 Existing Cement Plant Information (1500tpd)

Parameter	Quantity	Unit	Note
Output			
Clinker per day	1500	ton/day	Data provided by Shwe Tanug Cement
Clinker produced	493500	ton/year	Data provided by Shwe Tanug Cement
Operating hours	7896	hours	Data provided by Shwe Tanug Cement
Input			
Coal	113505	ton/year	Data provided by Shwe Tanug Cement
Limestone	709628	ton/year	Data provided by Shwe Tanug Cement
Mudstone	84464	ton/year	Data provided by Shwe Tanug Cement
Laterite	21883	ton/year	Data provided by Shwe Tanug Cement
Dolomite	24686	ton/year	Data provided by Shwe Tanug Cement
Other relevant data			
Moisture content of limestone	3	%	Data provided by Shwe Tanug Cement
Mean wind speed	3.36	m/s	Weather Research and Forecasting Model (WRF) data

Table 3.2 Fugitive Dust Emissions Inventory for Existing Cement Plant (1500tpd)

Project Process	Representative USEPA/NPI Process (see *Section 1*)	TSP Emission Factor	Unit	Emission Rate (g/s)
Loading Crusher	Material Transfer	1.16×10^{-3}	kg/ton of material process	0.0262
Primary Limestone crusher	Primary limestone crushing with fabric filter	5.00×10^{-4}	kg/ton of material process	0.0113
Secondary limestone crusher	Secondary limestone screening and crushing with fabric filter	1.60×10^{-4}	kg/ton of material process	3.60×10^{-3}
Conveyor transfer point	*Assumed covered*	*n/a*	*n/a*	*n/a*
Limestone Storage	Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process	3.38×10^{-4}
Limestone Stacker	Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process	3.38×10^{-4}
Limestone Re-claimer	Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process	3.38×10^{-4}
Auxiliary Material Crusher	Primary limestone crushing with fabric filter	5.00×10^{-4}	kg/ton of material process	1.69×10^{-3}
Raw Mill	Raw mill with fabric filter	6.20×10^{-3}	kg/ton of material process	0.160
	Raw mill feed belt with fabric filter	1.60×10^{-3}	kg/ton of material process	0.041
	Raw mill weigh hopper with fabric filter	0.0100	kg/ton of material process	0.259
Clinker Silo	*Assumed covered*	*n/a*	*n/a*	*n/a*
Cement Silo	*Assumed covered*	*n/a*	*n/a*	*n/a*
Coal Crusher	Primary limestone crushing with fabric filter	5.00×10^{-4}		1.80×10^{-3}
Coal Handling	*Assumed covered*	*n/a*	*n/a*	*n/a*
Coal Storage	*Assumed covered*	*n/a*	*n/a*	*n/a*
Coal Mill	Raw mill with fabric filter	6.20×10^{-3}	kg/ton of material process	0.0223
Cement Mill	Finish grinding mill with fabric filter	4.20×10^{-3}	kg/ton of material process	0.0690
	Finish grinding mill feed belt with fabric filter	1.20×10^{-3}	kg/ton of material process	0.0197
	Finish grinding mill weigh hopper with fabric filter	4.70×10^{-3}	kg/ton of material process	0.0772
	Finish grinding mill air separator with fabric filter	0.0140	kg/ton of material process	0.230
Packer	*Assumed covered*	*n/a*	*n/a*	*n/a*
Total fugitive TSP emission rate from facility				***0.92***

Table 3.3 Preheater Stack Emission Inventory for Existing Cement Plant (1500tpd)

Stack Parameter	Data	Unit	Note
Stack Location	20°52'5.00"N 96°23'30.77"E	Latitude/Longitude	Location of stack identified using aerial imagery
Stack height	87	m	Data provided by Shwe Tanug Cement
Stack diameter	2.80	m	Data provided by Shwe Tanug Cement
Emission velocity	16.3	m/s	Data provided by Shwe Tanug Cement
Volume flow rate	100	(Am^3/s)	Calculated based on emission velocity and stack diameter
Volume flow rate	67.8	(Nm^3/s)	Volume flow rate corrected for temperature only as actual oxygen and moisture content of exhaust gas not known(1)

Stack Parameter	Data	Unit	Note
Exit temperature	404	kelvin	Data provided by Shwe Tanug Cement
Reference temperature	273	kelvin	IFC EHS (2007)(2)
Oxygen (actual)	*n/a*	%	No data provided
Oxygen (normalised)	10	%	IFC EHS (2007)(2)
Moisture (actual)	*n/a*	%	No data provided
Moisture (normalised)	0	%	IFC EHS (2007)(2)
Expected hours of operation per year	7680	hours	Data provided by Shwe Tanug Cement
Emission Concentrations			
NO_x	600	mg/Nm^3	Myanmar emission limit guideline(2)(3)
SO_2	13	mg/Nm^3	Data provided by Shwe Tanug Cement
PM	100	mg/Nm^3	Myanmar emission limit guideline(2)(3)
Emission Rates			
NO_x	40.7	g/s	Calculated based on emission concentration and normalised volume flow rate specified.
SO_2	0.881	g/s	
PM	6.78	g/s	

(1) Environmental Permitting (England and Wales) Regulations 2010 Regulation 60(1) – Pollution Inventory Reporting – Combustion Activities Guidance Note, Version 4 January 2013

(2) International Finance Corporation (IFC) Environmental, Health and Safety Guidelines for Cement and Lime Manufacturing, 2007.

(3) Myanmar national Environmental Quality (Emission) Guidelines, 2015.

Table 3.4 Grate Cooler Stack Emission Inventory for Existing Cement Plant (1500tpd)

Stack Parameter	Data	Unit	Note
Stack Location	20°52'1.34"N 96°23'32.58"E	Latitude/Longitude	Location of stack identified using aerial imagery
Stack height	30	m	Data provided by Shwe Tanug Cement
Stack diameter	2.20	m	Data provided by Shwe Tanug Cement
Emission velocity	14.1	m/s	Data provided by Shwe Tanug Cement
Volume flow rate	53.6	(Am^3/s)	Calculated based on emission velocity and stack diameter
Volume flow rate	31.2	(Nm^3/s)	Volume flow rate corrected for temperature only as actual oxygen and moisture content of exhaust gas not known(1)
Exit temperature	469	kelvin	Data provided by Shwe Tanug Cement
Reference temperature	273	kelvin	IFC EHS (2007)(2)
Oxygen (actual)	*n/a*	%	No data provided
Oxygen (normalised)	10	%	IFC EHS (2007)(2)
Moisture (actual)	*n/a*	%	No data provided
Moisture (normalised)	0	%	IFC EHS (2007)(2)
Expected hours of operation per year	7680	hours	Data provided by Shwe Tanug Cement
Emission Concentrations			

Stack Parameter	Data	Unit	Note
PM	50	mg/Nm^3	Myanmar emission limit guideline[2][3]
Emission Rates			
PM	1.56	g/s	Calculated based on emission concentration and normalised volume flow rate specified.

(1) Environmental Permitting (England and Wales) Regulations 2010 Regulation 60(1) – Pollution Inventory Reporting – Combustion Activities Guidance Note, Version 4 January 2013

(2) International Finance Corporation (IFC) Environmental, Health and Safety Guidelines for Cement and Lime Manufacturing, 2007.

(3) Myanmar national Environmental Quality (Emission) Guidelines, 2015.

The information used to calculate the emission rates for input into the AERMOD model are presented below in *Table 4.1.* The emission inventory is presented in *Table 4.2, Table 4.3* and *Table 4.4.*

The emissions inventory has been developed based on the maximum amount of clinker produced in one full operational year.

Table 4.1 Proposed Cement Plant Information (4000tpd)

Parameter	Quantity	Unit	Note
Output			
Clinker per day	4000	ton/day	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Clinker per year	1240000	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Cement produced per year	1488000	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Operating hours	7896	hours	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Input			
Coal	220007	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Limestone	1566492	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Mudstone	262260	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Laterite	73780	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Raw Meal	1902532	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Gypsum	37216	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Mix material	74431	ton/year	Myanmar Shwe Tanug 4000TPD Technical Introductions, 2016
Other relevant data			
Moisture content of limestone	3.00	%	Data provided by Shwe Taung Cement
Mean wind speed	3.36	m/s	Weather Research and Forecasting Model (WRF) data

Table 4.2 Fugitive Dust Emission Inventory for the Proposed Cement Plant (4000tpd)

Project Process	Representative USEPA/NPI Process (see *Section 1*)	TSP Emission Factor	Unit	Emission Rate (g/s)
Loading Crusher	Material Transfer	1.16×10^{-3}	kg/ton of material process	0.0578
Primary Limestone crusher	Primary limestone crushing with fabric filter	5.00×10^{-4}	kg/ton of material process	0.0248
Secondary limestone crusher	Secondary limestone screening and crushing with fabric filter	1.60×10^{-4}	kg/ton of material process	7.95×10^{-3}
Conveyor transfer point	*Assumed covered*	*n/a*	*n/a*	*n/a*
Limestone Storage	Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process	7.45×10^{-4}
Limestone Stacker	Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process	7.45×10^{-4}
Limestone Re-claimer	Limestone transfer with fabric filter	1.50×10^{-5}	kg/ton of material process	7.45×10^{-4}
Auxiliary Material Crusher	Primary limestone crushing with fabric filter	5.00×10^{-4}	kg/ton of material process	5.33×10^{-3}
Raw Mill	Raw mill with fabric filter	6.20×10^{-3}	kg/ton of material process	0.374
	Raw mill feed belt with fabric filter	1.60×10^{-3}	kg/ton of material process	0.097
	Raw mill weigh hopper with fabric filter	0.0100	kg/ton of material process	0.603
Clinker Silo	*Assumed covered*	*n/a*	*n/a*	*n/a*
Cement Silo	*Assumed covered*	*n/a*	*n/a*	*n/a*
Coal Crusher	Primary limestone crushing with fabric filter	5.00×10^{-4}		3.49×10^{-3}
Coal Handling	*Assumed covered*	*n/a*	*n/a*	*n/a*
Coal Storage	*Assumed covered*	*n/a*	*n/a*	*n/a*
Coal Mill	Raw mill with fabric filter	6.20×10^{-3}	kg/ton of material process	0.0433
Cement Mill	Finish grinding mill with fabric filter	4.20×10^{-3}	kg/ton of material process	0.198
	Finish grinding mill feed belt with fabric filter	1.20×10^{-3}	kg/ton of material process	0.0566
	Finish grinding mill weigh hopper with fabric filter	4.70×10^{-3}	kg/ton of material process	0.222
	Finish grinding mill air separator with fabric filter	0.0140	kg/ton of material process	0.661
Packer	*Assumed covered*	*n/a*	*n/a*	*n/a*
Total fugitive TSP emission rate from facility				2.36

Table 4.3 Preheater Stack Emission Inventory for the Proposed Cement Plant (4000tpd)

Stack Parameter	Data	Unit	Note
Stack Location	20° 52.065'N 96° 23.433'E	Latitude/Longitude	Location of stack identified using aerial imagery
Stack height	87	m	Data provided by Shwe Tanug Cement
Stack diameter	3.60	m	Data provided by Shwe Tanug Cement
Emission velocity	16.5	m/s	Data provided by Shwe Tanug Cement
Volume flow rate	168	(Am^3/s)	Calculated based on emission velocity and stack diameter
Volume flow rate	117	(Nm^3/s)	Volume flow rate corrected for temperature only as actual oxygen and moisture content of exhaust gas not known(1)

Stack Parameter	Data	Unit	Note
Exit temperature	393	kelvin	Data provided by Shwe Tanug Cement
Reference temperature	273	kelvin	IFC EHS (2007)(2)
Oxygen (actual)	*n/a*	%	No data provided
Oxygen (normalised)	10	%	IFC EHS (2007)(2)
Moisture (actual)	*n/a*	%	No data provided
Moisture (normalised)	0	%	IFC EHS (2007)(2)
Expected hours of operation per year	7680	hours	Data provided by Shwe Tanug Cement
Emission Concentrations			
NO_x	600	mg/Nm^3	Myanmar emission limit guideline(2)(3)
SO_2	400	mg/Nm^3	Data provided by Shwe Tanug Cement
PM	30	mg/Nm^3	Myanmar emission limit guideline(2)(3)
Emission Rates			
NO_x	70	g/s	Calculated based on emission concentration and normalised volume flow rate specified.
SO_2	46.6	g/s	
PM	3.50	g/s	

(1) Environmental Permitting (England and Wales) Regulations 2010 Regulation 60(1) – Pollution Inventory Reporting – Combustion Activities Guidance Note, Version 4 January 2013

(2) International Finance Corporation (IFC) Environmental, Health and Safety Guidelines for Cement and Lime Manufacturing, 2007.

(3) Myanmar national Environmental Quality (Emission) Guidelines, 2015.

Table 4.4 Grate Cooler Stack Emission Inventory the for Proposed Cement Plant (4000tpd)

Stack Parameter	Data	Unit	Note
Stack Location	20° 52.013'N 96° 23.472'E	Latitude/Longitude	Location of stack identified using aerial imagery
Stack height	30	m	Data provided by Shwe Tanug Cement
Stack diameter	3.35	m	Data provided by Shwe Tanug Cement
Emission velocity	16.0	m/s	Data provided by Shwe Tanug Cement
Volume flow rate	141	(Am^3/s)	Calculated based on emission velocity and stack diameter
Volume flow rate	72.4	(Nm^3/s)	Volume flow rate corrected for temperature only as actual oxygen and moisture content of exhaust gas not known(1)
Exit temperature	469	kelvin	Data provided by Shwe Tanug Cement
Reference temperature	273	kelvin	IFC EHS (2007)(2)
Oxygen (actual)	*n/a*	%	No data provided
Oxygen (normalised)	10	%	IFC EHS (2007)(2)
Moisture (actual)	*n/a*	%	No data provided
Moisture (normalised)	0	%	IFC EHS (2007)(2)
Expected hours of operation per year	7680	hours	Data provided by Shwe Tanug Cement
Emission Concentrations			

Stack Parameter	Data	Unit	Note
PM	50	mg/Nm^3	Myanmar emission limit guideline[2][3]
Emission Rates			
PM	3.62	g/s	Calculated based on emission concentration and normalised volume flow rate specified.

(1) Environmental Permitting (England and Wales) Regulations 2010 Regulation 60(1) – Pollution Inventory Reporting – Combustion Activities Guidance Note, Version 4 January 2013

(2) International Finance Corporation (IFC) Environmental, Health and Safety Guidelines for Cement and Lime Manufacturing, 2007.

(3) Myanmar national Environmental Quality (Emission) Guidelines, 2015.

The information used to calculate emission rates for input into the AERMOD model are presented below in *Table 5.1.* The emission inventory is presented in *Table 5.2.*

The emissions inventory has been developed based on the 5,500tpd information.

Table 5.1 Limestone Quarry Information

In-Pit Information	Units	1500tpd[1]	5500tpd[2]
Total rock	ton/yr	684000	2584000
Total Ore for stockpiling	ton/yr	624000	2357333
Total Waste Rock Production	ton/yr	60000	226667
Crusher Feed	ton/yr	576000	2176000
Number of Blasting Holes	no.	80	302
Number of Blasts	per yr	84	317
Typical Area Blasted	m^2	600	600
Depth of blast hole	m	6	6
Moisture of Material	%	3[3]	
Mean Wind Speed	m/s	3.36[4]	
Silt Content	%	3.9[5]	
Area			
Pit Area	m^2	123147	465222
Length of pit	m	351[6]	682[6]
Waste dump area	m^2	12140	45862
Stockpile area	m^2	24281	91728
Vehicle			
Vehicle mass	ton	17	17
Number of trucks	no.	10	38
Total length of product road	m	5100	5100
Haul truck journeys per day	journeys/day	12	12
Total truck journeys per day	journeys/day	120	453
Average speed	km/hr	25	25

(1) Information for limestone quarry for existing production line was provided by Shwe Tanug Cement.

(1) The new production line will require an additional 1.6 million tons of limestone per year. The information for the 1500tpd production line indicates 576,000 tons of limestone per year goes through the crusher system. The total production with the 5,500tpd production line operational will therefore be 2,176,000 tons of limestone per year. The data for the new production line is therefore multiplied by a factor of 3.78 to estimate the required information for the 5,500tpd production line.

(2) Moisture of limestone provided by Shwe Tanug Cement.

(3) Mean wind speed calculated from Weather Research and Forecasting Model (WRF) data.

(4) USEPA AP-42: Chapter 13.2.4 - Aggregate handling and storage piles (mean silt content for general limestone)

(5) Length of pit is the square root of the area. This has been used to define the volume source in AERMOD.

Table 5.2 Limestone Quarry Emission Inventory for 5500tpd Production Line

Project Process	Representative USEPA/NPI Process (see *Section 1*)	TSP Emission Factor	Unit	Emission Rate (g/s)
Clearing/excavating	Material Transfer	3.23×10^{-4}	kg/ton of material process	0.0265
Bulldozing	Bulldozer on Material other than Coal	3.19	kg/hr	0.887
Drilling	Drilling	178	kg/yr	5.65×10^{-3}
Blasting	Blasting	3.2	kg/blast	0.0325
Loading and unloading haul trucks (ore)	Material Transfer	1.16×10^{-3}	kg/ton of material process	0.0870
Loading and unloading haul trucks (ore)	Material Transfer	1.16×10^{-3}	kg/ton of material process	0.0870
Loading and unloading haul trucks (ore)	Material Transfer	1.16×10^{-3}	kg/ton of material process	0.0804
Loading and unloading haul trucks (ore)	Material Transfer	1.16×10^{-3}	kg/ton of material process	0.0804
Vehicle movements over unpaved surfaces	Wheel generated dust from unpaved roads	1.38	kg/VKT	0.517(1)
Conveying	*Assume covered – no emission*			
Wind erosion from limestone stockpiles	Wind erosion from active coal stockpiles	1305	kg/ha/yr	0.0643
Loading and unloading haul trucks (waste)	Material Transfer	3.23×10^{-4}	kg/ton of material process	2.32×10^{-3}
Loading and unloading haul trucks (waste)	Material Transfer	3.23×10^{-4}	kg/ton of material process	2.32×10^{-3}
Wind erosion from waste rock stockpiles	Wind erosion from active coal stockpiles	1305	kg/ha/yr	0.190
Total fugitive TSP emission rate from limestone quarry				2.06

(1) Based on total truck journeys per day assuming each truck travels the length of the pit area (682m) each journey as a worst case assumption.

The information used to calculate emission rates for input into the AERMOD model are presented below in *Table 6.1.* The emission inventory is presented in *Table 6.2.*

The emissions inventory has been developed based on the 5,500tpd information.

Table 6.1 Mudstone Quarry Information

In-Pit Information	Units	1500tpd[1]	5500tpd[2]
Total rock	ton/yr	168000	430260
Total Ore for stockpiling	ton/yr	84000	215130
Total Waste Rock Production	ton/yr	84000	215130
Crusher Feed	ton/yr	84000	215130
Number of Blasting Holes	no.	80	205
Number of Blasts	per yr	23	59
Typical Area Blasted	m^2	600	600
Depth of blast hole	m	6	6
Moisture of Material	%	10[3]	
Mean Wind Speed	m/s	3.36[4]	
Silt Content	%	7.5[5]	
Area			
Pit Area	m^2	378500	969366
Length of pit	m	615[6]	985[6]
Waste dump area	m^2	4800	12293
Stockpile area	m^2	6070	15546
Vehicle			
Vehicle mass	ton	17	17
Number of trucks	no.	5	13
Total length of product road	m	2500	2500
Haul truck journeys per day	journeys/day	20	20
Total truck journeys per day	journeys/day	100	260
Average speed	km/hr	25	25

(1) Information for mudstone quarry servicing the 1500tpd cement plant was provided by Shwe Tanug Cement.

(2) The new production line will require an additional 262,260 tons of mudstone per year. The information for the 1500tpd production line indicates 168,000 tons of mudstone per year is required. The total production with the 5,500tpd production line operational will therefore be 430,260 tons of mudstone per year. The data for the new production line is therefore multiplied by a factor of 2.56 to estimate the required information for the 5,500tpd production line.

(3) Moisture of limestone provided by Shwe Tanug Cement.

(4) Mean wind speed calculated from Weather Research and Forecasting Model (WRF) data.

(5) USEPA AP42 - Chapter 13.2.4 - Aggregate handling and storage piles (mean silt content of overburden at western surface coal mining

(6) Length of pit is the square root of the area. This has been used to define the volume source in AERMOD.

Table 6.2 Mudstone Quarry Emission Inventory for 5500tpd Production Line

Project Process	Representative USEPA/NPI Process (see *Section 1*)	TSP Emission Factor	Unit	Emission Rate (g/s)
Clearing/excavating	Material Transfer	3.23×10^{-4}	kg/ton of material process	4.40×10^{-3}
Bulldozing	Bulldozer on Material other than Coal	1.46	kg/hr	0.406
Drilling	Drilling	121	kg/yr	3.83×10^{-3}
Blasting	Blasting	3.2	kg/blast	6.04×10^{-3}
Loading and unloading haul trucks (ore)	Material Transfer	2.16×10^{-4}	kg/ton of material process	1.47×10^{-3}
Loading and unloading haul trucks (ore)	Material Transfer	2.16×10^{-4}	kg/ton of material process	1.47×10^{-3}
Wind erosion from mudstonestockpiles	Wind erosion from active coal stockpiles	2788	kg/ha/yr	0.137
Loading and unloading haul trucks (waste)	Material Transfer	3.23×10^{-4}	kg/ton of material process	2.20×10^{-3}
Loading and unloading haul trucks (waste)	Material Transfer	3.23×10^{-4}	kg/ton of material process	2.20×10^{-3}
Wind erosion from waste rock stockpiles	Wind erosion from active coal stockpiles	2788	kg/ha/yr	0.109
Vehicle movements over unpaved surfaces	Wheel generated dust from unpaved roads	2.18	kg/VKT	0.377(1)
Total fugitive TSP emission rate from mudstone quarry				1.05

(1) Based on total truck journeys per day assuming each truck travels the length of the pit area (985m) each journey as a worst case assumption.

7 COAL MINE EMISSION INVENTORY

The information used to calculate the emission rates for input into the AERMOD model are presented below in *Table 7.1.* The emission inventory is presented in *Table 7.2* and *Table 7.3.*

The emissions inventory has been developed based on the coal mine producing 100,000tpa of coal for stockpiling and transporting.

Table 7.1 Coal Mine Information

In-Pit Information	Units	100,000tpa[1]
Total rock	ton/yr	1900000
Total Ore for stockpiling	ton/yr	100000
Total Waste Rock Production	ton/yr	1800000
Moisture of Material	%	9[2]
Mean Wind Speed	m/s	3.36[3]
Silt Content	%	6[4]
Area		
Pit Area	m^2	1800000
Length of pit	m	1341[5]
Waste dump area	m^2	7000
Stockpile area	m^2	150000
Length of stockpile area	m	1342[6]
Vehicle on product road		
Vehicle mass	ton	17
Number of trucks	no.	10
Total length of product road at mine site	m	400
Haul truck journeys per day	journeys/day	42
Total truck journeys per day	journeys/day	420
Average speed	km/hr	25
Vehicle at stockpiling area		
Vehicle mass	ton	17
Number of trucks	no.	10
Total length of product road at mine site	m	387
Haul truck journeys per day	journeys/day	42
Total truck journeys per day	journeys/day	420
Average speed	km/hr	25

(1) Information for coal mine producing 100,000tpa provided by Shwe Tanug Cement.
(2) Moisture of limestone provided by Shwe Tanug Cement.
(3) Mean wind speed calculated from Weather Research and Forecasting Model (WRF) data.
(4) USEPA AP42 - Chapter 13.2.4 - Aggregate handling and storage piles (mean silt content of coal at western surface coal mining)
(5) Length of pit is the square root of the area. This has been used to define the volume source in AERMOD.
(6) Length of stockpile area is the square root of the total area. This has been used to define the volume source in AERMOD.

Table 7.2 Coal Mine Emission Inventory - 100,000tpd Production

Project Process	Representative USEPA/NPI Process (see *Section 1*)	TSP Emission Factor	Unit	Emission Rate (g/s)
Clearing/excavating	Material Transfer	3.23E-04	kg/ton of material process	0.0195
Bulldozing	Bulldozer on coal	14.67	kg/hr	4.07
Loading and unloading haul trucks (ore)	Excavators/shovels/front-end loaders (on coal)	0.0415	kg/ton of material process	0.132
Loading and unloading haul trucks (waste)	Material Transfer	3.23E-04	kg/ton of material process	0.0184
Loading and unloading haul trucks (waste)	Material Transfer	3.23E-04	kg/ton of material process	0.0184
Wind erosion from waste rock stockpiles	Wind erosion from active coal stockpiles	2075	kg/ha/yr	0.0460
Haul trucks movements over unpaved surfaces	Wheel generated dust from unpaved roads	1.91	kg/VKT	0.360(1)
Dump truck movements over unpaved surfaces	Wheel generated dust from unpaved roads	1.91	kg/VKT	0.360(1)
Total fugitive TSP emission rate from coal mining area				5.03

(1) Based on total truck journeys per day assuming each truck travels the length of the product road (400m) each journey as a worst case assumption.

Table 7.3 Coal Stockpiling Area Emission Inventory - 100,000tpd Production

Project Process	Representative USEPA/NPI Process (see *Section 1*)	TSP Emission Factor	Unit	Emission Rate (g/s)
Loading and unloading haul trucks (ore)	Excavators/shovels/front-end loaders (on coal)	0.0415	kg/ton of material process	0.132
Loading and unloading haul trucks (ore)	Excavators/shovels/front-end loaders (on coal)	0.0415	kg/ton of material process	0.132
Wind erosion from coal stockpiles	Wind erosion from active coal stockpiles	2075	kg/ha/yr	0.987
Vehicle movements over unpaved surfaces	Wheel generated dust from unpaved roads	1.91	kg/VKT	0.349(1)
Total fugitive TSP emission rate from coal stockpiling area				1.60

(1) Based on total truck journeys per day assuming each truck travels the length of the stockpile area (1342m) each journey as a worst case assumption.

8 SUMMARY OF AERMOD INPUTS FOR CEMENT PLANT, LIMESTONE QUARRY, MUDSTONE QUARRY AND COAL MINE

8.1 CEMENT PLANT

The AERMOD model inputs for the cement plant are summarised in *Table 8.1* and *Table 8.2* below.

Table 8.1 Volume Source Information

Parameter	Data used in AERMOD	Unit
Source Type	Volume	Source type
Location	20°52'1.75"N 96°23'27.22"E	Lat/Long
Release height	2.5	m
Area of volume source	331776	m^2
Length of side	576	m
Emissions rate	3.28	g/s TSP

Table 8.2 Point Source Information

Parameter	1500tpd		4000tpd		Unit
Stack type	Preheater Stack	Grate Cooler Stack	Preheater Stack	Grate Cooler Stack	
Stack location	20°52'5.00"N 96°23'30.77"E	20°52'1.34"N 96°23'32.58"E	20° 52.065'N 96° 23.433'E	20° 52.013'N 96° 23.472'E	Lat/Long
Stack height	87.0	30.0	87.0	30.0	m
Stack diameter	2.80	2.20	3.60	3.35	m
Emission velocity	16.3	14.1	16.5	16.0	m/s
Actual Volume flow rate from stack	100	53.6	168	141	Am^3/s
Exit temperature	404	469	393.2	469	k
Expected/maximum hours of operation per year	8760	8760	8760	8760	hours
Emission Rate					
NO_x	40.7	*n/a*	70.0	*n/a*	g/s
SO_2	0.881	*n/a*	46.6	*n/a*	g/s
PM	6.78	1.56	3.50	3.62	g/s

8.2 LIMESTONE QUARRY

The AERMOD model inputs for the limestone quarry are summarised in *Table 8.3*.

Table 8.3 Volume Source Information

Parameter	Data used in AERMOD	Unit
Source Type	Volume	Source type
Location	20°52'33.64"N 96°24'25.32"E	Lat/Long
Release height	2.5	m
Area of volume source	465124	m^2
Length of side	682	m
Emissions rate	2.06	g/s TSP

8.3 MUDSTONE QUARRY

The AERMOD model inputs for the mudstone quarry are summarised in *Table 8.4 and* ***Error! Reference source not found.***.

Table 8.4 Volume Source Information for Proposed Pit

Parameter	Data used in AERMOD	Unit
Source Type	Volume	Source type
Location	20°52'4.45"N 96°22'40.28"E	Lat/Long
Release height	2.5	m
Area of volume source	970225	m^2
Length of side	985	m
Emissions rate	1.05	g/s TSP

8.4 COAL MINE

The AERMOD model inputs for the coal mine and associated stockpiling area are summarised in *Table 8.5* and *Table 8.6.*

Table 8.5 Volume Source Information for Coal Mine

Parameter	Data used in AERMOD(1)	Unit
Source Type	Volume	Source type
Location	23°26'39.26"N 94°16'58.80"E	Lat/Long
Release height	2.5	m
Area of volume source	448900	m^2
Length of side	670	m
Emissions rate	2.51 (5.03 total)	g/s TSP

(1) Two volume sources modelled due to model restriction.

Table 8.6 Volume Source Information for Stockpiling Area

Parameter	Data used in AERMOD	Unit
Source Type	Volume	Source type
Location	23°27'1.80"N 94°20'10.47"E	Lat/Long
Release height	2.5	m
Area of volume source	150000	m^2
Length of side	387	m
Emissions rate	1.6	g/s TSP

Annex D

Biodiversity Impact Assessment – Technical Inputs

Annex D1

Survey Reports

Mammal survey at Paluzawa Coal Mine and Pyinyaung Limestone Mine

Dr. Christian Matauschek and Aung Lin

February 2017

Client ERM	Client Representative
Project Mammal survey at Paluzawa Coal Mine and Pyinyaung Limestone Mine	Project Reference Number --
Authors Christian Matauschek, PhD (Consultant biologist) Aung Lin, MSc. (Field biologist)	Date 25-02-17
	Approved By

Revision	Description	Prepared by		Examined by	Date
	Survey report				

Key Words	Classification
Mammal survey, camera trapping, transect	☐ Open ■ Internal ☐ Proprietary

Distribution	Medium	Copy
	Soft copy	1

Content

Abbreviations

IUCN	International Union for Conservation of Nature and Natural Resources
ST	Shwe Taung
WS	Wildlife Sanctuary

Paluzawa Coal Mine

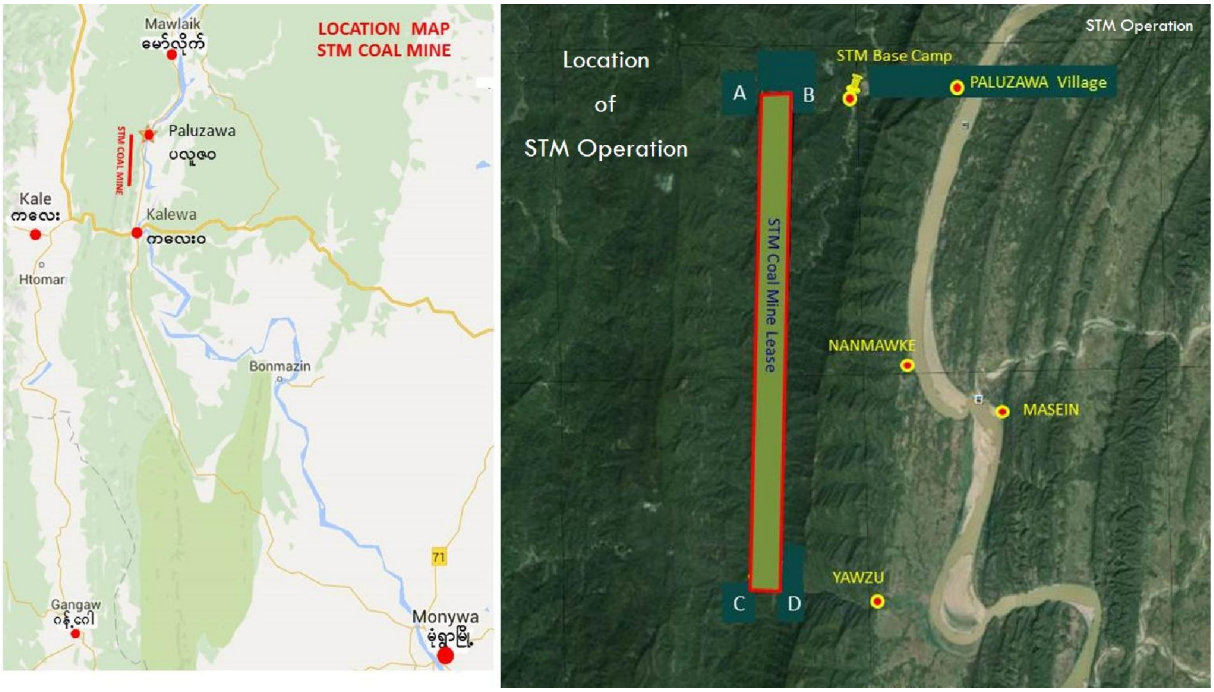
Site description

The project site is located close to Chaung Sone village (Paluzawa area), Ywar Thar village Tract, Kalaywa Township, 22 miles north of Kalaywa Town and 18 miles south of Maw Lite Town. The whole area lies west of Kalaywa -Maw Lite Road and about 4 miles west of the Chindwin River.

The base camp compound includes the a office, messing hall, clinics, oil depot, work shop, store, housings for employees, guest house, family line, nursery plot, and heavy machinery park. The coal mining area and three extraction (excavation) sites are in the west; the designated mining area is 3378.2 acres. The company has also a base camp at Paluzawa village 2 miles east on the Kalaywa-Maw Lite Road. The main fuel depot and coal stock yard are at this base camp. The coal from the stock yard is transported by truck east to Chindwin River and load on the river barge. The coal is mainly for use at a cement plant owned by the company at Pyi Nyaung, Thazi Township, Mandalay Region.

The study area is a hilly area with low mountain ranges and valleys. The area is within Mahtuu Reserved Forest area. Due to certain variation in elevation the forests are a mixture of mixed deciduous forest and moist evergreen forest. The forest is mostly secondary and partially degraded, but the vegetation as is still in relatively good condition. The mountain range and most of the streams are directed from north to south.

The coal mining lease of Shwe Taung company stretches from north to south. It is divided in several production sites (Phase 1-7) (Fig.1). Only Phase 1 to 4 are operated at the moment. The southern part of the lease is still not affected by mining activities.



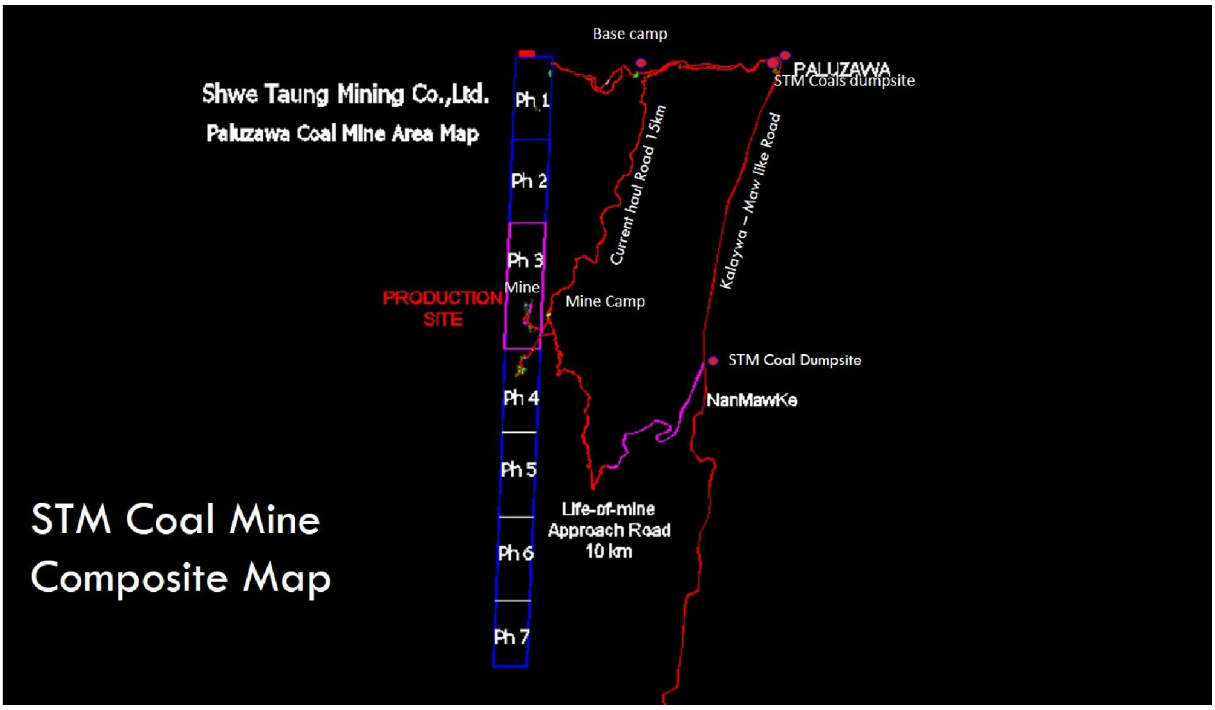


Fig 1: Location and site map of Paluzawa coal mine

Methodology

The survey methodology and resulting recommendations were planned and conducted under IFC Performance Standard (PS) 6.

Interviews

Interviews with local residents and hunters were used to obtain important information on presence or absence of mammal species. Both structured and unstructured interview were used to conduct these interviews. The interviews were focused on the target species like gibbon, langur, gaur or pangolin, but included also other mammals. The questions were designed to obtain data about each species: their population; their local status in terms of the past, present, and future; their ecological behavior and ecological niche; their breeding season; and the types of threats, both direct, and indirect, that each species faces. Questions were also asked about the wildlife trade, human animal conflict and habitat loss. Where possible, dates were identified. Questions were also asked about methods employed to kill or capture the animals, and what trade routes were used. For species identification the drawings in “A Field Guide to the Mammals of South-East Asia” (Francis 2008) and additional photos and drawings of primates were used. Locations of interviews are shown in supplementary map 2 and results are listed in Table 1.

Tab 1.: Overview interviews around Paluzawa coal mine

Date	Location	No. Participants	Special Remarks
26.01.17	Logging camp close to Chinese mining site	3	2 muntjac skins
04.02.	Sunflower farmers, south of the St lease	5	-
05.02.	Tin Win Tun, coal mining company	3	Reliable gaur and sambar evidence
05.02.	Bamboo collector`s camp	3	Reliable pangolin evidence
05.02.	Local hunter	1	Dhole teeth, gaur and gibbon evidence
05.02.	Hunter`s camp close to Chinese site	2	Pangolin evidence, wildlife trade
06.02.	Hunter`s camp close to Phase 1	3	Porcupine spines and intestine

Transect walks

The area has almost no proper trails beside the roads, which are connecting the operation sites with the base camp. The road ends at the operation site Phase 4. The southern half of the lease was not assessed by roads or trails yet and only poorly surveyed by the exploration team of the mine. In most parts we completely relied on the experience of an old hunter who used to hunt in that area in previous times. The surveyed distance covered app. 31 km (Tab.2). Efficient night surveys were difficult to realize. Given the difficult steep terrain with no trails in place, resulted in security concerns and the necessarily noisy movements in the dense understory vegetation made wildlife sightings rather unlikely.

Tab.2: Survey activities at Paluwaza coal mine

Date	Description	Purpose	Remarks
25.01	Walk from Phase 1 to Phase 2 and the Chinese mining site, and around Phase 4	Deployment of camera traps	
26.01.	Walk from Phase 3 to Phase 2, walk along the stream between Phase 4 and Phase 3	Deployment of camera traps	Cat tracks
04.02.	Walk from Phase 4 through the southern half of the ST lease	Exploration of the unexplored southern part of the lease	
05.02.	Survey of the landscape northwest of Phase 1, night survey around Phase 1	Exploration of the broader landscape, interviews	
06.02.	Survey of the stream, valley and mountains west of the ST lease starting from Phase 1	Exploration of the proposed offset area next to the lease	Cat tracks, Yellow-throated marten and giant squirrel sighting; Great hornbill sighting

07.02.	Survey around the bamboo collector`s camp	Langur survey	Gibbons calls

Camera trapping

For more than twenty years camera trapping presents a popular method to determine the presence of a species in a certain study area (Rovero et al. 2010; Pitett & Bennett 2014). They have been shown to be particularly useful for determining species richness in challenging rainforest ecosystems (Tobler et al. 2008; Srbek-Araujo & Chiarello 2005). Camera trap stations can be easy deployed on a cost efficient base, due to simple materials and low complexity. This non-invasive survey method opened possibilities for researchers to study terrestrial wildlife across large and remote areas, without much effort in space and time (Long et al. 2008). This is a main advantage when compared to the tracking-techniques, described above and other more elaborate research methods.

Fig 2: Deployment of camera traps

Camera trapping for the assessment of inventories can serve multiple purposes: it can provide reliable records of species presence (Tobler et al. 2008) in a certain study area, to show species diversity at a specific site, allow the comparison of species composition, occurrence and abundance at different sites (Rovero et al. 2010; Melo et al. 2012), or at different times of seasons in the year (Tobler et al. 2008) and study activity patterns of captured species (Gómez et al. 2005). They assist furthermore in refinement of distribution maps for individual species and can be used to assess anthropogenic or environmental impacts on mammalian communities (Tobler et al. 2008; Gomez et al. 2005). Additionally, camera-trapping is an efficient method to support long-term monitoring (O`Brien et al. 2003, Ahumada et al. 2011).

Camera trap location have been selected carefully in preliminary site surveys. See supplementary map 1 for camera trap locations (Tab. 3).

Tab. 3: Camera trap locations

Camera trap location no.	Camera Trap Label	Coordinates	Remarks	
Phase 1/Phase 2				
C1	ERM UV C27	N23° 26.865' E94° 16.707'	Fruiting tree	Yellow-throated marten, Porcupine, Domestic cattle, Humans
C2	ERM UV C29	N23° 26.430' E94° 16.464'	Mountain ridge	-
C3	ERM SG C25	N23° 26.369' E94° 16.480'	Ridge, near fruiting tree	-
C4	ERM SG C07	N23° 22.875' E94° 16.405'	Ridgeline, bamboo	Red muntjac, Leopard cat, Kalij pheasant
C5	ERM UV 15	N23° 22.794' E94° 16.366'	Bamboo	Porcupine, Red muntjac, Pallas` squirrel
C6	ERM UV C28	N23° 22.702' E94° 16.501'	Bamboo	Red jungle fowl
C7	ERM UO C05	N23° 22.709' E94° 16.533'	Fruiting tree	Porcupine, Red muntjac, Rhesus macaque, Rat, Kalij pheasant
Phase 3				
C8	-	N23° 24.662' E94° 16.668'	Dry bed of a small rocky stream, degraded bamboo forest, close to mining site	Yellow-throated marten, Leopard cat, Squirrel
C9	ERM UV 20	N23° 24.739' E94° 16.659'	bamboo	Red muntjac
Phase 2/Phase 3				
C10	ERM SG C08	N23° 24.776' E94° 16.665'	Fruiting tree, dense bamboo	Red muntjac
C11	ERM SG C23	N23° 24.941' E94° 16.643'	Dense bamboo forest	Wild boar, Northern tree-shrew
C12	ERM UO C01	N23° 24.959' E94° 16.672'	Dense bamboo forest, carnivore tracks	Wild boar, Squirrel
C13	ERM SG C06	N23° 25.057' E94° 16.734'	Ridge, degraded bamboo forest	Large indian civet, Domestic water buffalo, Scaly trush, Red jungle fowl
C14	ERM SG C22	N23° 24.920' E94° 16.723'	Ridge, dry stream, bamboo	Red muntjac, Greater necklaced laughingthrush
Phase 3/Phase 4				
C15	ERM SG C10	N23° 23.771' E94° 16.675'	Next to small stream, muntjac and carnivore tracks, secondary growth	Red muntjac, Red jungle fowl
C16	ERM UO C04	N23° 23.767' E94° 16.618'	Small stream, close to mining area, degraded forest, tracks of wild boar and muntjac	Fishing cat, Yellow-throated marten, red muntjac, Humans
C17	ERM UV 30	N23° 23.781' E94° 16.545'	Upstream small rocky stream, banana palm, small cat track, muntjac track	Red muntjac,Red-billed blue magpie

For the study we used 10 ScoutGuard, and 7 UO Vision camera traps. Both camera trap models using a passive heat in motion triggered sensor, which delivers high quality day and night images.

Additional equipment:

- Batteries (1 set per camera, 8 per set)
- SD memory cards (1 per camera)

The cameras in both camera trap studies were placed opportunistically at locations, which seemed promising in generating photographic images of terrestrial wildlife (App.1, Fig. 2). The area has only a very limited number of existing trails, which could be used for access to the site.

The cameras were set at an average height of 50 cm above the ground, to allow the recording of smaller mammals, as well (Kelly 2008; Jansen et al. 2014). The cameras have been be attached to trees, which had at least 15 cm BHD (Srbek-Araujo & Chiarello 2005), to allow a tight fit, and prevent dislocation, when individual animals are examining the camera trap unit at close distance.

Camera traps preferably were facing towards north or south, to have photographs without influence of backlight and to avoid ghost pictures, caused by false trigger by direct sunlight at sunrise and sunset (Jansen et al. 2014; Si et al. 2014). In order to avoid entanglement by woody vegetation (e.g. reflection of infrared flash), mainly locations with little or no woody vegetation in front of the camera have been selected (Tab.4).

Tab. 4: Settings of camera trap devices. These settings were used as standard for all cameras, to follow a homogenous camera trap setting

Camera Settings								
Set Mode	Image Size	Image Format	Set Mode Interval	Sensor Level	Night Vision Shutter	Time Stamp	Set Date	Coordinate Input
Camera	8 MP	Widescreen	1 Minute	Normal	Medium	On	Ind. Date	Off

All collected images were entered into Camera Base 1.6.1 (Tobler 2007), an MS Access based database designed for managing camera trap survey data. For every photograph taken, the camera trap device saves the camera trap location, date and time of individual capture event, moon phase and temperature as metadata in exif-Format. Afterwards, it is possible to readout the collected information and generate datasets for each individual captured species and capture event in Camera Base and save them for further data analysis.

The data will be filtered to exclude images of the same species at the same station within a period of one hour, in order to reduce entanglement, and ensure that capture events are independent (O´Brien et al. 2003; Tobler et al. 2008).

Presence/absence of species

The study provide basic data on presence/absence of terrestrial mammal species in the vicinity of the mining site. In total the camera trap days were 228. We registered 73 independent camera trap events for mammals and 14 for birds. In total 12 species of mammals and 5 species of birds were recorded (Tab. 5).

Tab. 5: Mammal species recorded on camera traps during the present study

Common name	Scientific name	RAI	IUCN status
Northern Treeshrew	*Tupaia belangeri*	1,32	LC
Rhesus Macaque	*Macaca mulatta*	0,44	LC
Leopard Cat	*Prionailurus bengalensis*	0,88	LC
Fishing Cat	*Prionailurus viverrinus*	0,44	VU
Yellow-throated marten	*Martes flavigula*	1,75	LC
Large Indian Civet	*Viverra zibetha*	0,44	LC
Common Palm Civet	*Paradoxurus hermaphroditus*	0,44	LC
Red muntjac	*Muntiacus muntjac*	5,7	LC
Wild boar	*Sus scrofa*	0,88	LC
Malayan Porcupine	*Hystrix brachyura*	9,6	LC
Rat	Muridae	7,2	-
Squirrel	*Callosciurus sp.*	2,19	-

Relative abundance

To measure the relative abundance of species in the study area the Relative Abundance Index (RAI) can be applied (Carbone et al. 2001; O`Brien et al. 2003). It is based on the number of pictures of a species of interest per 100 trap nights. Another abundance index is the percentage of photos of a target species in relation to all other animal photos.

Porcupine (9,6);Rat (7,2), Muntjac (5,7); Squirrel (2,19); Yellow-throated marten (1,75); Treeshrew (1,32); leopard cat, Wild boar (0,88); Fishing cat, Rhesus macaque, Large indian civet, Common palm civet (0,44) (Tab. 5). Please note, that relative abundance indices cannot provide conclusion about the real abundance of species. It can provide just a rather rough relative estimate in relation to the sampling effort.

Species accumulation curve

The success of the completeness of a species inventory is determined by Species Accumulation Curves (SAC), which saturate when all species of interest in the study area are detected (Tobler et al. 2008). The SAC represents the relationship of the number of species and the sampling

effort (number of camera days), which depend on the duration of sampling time, which gets consequently determined by the size and structure (homo-/heterogeneity) of the area sampled (Colwell 2009). The curve is expected to approach an asymptote, which gives a judgement of sampling adequacy of targeted large- and medium-sized mammal species composition in the study area. With increasing trapping effort the species richness curve should level off, when the sampling effort (respective camera trap days) is large enough, showing the inventorying of targeted mammalian taxa is sufficient (Ugland et al. 2003). Given the limited amount of time the SAC in this study is not saturated yet. Potentially rare and elusive species might have been not assessed yet. Nevertheless, considering the relatively high disturbance by human activities and the considerable degree of habitat degradation, we found a surprisingly high number of species in a short study period.

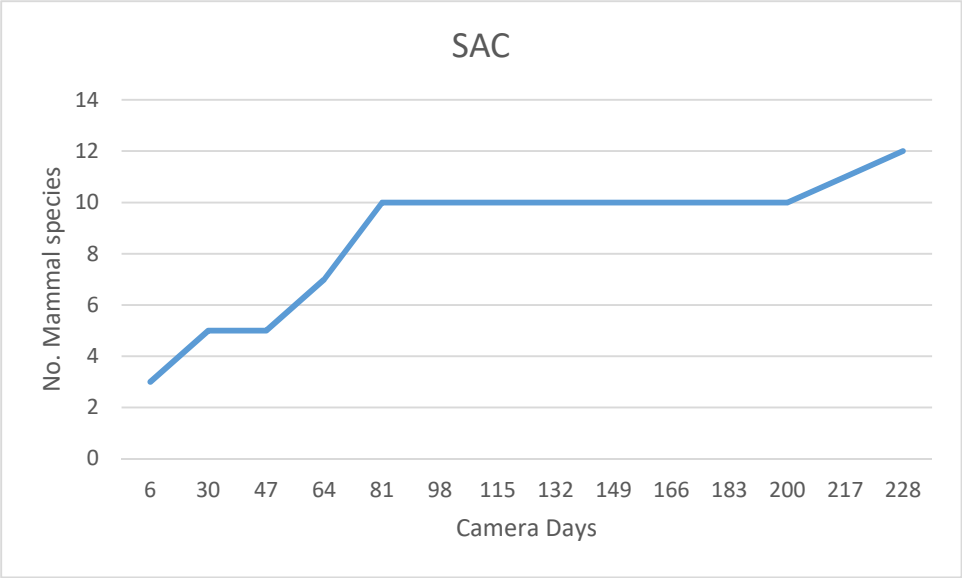


Fig. 3: Species accumulation curve for the present study

Target species

According to IFC PS 6 the main focus of this study was on threatened species which are classified under IUCN redlist criteria. Species accounts and taxonomy following Wilson & Mittermeier (2009-2012). A previous study done in November 2015 identified 25 species of mammals.

In total 12 species were confirmed by camera trapping. Two more species were recorded by direct sighting or acoustic evidence, two by skin/teeth, one by a video of a mining worker. Seven species were identified in interviews with local people (for species records see suppl. Maps 3 and 4). Only species which have been identified clearly or by more than one independent people are considered as confirmed (Tab. 6).

Critically Endangered

Chinese pangolin (*Manis pentadactyla*) CR

One of the target species is the Chinese Pangolin. All species of pangolins suffered a severe decline in recent years. The scales and their meat are highly demanded in Chinese traditional medicine. We got a video evidence of a of a pangolin found at one of the Shwe Taung mining

operation sites, close to the Chinese mining operation site. One of the miners took a video with his smartphone. The pangolin was released to the forest. Another pangolin was sold one day before our interview to a wildlife trader from Kale (1 vis = 620,000 MMK). It was caught just outside the ST mining lease by logging workers. Bamboo collectors had a sighting two weeks before our interview close to the ST lease. The presence of the Critically Endangered Chinese Pangolin in the area can be confirmed.

Endangered

Phayre`s langur (*Trachypithecus phayrei phayrei*) EN

The presence of this species was confirmed by all interviews, and a previous survey had a direct sighting (ERM internal report). During the years of logging for timber many domestic elephants where brought to the area. The mahouts were in their majority Kayen people, where the consumption of primate meat is common. Especially the intestines of langurs. During that period langurs have undergone a substantial decline in the region. This was confirmed in several independent interviews.

Langurs have been confirmed during previous survey in 2015. Most of the interviews we have undertaken in and around the area confirmed their presence but in general low numbers.

A bamboo collector claimed to have regular encounters with a langur group of about 7-10 individuals. A firewood collector and hunter described a group of 6-7 individuals which he regular sees around the Chinese mining site.

Western hoolock gibbon (*Hoolock hoolock*) EN

Two species of hoolock gibbon are recognized: the western hoolock gibbon (*Hoolock hoolock*), which is considered to be globally Endangered, and the eastern hoolock gibbon (*Hoolock leuconedys*), which is considered globally Vulnerable. The vast majority of the global populations of both western and eastern hoolock gibbons remain within Myanmar. Myanmar accounts for 100% of the global population of the eastern hoolock gibbon and at least 90% of the global population of the western hoolock gibbon. Previous studies suggests that within Myanmar there are from 310,000 to 370,000 eastern hoolock gibbons, 82,000 to 110,000 western hoolock gibbons

On the last survey day we had an acoustic record of Hoolock gibbons. One gibbon group was singing around 10 am.

There was also one interview evidence for the presence of gibbons. A 70 year old hunter saw two gibbons app. 7 month before the interview. He described a drastic decline of the local gibbon population in recent years due to the increasing hunting pressure by Chin hunters from Kale area.

Dhole (*Cuon alpinus*) EN

One of the interviewed hunters reported, that he caught a dhole inside the Shwe Taung area. The animal was trapped with a snare about eight month before our survey. The canines of the dhole were found at the local hunter`s house. He allowed us to take one as proof.

Vulnerable

Bengal slow loris (*Nycticebus bengalensis*) VU

Confirmed by all interviews, but seems to be very rare. Two month before our interview one individual was killed by the dog of a hunter while it was moving on the ground.

Asiatic black bear (*Ursus thibetanus*) VU

Bears suffer under heavy hunting pressure in most areas of south-east Asia. Given the high number of snare hunters and human activities in this specific landscape indicate only little numbers of bears. Nevertheless the last credible sighting of an Asiatic black bear inside the ST mining lease was only one year ago by mining worker. Other reliable sightings by local hunters seem to be not very recent, sometimes more than eight or ten years ago.

Fishing Cat (*Prionailurus viverrinus*) VU

An exceptional record is the camera trap record at a heavily degraded rocky stream between Phase 3 and 4 in very close distance to one of the mining operation sites. The cat on the picture is distinguished from leopard cat by its smaller spots, which form distinctive lines and the relative shorter tail (max 50% of head-body length) and its bulky appearance. The local leopard cats show much larger and darker spots, scattered in a more irregular pattern across the body. Rather large cat tracks were also found along another stream in the valley west of the lease.

Fishing cats are currently classified as Vulnerable. Very little is known about this species and records are generally scarce. Home ranges can be as large as 22 km² (males, females up to 6 km²). To contribute towards a conservation of such species, a broader approach on the landscape level is needed.

Fig 4: Cat tracks found along streams and riverbeds

Gaur (*Bos gaurus*) VU

One of the management staff of the mine saw one individual crossing the road close to Phase 3. 7 individuals were seen at Tin Win Tun site for month before the interview. One old hunter saw 3 individuals one month before the survey close to ST area.

Although we had no direct evidence (Photo, sighting) we consider the presence of the species inside ST area and in surrounding forests as confirmed. The species is highly distinctive due to its size, color, behavior or horn shape, that a confusion with domestic cattle or buffalo is very unlikely.

Sambar deer (*Rusa unicolor*) VU

Sambar deer seem to be very rare in the area. There was only one interview evidence at the mining site of another company (Tin Win Tun). One of the interviewed workers saw two individuals just four days prior to the interview.

Near Threatened

Assamese Macaque (*Macaca assamensis*) NT

In one of our interviews Assamese macaque (*Macaca assamensis*) were identified beside the common and regularly identified Rhesus macaques (*Macaca mulatta*). Rhesus macaques were recorded inside ST area on one of the camera traps.

Assamese macaques are classified as Near Threatened.

Chinese serow (*Capricornis milneedwardsi*) NT

No direct evidence, just indirect evidence by interviews. The species seems to be quite rare. Only one interview revealed some evidence for the presence of the species inside the ST lease.

Black Giant Squirrel (*Ratufa bicolor*) NT

Direct sighting of one individual very close to the mining lease. This species is widely distributed, but highly dependent to high canopy. Populations are declining due to loss of tall forest.

Other species

Other common species were Red Muntjac (*Muntiacus muntjak*) and Eurasian wild boar (*Sus scrofa*). Tracks of those species could be found frequently along streams, mountain ridges and inside degraded bamboo forests inside ST lease as well as in surrounding areas. These two species are also among the most targeted species of local hunters. The Malayan porcupine () was also recorded frequently on our camera traps. It is hunted with dogs and snares, not only for their meat, but also for their intestines, which are used in traditional medicine for stomach problems.

Among small carnivores we recorded Leopard cat (*Prionailurus bengalensis*) on two occasions, Large indian civet (*Viverra zibetha*) and yellow-throated marten (*Martes flavigula*). The latter still seems quite common in the area. Two individuals could be observed foraging along a small stream close to the Phase 1 mining site. One common palm civet (*Paradoxurus hermaphroditus*) was found dead at one of the small tea shops along the road inside ST area. According to the shop owners the animal was killed by a truck. The skin was dried and stuffed.

Fig 5: Stuffed skin of a common palm civet

We found tracks of small cats on several occasions throughout the ST lease. It is difficult to determine the species only according to the footprints, but due to the small size and the record of Leopard cat in the camera traps, we assume that most of the recorded tracks can be assigned to this species. The footprints of Fishing cat found along one of the streams were substantially larger and were also found inside the water (see above).

During the interviews there was no evidence of the presence of large cats like tigers, leopards or clouded leopards, although the clouded leopard is known to persist also in disturbed habitats, often overlooked due to its elusive and secretive life.

The carcass of a Northern treeshrew (*Tupaia belangeri*) was found inside a stream. It was obviously killed by humans and probably burned to remove the fur. Why it was left in the stream is not known.

Fig 6: Carcass of a northern treeshrew found in a stream

Two species records, which have been recorded during interview surveys in a previous study, are likely to be the result of some misidentification. The record of moon rat (*Echinosorex gymnurus*) would be highly surprising as the distribution area of this species is far off the survey site with its northern limits in Malaysia and southern Thailand, reaching Myanmar only in its most southern part. Also the presence of red goral (*Capricornis rubidus)* must be doubted. This species has been recorded in Myanmar only from few locations in the far north of Kachin state. During the interviews it may have been confused with red muntjac by local people and misidentified them in the pictures shown to them.

Recorded bird species, which are not included in the previous bird survey are listed in Tab. 7.

Tab. 6: Mammal species recorded during the present study at Paluwaza coal mine

Common name	Scientific name	Evidence	Inside ST area	Adjacent ST area	IUCN status
Order Scandentia					
Northern Treeshrew	*Tupaia belangeri*	Camera trap, carcass	+	+	LC
Order Pholidota					
Chinese Pangolin	*Manis pentadactyla*	Interview, video	+	+	CR
Order Primates					
Bengal Slow Loris	*Nycticebus bengalensis*	Interview	+	+	VU
Phayre`s Langur	*Trachypithecus p. phayrei*	Interview	-	+	EN
Rhesus Macaque	*Macaca mulatta*	Camera trap, interview	+	+	LC
Assamese Macaque	*Macaca assamensis*	Interview	-	+	NT
Western Hoolock Gibbon	*Hoolock hoolock*	Acoustic record, interview	-	+	EN
Order Carnivora					
Leopard Cat	*Prionailurus bengalensis*	Camera trap	+	-	LC
Fishing Cat	*Prionailurus viverrinus*	Camera trap, tracks	+	+	VU
Asiatic Black Bear	*Ursus thibentanus*	Interview	+	-	VU
Yellow-throated marten	*Martes flavigula*	Direct sighting, camera trap	+	+	LC
Large Indian Civet	*Viverra zibetha*	Camera trap	+	-	LC
Common Palm Civet	*Paradoxurus hermaphroditus*	Skin, camera trap	+	-	LC
Dhole	*Cuon alpinus*	Canine, interview	+	-	EN
Order Artiodactyla					
Gaur	*Bos gaurus*	Interview	+	+	VU
Chinese Serow	*Capricornis milneedwardsi*	Interview	+	-	NT

Sambar	*Rusa unicolor*	Interview	-	+	VU
Red muntjac	*Muntiacus muntjac*	Camera trap, sighting, skins	+	+	LC
Wild boar	*Sus scrofa*	Camera trap	+	+	LC
Order Rodentia					
Malayan Porcupine	*Hystrix brachyura*	Camera trap, spines/intestines	+	+	LC
Black Giant Squirrel	*Ratufa bicolor*	Sighting	-	+	NT

Tab 7. Additional bird species recorded during the mammal survey at ST coal mining site

Common name	Scientific name	Evidence	IUCN status
Kalij Pheasant	*Lophura leucomelanos*	Camera trap	LC
Great Hornbill	*Buceros bicornis*	Direct sighting	NT
Scaly Thrush	*Zoothera dauma*	Camera trap	LC
Red-headed Trogon	*Harpactes erythrocephalus*	Direct sighting	LC

Identified threats

Indirect effects of the mining activities bear more threats to wildlife than the mining operation itself. The newly constructed roads provide easy access for all kinds of people exploiting the natural resources of the area. All along the roads inside and outside the various mining leases you can find campsites with hunters and loggers.

The area was logged for timber between 2011 and 2014. The current logging activities are uncontrolled harvesting of firewood, destroying and degrading the remaining forest almost along all roads. Firewood is consumed not only in private households, it is also used to supply the worker`s camps with fuel and to provide construction material for the underground mines of adjacent mining operators.

Alongside with the logging goes the hunting of wildlife for food and international wildlife trade. Hunting methods include trapping with snares, as well as hunting with dogs and powder guns. Bushmeat is consumed by local people and workers. Most commonly hunted species for meat are wild boar and muntjac.

Fig 7: Skins of two muntjacs at a hunter`s camp

During the years of logging for timber many domestic elephants where brought to the area. The mahouts were in their majority Kayen people, where the consumption of primate meat is common. Especially the intestines of langurs. During that period langurs have undergone a substantial decline in the region. This was confirmed in several independent interviews.

Wildlife trade seems to be a major issues in the area. Traders and hunters follow the roads which are developed by the mining companies. Traders in Kale are buying pangolin scales, gaur horns, antlers of sambar deer, as well as tortoises.

Main threats

- Hunting and wildlife trade
- Logging for firewood
- Bamboo collection
- Road construction
- Degradation of streams and rivers
- Pollution with waste water
- Waste

Recommendations for reduction and mitigation of threats and biodiversity offset

To contribute towards conservation of mammal populations means to think in landscape dimensions. Therefore it is necessary to incorporate also the other four mining companies in all biodiversity conservation efforts. Regular meetings and consistent rules, regulations and mitigation methods should be in place for all operating companies.

A wildlife monitoring system should be in place. Collection of data on wildlife sightings, hunting, road kills etc can provide useful information on wildlife populations and can function as indicator of management success. A conservation officer or wildlife biologist should be hired to conduct monitoring, awareness and enforcement of rules and regulations. This person could also be involved in the awareness activities in schools, which are already supported by the mine, but so far focused only on general education. Awareness activities should also include environmental and wildlife related topics.

The conservation officer could be in charge to link the activities of the different operators and coordinate efforts towards a sustainable biodiversity conservation. Ideally a representative of the township forest department should be involved in all activities. DSA and travel costs should be covered by the mining operators. A conservation fund, jointly developed by all operators could provide funding for such activities.

The road between Paluzawa and Kalewa which is currently under construction is a joint project between all five mining companies. If it is possible to construct a road in a joint project between the five mining companies it should also be possible to contribute towards a joint conservation effort in the region. A financial mechanism with contributions depending on the size of the respective lease, similar like in the road construction project, could be applied.

As mentioned above the mining operations are the least problem in terms of mammal conservation. The indirect effects coming along the mining roads, such as hunters, loggers, bamboo collectors as well as unsustainable and habitat degrading activities of mining workers are much more harmful and destructive. So far no real mitigation measures by the mining operators are addressing these indirect negative effects.

Mining workers involved in illegal activities, such as wildlife trade, need to be warned, and eventually fined. Encroachment along the mining roads needs to be controlled.

The management of aquatic habitat, such as streams and rivers needs to be redeveloped. Gravel extraction, dumping of excavated material from road construction into river beds, construction of dams and pollution by wastewater from worker`s camps are destroying important habitats. As we discovered fishing cats in the area this gets even more important. These cats are dependent on riverine habitats. To maintain a population of this rare species and to avoid the decline or loss of another population of fishing cats sustainable and less destructive operational procedures needs to be developed and implemented.

Summary of recommended activities:

- Cease hunting
- Cease illegal logging
- Control of encroachment along the roads
- Control of workers and employees (fines for illegal activities, like wildlife trade or hunting)

- Conservation officer
- Include the township forest department in conservation activities
- Include wildlife conservation in awareness activities
- Redevelop water management and management of streams and rivers
- Establish monitoring of wildlife (collection of information on sightings, road kills etc)
- Establishment of a Conservation fund (consider contribution of all five mining companies of the region)
- Large-scale offset funded and managed in a joint effort of all five mining companies

The requirements for biodiversity offsets as recommended by IFC provide criteria and a basis for the planning of effective biodiversity offsets:

"For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied.

• Measurable conservation outcomes reasonably expected to result in no net loss and preferably a net gain of biodiversity. Net gain is required in critical habitats

• Must be demonstrated "on-the-ground" and on an appropriate geographic scale

• The design must adhere to the "like-for-like or better" principle ("trading-up" in certain circumstances)

For critical habitats:

• Project doesn't lead to net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over time (mainly IUCN Red List)

• Mitigations will be designed to achieve net gains of those biodiversity values for which critical habitat was designated

• Biodiversity offsets may sometimes be necessary to meet critical habitat requirements

• The project's mitigation strategy will be described in a Biodiversity Action Plan

• A biodiversity monitoring and evaluation program must be developed"

According to an existing offset plan (fig. 8) a biodiversity offset area covering 10,250 acres (4100 ha) is projected right next to the ST mining lease to the west. During our survey of the proposed offset area, we encountered still good forest, maybe the best during our whole survey. Although we found tracks of humans and domestic dogs, and banana plantation inside the valley, we encountered Yellow-throated marten, Black giant squirrel, Crested serpent eagle, and Great hornbill. Along and inside the stream we found tracks of cats (one of them potentially of fishing cat).

Before defining an offset area we recommend further surveys in the area and the consideration of a large-scale offset area, established in a joint effort by all mining companies operating in the area. The area still might provide sufficient habitat, even for large mammals such as gaur or sambar. According to local hunters there is relatively high gaur and sambar activity,

especially during rainy season, in Tafanchaung valley, which is located at the confluence of three streams. The area has a saltlick and is quite difficult to reach. It can be reached from the ST base camp following the nearby stream. According to the mining employees there is so far no mining lease or human settlement. This needs to be verified and maybe considered for future biodiversity offset planning (Fig 9).

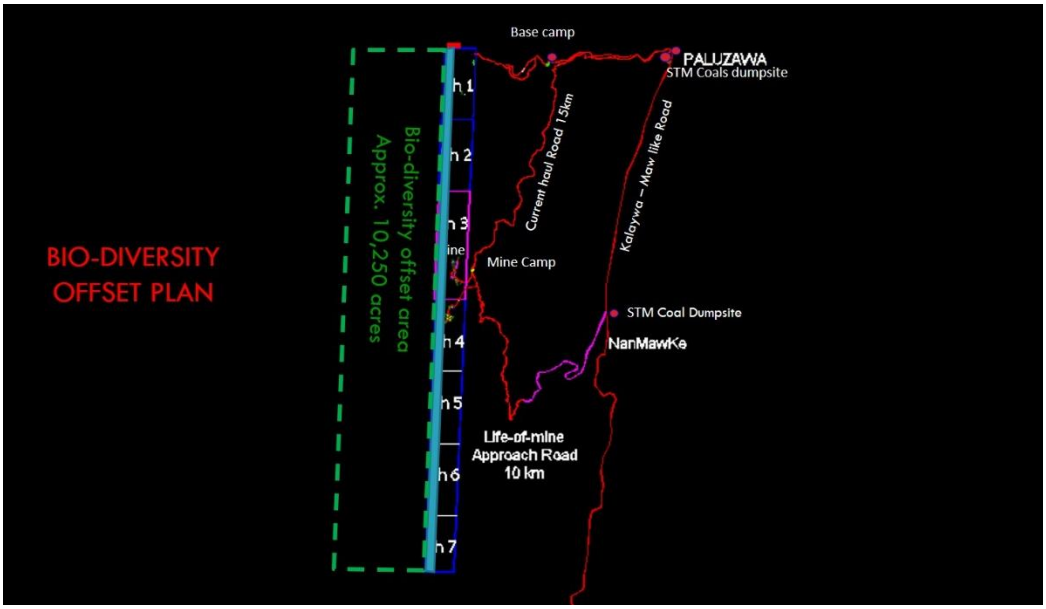


Fig 8: Biodiversity offset plan for Paluzawa coal mine

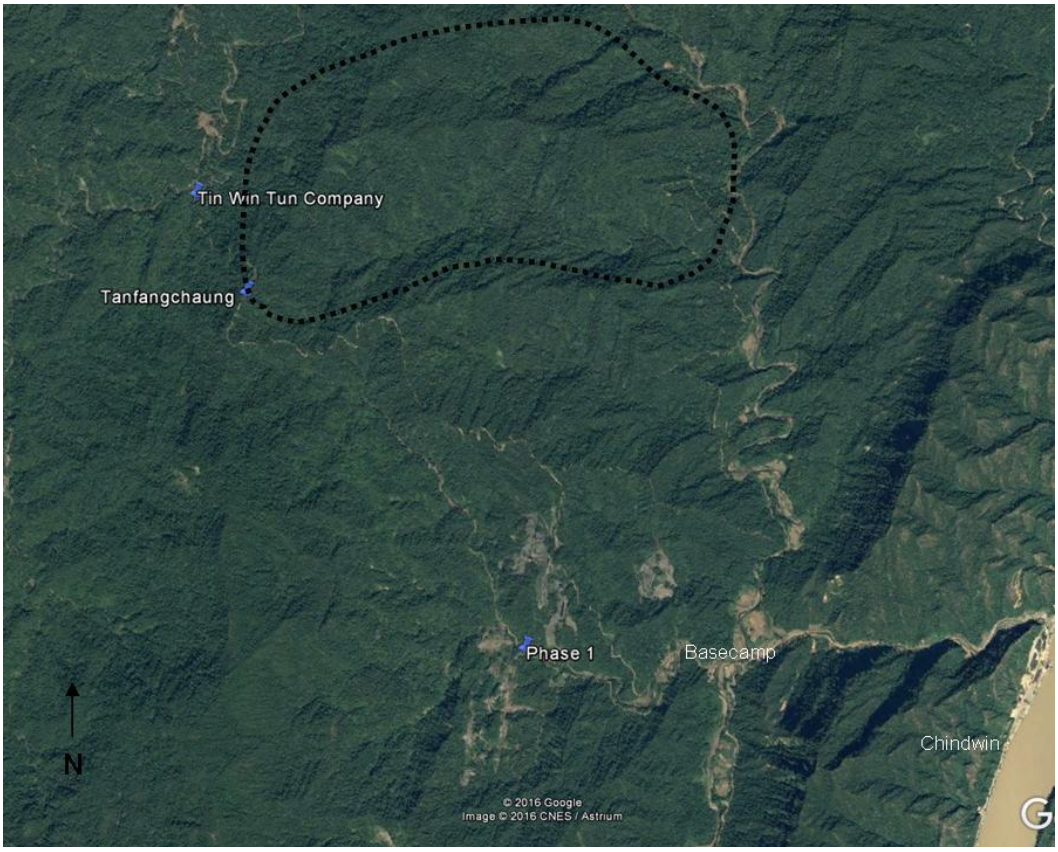


Fig 9: Potential offset area (black line) in Tanfangchaung valley

Pyinyaung Limestone Mine

Site description

The project area is situated on the valley surrounded by the mountains range and near the Thazi – Kalaw high-way road and 3 miles 6 furlong far from Pyin Nyaung Village, 2 miles far from Ku Byin Village, 25 miles from east of Tharzi Township, 30 miles from west of Kalaw, 124 miles from east of Mandalay and 330 miles from Yangon. The APACHE Cement Plant and Employee Housing Areas are 400 acres, limestone quarry site area is 600 acres in front of the cement plant and mud stone quarry site area is 165 acres behind of the cement plant.

The area is composed of four separate parts: the factory area 161.87 hectare (400 acre), limestone mining area 242.8 hectare (600 acre), mudstone mining area 66.77 hectare (165 acre) and mudstone mining and weir 28.7 hectare (71 acre). The total project area is 500.19 hectare (1236 acre). The project operation system also include two separate processes: cement production and limestone and mudstone mining. Limestone and mudstone are raw material for cement production.

It is located in the Kupyin Reserve forest was founded since the colonial period. The total forest area including extension was 11800 hectare (29158 acre). It was subdivided into 56 blocks for timber extraction. The timber extraction was started since in colonial period. Kupyin Reserve Forest lies within the eco-region of Irrawaddy Moist Deciduous Forest and quite close to the Northern Indochina Subtropical Forest.

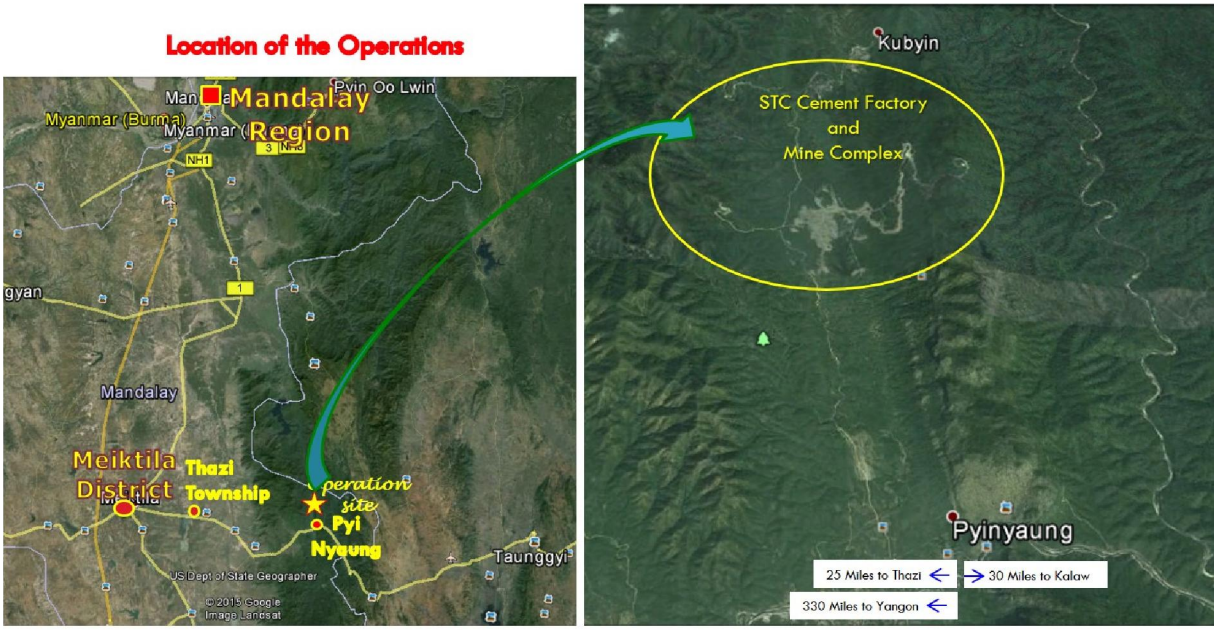


Fig 10: Location and site map of Pyinyaung cement mine

Methodology

Transect walks

Overall goal was not just to survey the small area directly affected by the limestone quarry mine, but rather have a look on the broader landscape in terms of habitat connectivity and potential biodiversity offset. We walked from Pyinyaung village to the ridgeline, reaching it from southwest. We descended from the mining site towards the cement factory and covered lower parts between the cement fact and Pyinyaung village. North of the ST area we examined the connectivity of habitats between the mountain with the cement mine and the neighboring mountain, which is separated by a small and during dry season shallow stream. The area north towards the Panlaung-Pyadalin WS was assessed by motorbike reaching the guard post of the WS rangers (Tab. 8; Suppl. Map 5)).

Tab. 8: Overview interviews around Pyinyaung cement mine

Date	Location	No. Participants	Special Remarks
27.01.17	Village north of mine, village head	2	
27.01.17	Village north of mine, local hunter	1	
29.01.17	Logger and bamboo collectors close to the mountain ridge inside ST area	3	Macaques (Assamese, rhesus), pangolin evidence (1 year old)
29.01.17	Ranger post of the P-P WS	3	
31.01.17	Farm north of the ST area	2	

Interviews

Interviews with local residents and hunters were used to obtain important information on presence or absence of mammal species. Both structured and unstructured interview were used to conduct these interviews. The interviews were focused on the target species like gibbon, langur, gaur or pangolin, but included also other mammals. The questions were designed to obtain data about each species: their population; their local status in terms of the past, present, and future; their ecological behavior and ecological niche; their breeding season; and the types of threats, both direct, and indirect, that each species faces. Questions were also asked about the wildlife trade, human animal conflict and habitat loss. Where possible, dates were identified. Questions were also asked about methods employed to kill or capture the animals, and what trade routes were used.

Fig 11: Interview with local people

Interviews were held along the walking trails, at the limestone mine, at the small village north of the ST area, small farms between ST and the Panlaung-Pyadalin WS and at the guard post of the WS (Tab. 9).

Tab. 9: Overview interviews around Paluzawa coal mine

Date	Location	No. Participants	Special Remarks
26.01.17	Logging camp close to Chinese mining site	3	2 muntjac skins
04.02.	Sunflower farmers, south of the St lease	5	-
05.02.	Tin Win Tun, coal mining company	3	Reliable gaur and sambar evidence
05.02.	Bamboo collector`s camp	3	Reliable pangolin evidence
05.02.	Local hunter	1	Dhole teeth, gaur and gibbon evidence
05.02.	Hunter`s camp close to Chinese site	2	Pangolin evidence, wildlife trade
06.02.	Hunter`s camp close to Phase 1	3	Porcupine spines and intestine

Target species

The area inside and around the mine is highly degraded and heavily disturbed by human activities. The probability for direct encounters with wildlife were rather low. During our walking surveys we encountered two species of squirrels. Wild boar and muntjac could be confirmed by tracks. For all other species we had to rely on interview evidence (Tab 10).

Critically Endangered

Chinese pangolin (*Manis pentadactyla*) CR

One of the target species is the Chinese Pangolin. Pangolin suffered a severe decline in recent years. The scales and their meat are highly demanded in Chinese traditional medicine.

One sighting last year in the degraded forest on the foothill of the limestone mining site. Another hunter killed one about one year ago in the plantations close to the mining site.

Endangered

Shan State langur (*Trachypithecus phayrei shanicus*) EN

The Shan State langur is the eastern subspecies of the endangered Phayre`s langur. It is only known from very few protected areas in Myanmar. As the Mount Popa population seems to be a distinct taxon, the conservation status of this subspecies seems to be even worse. It should occur in the P-P Wildlife Sanctuary, which southern boundary is located only 4 km north of the cement mine.

Interviews indicate the presence of the species possibly inside ST area, but more likely on the adjacent mountain, where it is frequently seen by a local farmer and by a hunter from the nearby village, who described a group size of 5-7 individuals.

Vulnerable

Bengal slow loris (*Nycticebus bengalensis*) VU

Slow loris were confirmed by all interviews, but seems to be quite rare and are not often seen.

Hog badger (*Arctonyx collaris)* VU

One interviewed person identified the hog badger. He could not specify location or time. We include the hog badger in the species list although it was not confirmed by other interviews or evidence. Because of its secretive behavior and often nocturnal activity it is likely to be overlooked by most people.

Near Threatened

Assamese Macaque (*Macaca assamensis*) NT

Assamese macaque were clearly identified in one interviews. According to the interviewed person they form smaller groups (10-15 individuals) than the more common Rhesus macaques.

Rhesus macaques are regularly seen in large groups (more than 80 individuals) by three people who are collecting wood and working on shifting cultivation. Last sighting of Assamese macaque was only one day before our interview.

Chinese serow (*Capricornis milneedwardsi*) NT

We found no direct evidence for the presence of serow. The habitat seems, despite being heavily degraded still suitable for serow. Several interviews provide indirect evidence, with all interviewed persons highlighted that this species became rather rare in recent years.

Black Giant Squirrel (*Ratufa bicolor*) NT

Direct sighting of one individual directly next to the limestone mining site. This species is widely distributed, but highly dependent to high canopy. Populations are declining due to loss of tall forest.

Other species

The Eastern hoolock gibbon (*Hoolock leuconedys*), which is classified as Vulnerable could not be confirmed. One of the interviewed hunters said he heard gibbon calls last time several years ago. All others didn`t know the species. It is likely that gibbons already disappeared from the areas several years ago.

Beside the jungle cat (*Felis chaus*), which was identified by two independent persons, one clearly identified and described the Asian golden cat (*Catopuma temminckii*), but couldn`t specify when he saw the golden cat. We consider it therefore as unconfirmed. It is classified as Near Threatened. Bears or large cats seems to have disappeared already more than 10 years ago. Small carnivores like Yellow-throated marten (*Martes flavigula*), three species of civets (Small indian civet (*Viverricula indica*), Small-toothed palm civet (*Arctogalidia trivirgata*), Common palm civet (*Paradoxurus hermaphroditus*) were regulary identified by interviewed people, Large-toothed ferret badger (*Melogale personata*) and hog badger (*Arctonyx collaris*) one time each.

The presence of red goral (*Capricornis rubidus*), which was indicated by a previous interview survey in this area must be doubted. This species has been recorded in Myanmar only from few locations in the far north of Kachin state. During the interviews it may have been confused with red muntjac by local people and misidentified them in the pictures shown to them.

Tab. 10: Mammal species recorded during the present study at Apache cement site

Common name	Scientific name	Evidence	Inside ST area	Adjacent ST area	IUCN status
Order Pholidota					
Chinese Pangolin	*Manis pentadactyla*	Interview	+	+	CR
Order Primates					
Bengal Slow Loris	*Nycticebus bengalensis*	Interview	+	+	VU
Shan Langur	*Trachypithecus. phayrei shanicus*	Interview	-	+	EN
Rhesus Macaque	*Macaca mulatta*	interview	+	+	LC
Assamese Macaque	*Macaca assamensis*	Interview	+	-	NT
Eastern Hoolock Gibbon	*Hoolock leuconedys*	-	-	-	VU
Order Carnivora					
Leopard Cat	*Prionailurus bengalensis*	Interview	+	+	LC
Jungle Cat	*Felis chaus*	Interview	-	+	LC
Common Palm Civet	*Paradoxurus hermaphroditus*	Interview	+	+	LC
Small-toothed palm civet	*Arctogalidia trivirgata*	Interview	+	+	LC
Large-toothed ferret badger	*Melogale personata*	Interview	+	+	LC
Yellow-throated marten	*Martes flavigula*	Interview	+	+	LC
Hog badger	*Arctonyx collaris*	Interview	-	+	VU
Order Artiodactyla					
Chinese Serow	*Capricornis milneedwardsi*	Interview	+	-	NT
Red muntjac	*Muntiacus muntjac*	interview	+	+	LC
Wild boar	*Sus scrofa*	Interview, tracks	+	+	LC
Order Rodentia					
Black Giant Squirrel	*Ratufa bicolor*	Sighting	+	-	NT

Identified threats

The habitat is already heavily degraded, with almost no larger trees left. The lower parts are used for firewood extraction, agriculture and cattle grazing. Several roads provide access to most of the area leaving only very limited space for wildlife. Wild boar and muntjac seems to be still present in the area. Also pangolin could still be present.

Logging and bamboo collection is also taking place on the stepper parts of the mountain almost to the top of the ridge. Most of the wood is used fuel for the production of limestone powder. Between Pyinyaung village and the mining site there are over 100 limestone powder production sites, all of them dependent on firewood from nearby forests. It is very unlikely that this can be stopped or reduced in the near future (Fig 12).

Fig 12: Large amounts of fuelwood are needed for limestone powder production

Hunting seems to be a minor threat as most interviewed people said, that wildlife has dramatically declined over the past years and hunting became more and more inefficient.

A major threat for mammals is the fragmentation of habitats and isolation of populations in the remaining forest patches.

Main threat include:

- Degradation of habitat
- Logging
- Fragmentation of habitats

Recommendations for reduction and mitigation of threats and biodiversity offset

There is already a proposed biodiversity offset plan. The plan includes 2253 acre (912 ha) of offset areas, all of them located directly next to mine lease (6oo acres/243 ha) (Fig. 13). All of these areas are already heavily degraded, especially the southern part (1809.5 acres). This area is affected by firewood extraction for the limestone powder production around Pyinyaung

village, agriculture and bamboo collection. Especially the high demand for fuelwood for limestone powder production seems to be not easy to solve.

In terms of an effective protection of remaining mammal populations the maintenance of habitat connectivity has to be considered. Genetic isolation of small populations in degraded and highly fragmented habitats needs to be avoided to prevent the loss of sub-populations or even the loss of whole populations. Therefore we suggest a substantial biodiversity offset towards the north to keep the mining area connected with the nearby Panlaung-Pyadalin Cave Wildlife Sanctuary. Other taxonomic groups like invertebrates or herpetofauna, or plants needs to be considered. It has to be clarified that the limestone formation north of the lease and inside the WS provide habitat for the same species affected by the mining activities at the limestone formation inside the ST lease (Suppl. Map 6).

App. 3-4 miles north of the lease is Panlaung-Pyadalin Cave Wildlife Sanctuary (Fig. 14). The WS has only limited staff. There are only two ranger posts for the whole area. During our interview the rangers pointed out that they don`t feel capable to prevent the WS sanctuary from further degradation. They suffer from a substantial lack of staff and equipment such as motorbikes or a boat, as the WS can be easily accessed by boat via an adjacent reservoir. In the past the WS provided habitat for endangered species such as banteng, dhole or Shan state langur. About the current status of wildlife populations inside the WS is only little known. A biodiversity study has not been conducted. To support a biodiversity assessment of the WS could also provide an opportunity for mining operators to contribute towards the conservation of biodiversity in the region.

Recommended activities to ensure habitat connectivity:

- Examine the possibilities of a biodiversity offset area connecting the remaining habitat around the mining site with with Panlaung-Pyadalin WS
- Consider financial support for Panlaung-Pyadalin WS (additional rangers, motorbikes, boat)
- Support a biodiversity study in Panlaung-Pyadalin WS

Further activities to address threats to wildlife inside the mining lease:

- Stop logging activities inside the companie`s lease
- Stop hunting activities inside the companie`s lease
- Include wildlife and wildlife trade in awareness activities
- Increase habitat restoration activities (maintenance of tree and plant diversity)

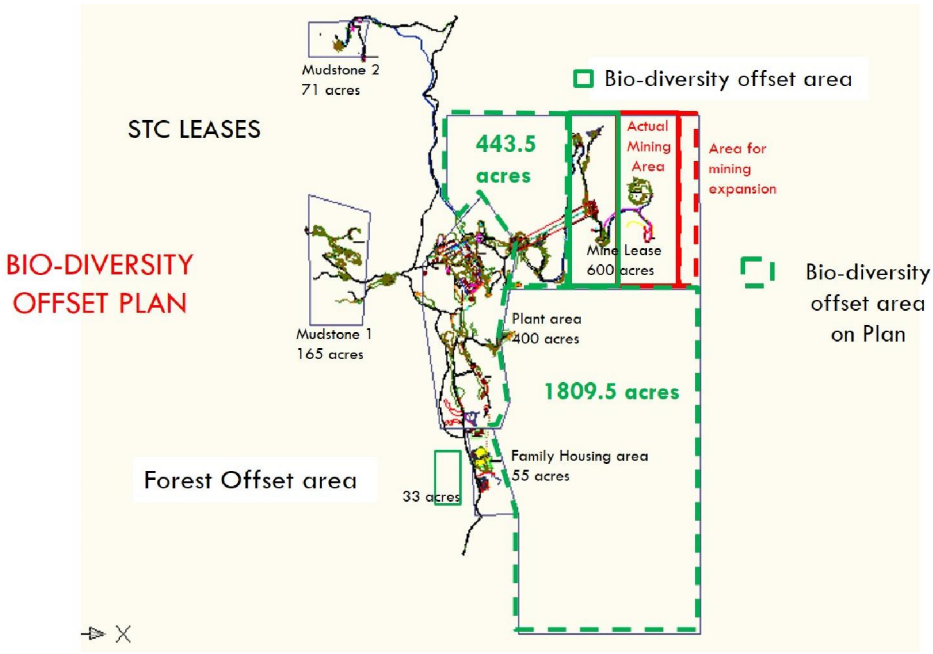


Fig 13: Existing biodiversity offset plan for Pyinyaung mine

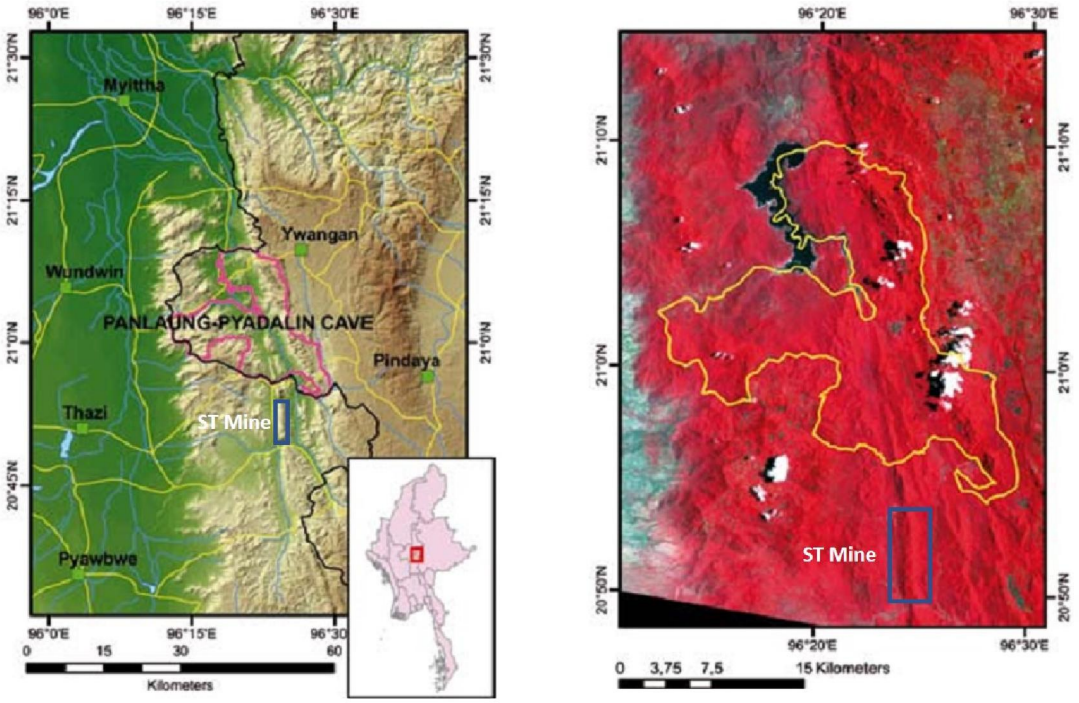


Fig 14: Location of Panlaung-Pyadalin Cave Wildlife Sanctuary in relation to the Shwe Taung Mine (Istituto Oikos & BANCA)

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Supplement 1: Selected camera trap pictures

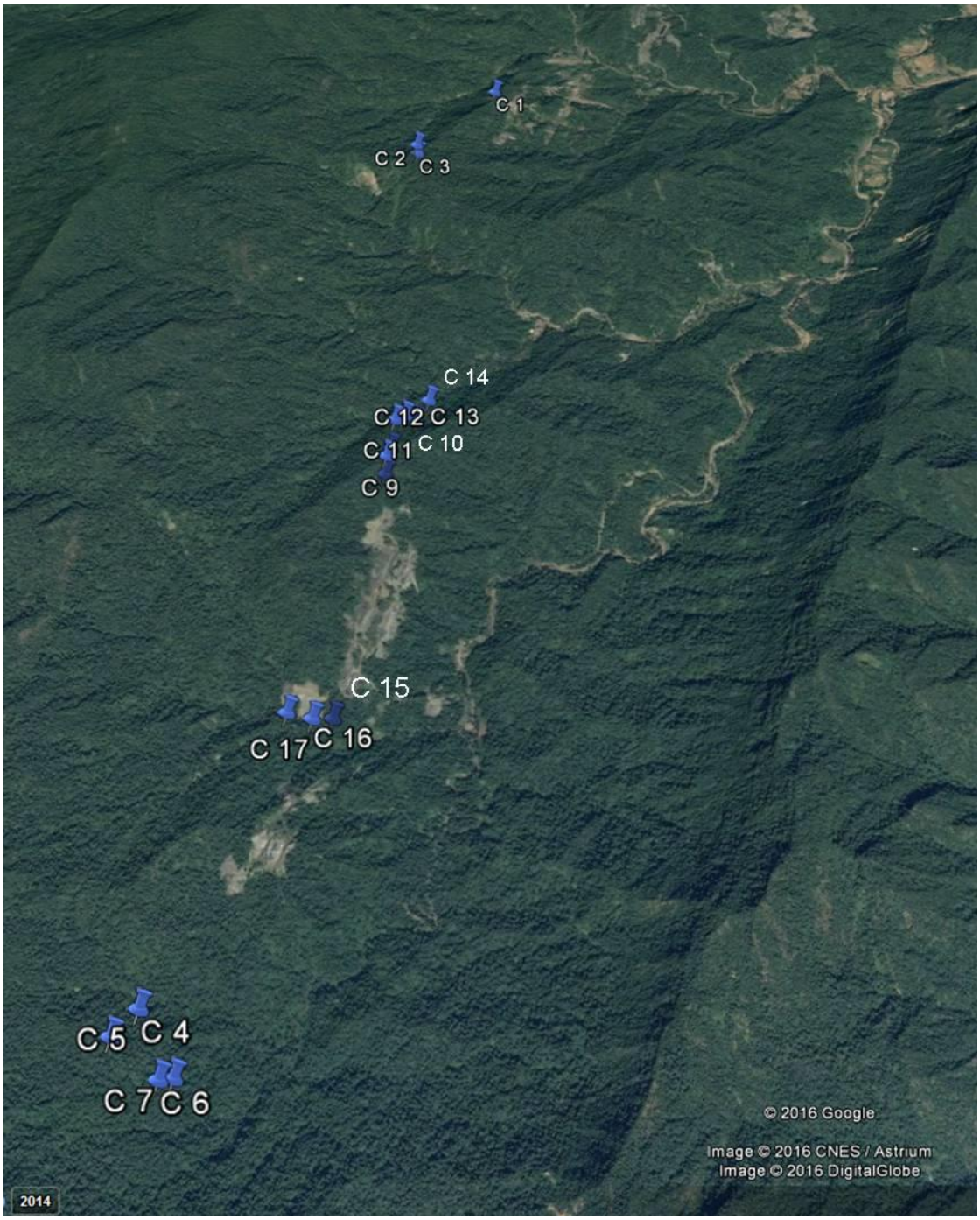
Red muntjac (left), Malayan porcupine (right)

Rhesus macaque (left), Eurasian wild boar (right)

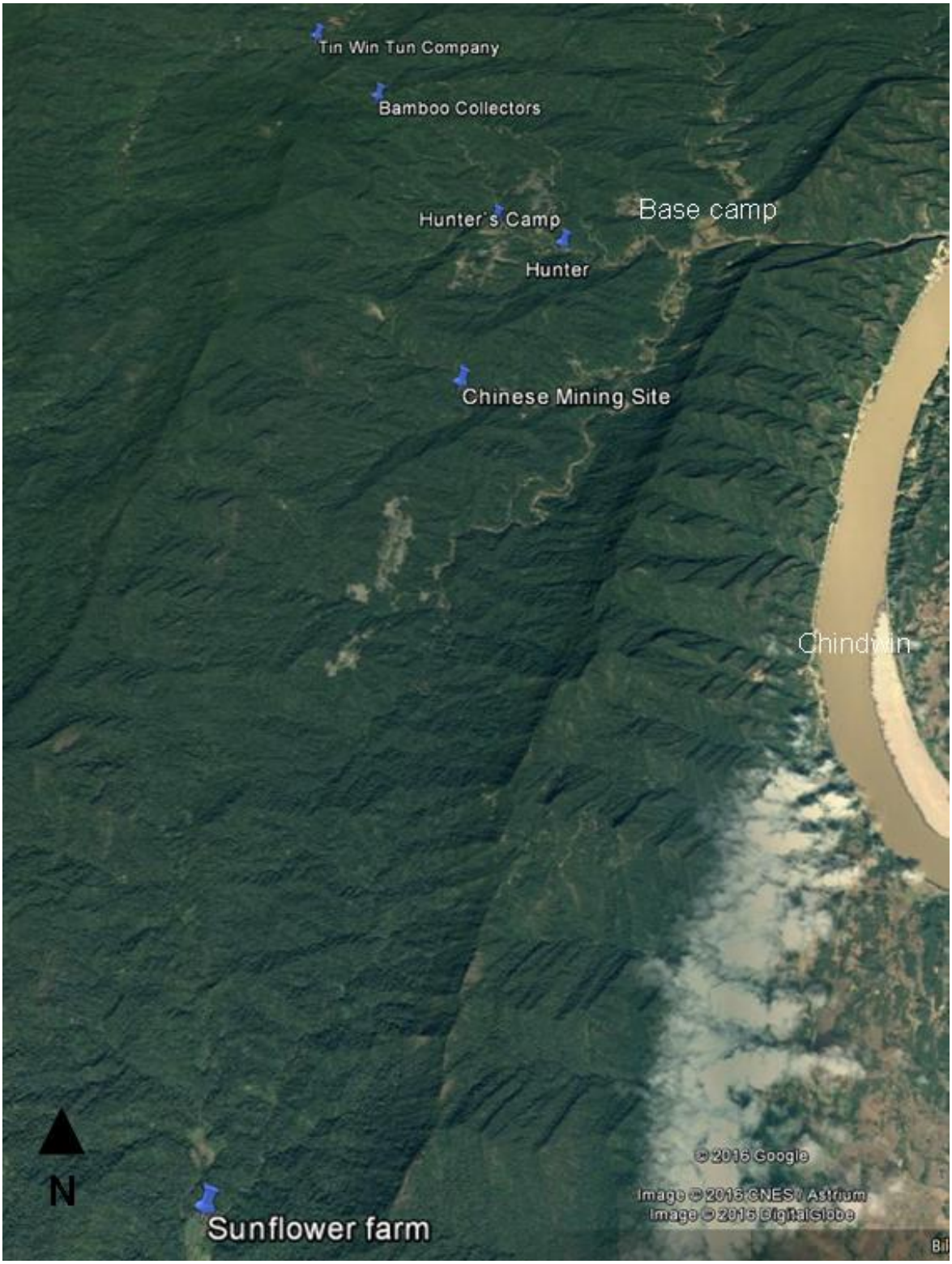
Large indian civet (left), Leopard cat (right)

Fishing cat (left), Yellow-throated marten (right)

Supplement 2: Maps

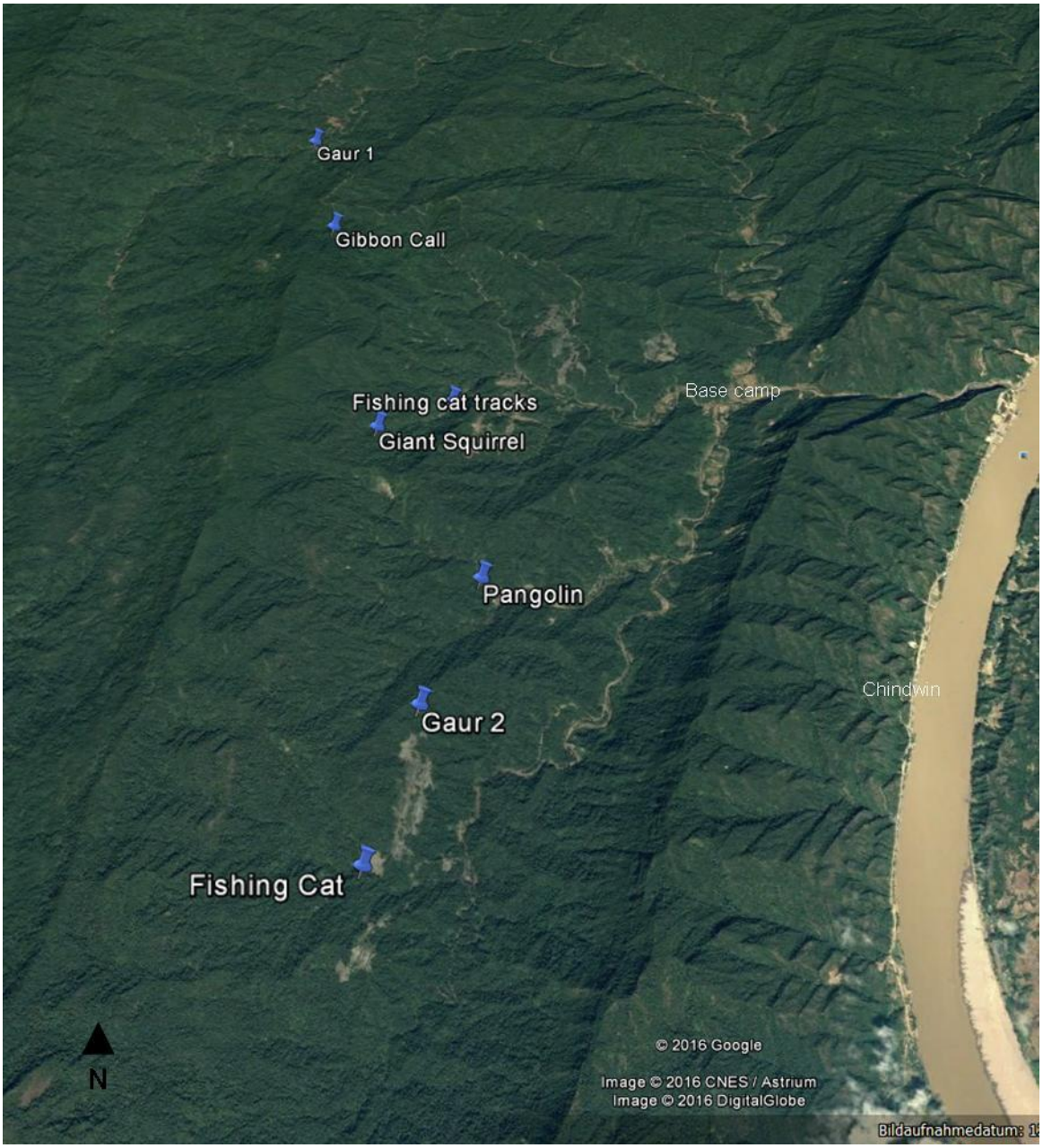


Map 1: Camera trap locations at Paluzawa coal mine

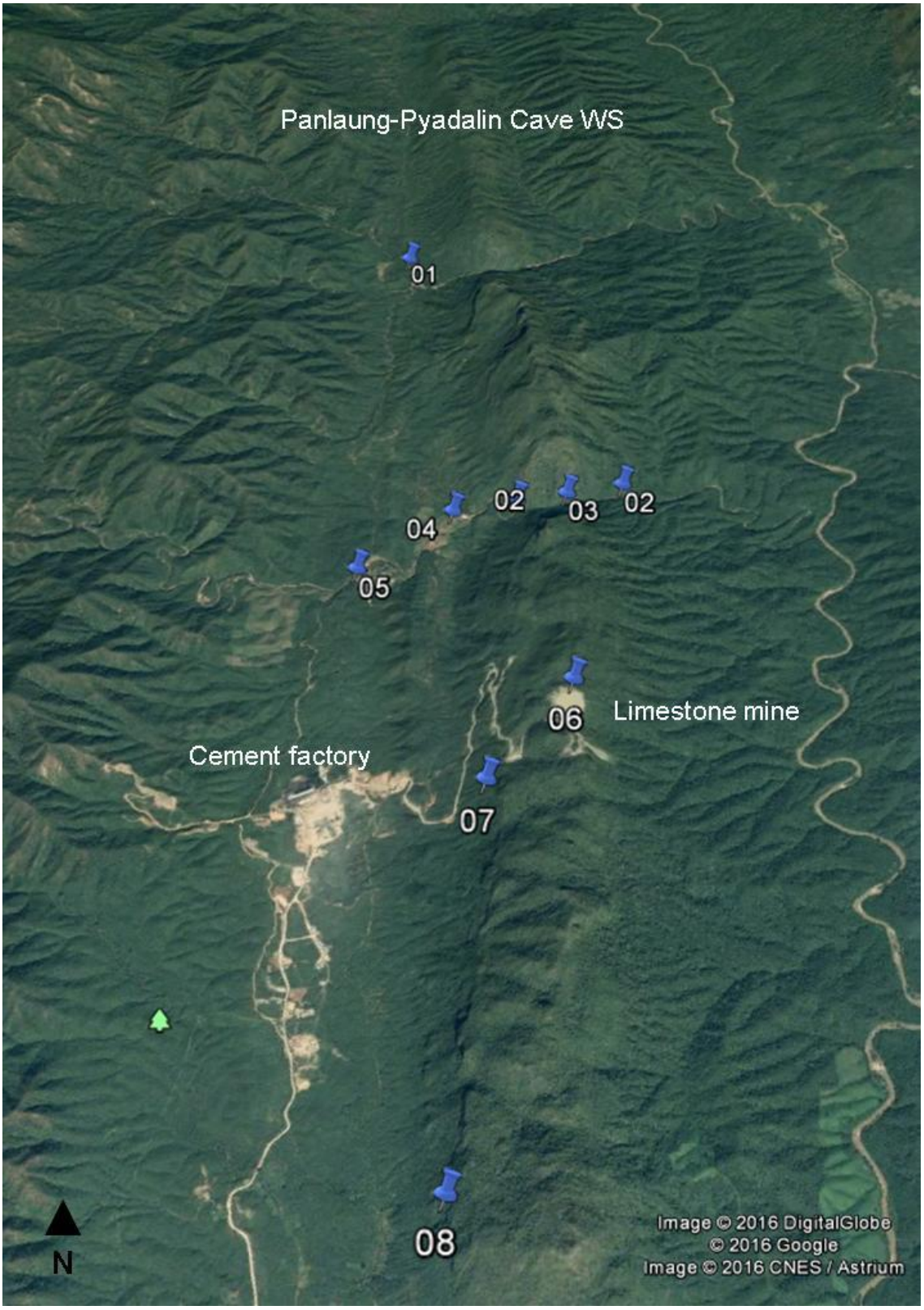


Map 2: Interview locations at Paluzawa coal mine

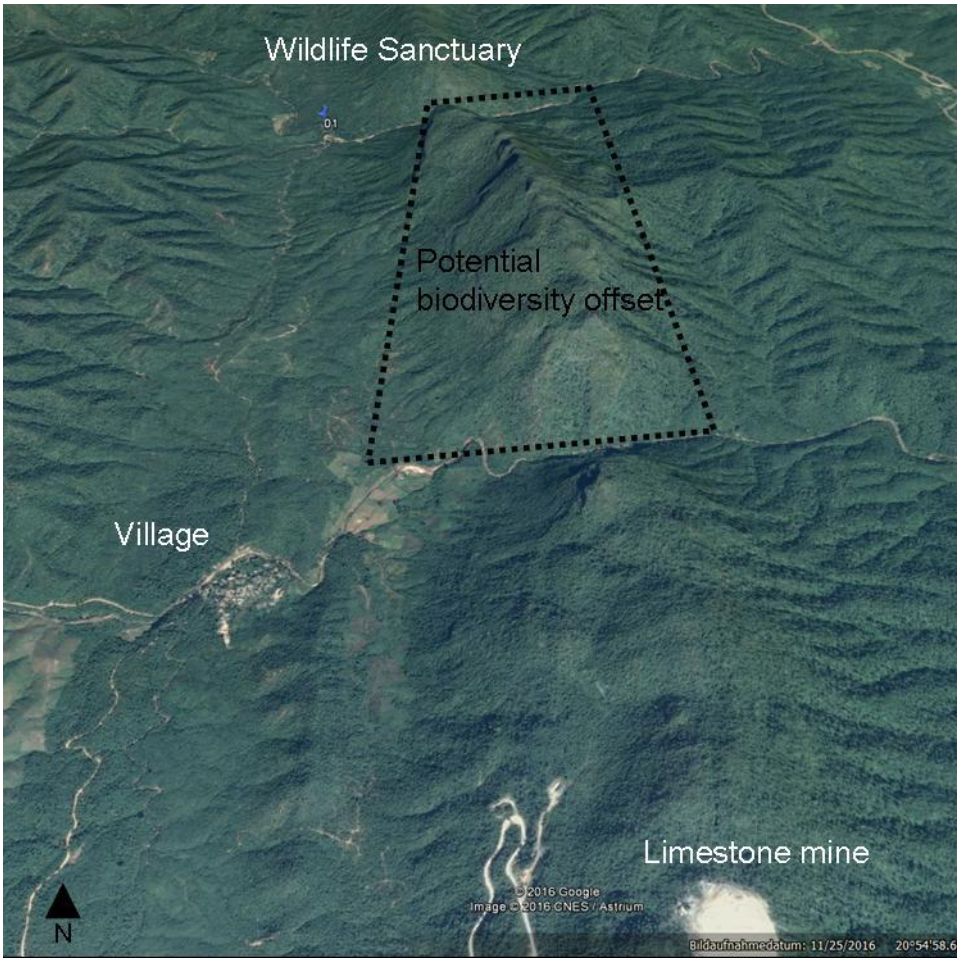
Map 3: Wildlife tracks and sightings (black dotted line: app. Boundaries of ST lease)



Map 4: Reliable records of IUCN listed species



Map 5: Survey locations at Pyinyaung cement mine (01: Wildldife Sanctuary ranger post, 02/03: stream north of the mining site; 04: Farm House; 05: Village; 06: Giant Squirrel sighting; 07-08: Surveyed area inside ST lease



Map 6: Potential offset area to ensure connectivity of habitats between the mining site and the nearby Wildlife Sanctuary.

Biodiversity assessment on the limestone ranges near the Shwe Taung Cement (=Apache Cement) concession between Pyinyaung and Kubyin, Mandalay Province

(based on land snails as indicator group)

Jaap J. Vermeulen PhD

Katja Anker MSc

Date: March 22, 2017.

A survey for

ERM (Environmental Resources Management)
Bangkok Office
Thailand

On behalf of

Shwe Taung Development (APACHE CEMENT)
Myanmar

Contents

1 – Major conclusions

Below, we call the limestone range in which the APACHE-concession is situated the *Pyinyaung limestone range*. For easy description we have divided the range in sectors A to F, see **Fig. 3a.**

Fig. 3b is A sketch map in which all available information (from sampling, field observation, Google Earth image interpretation, and from discussions with local people) is synthesized .

1.1 – Land snail fauna

1.1.1 – Presence of site-endemic species

- We did not find any potentially site-endemic species in the APACHE-concession area (sector D), that would trigger the IUCN Red List Criteria CR or EX as a result of the quarrying.
- We think it is less likely that true site-endemic species will occur in the APACHE-concession area. This is because we have not found caves, wells, or other environments suitable for site-endemic species in the APACHE-concession area.

Explanation. In more or less continuous limestone ranges, site-endemic species are often adapted to extreme environments, such as caves or limestone wells. These environments have a limited spatial extent, and the site-endemic species cannot spread beyond their boundaries.

1.1.2 – Presence of local-endemic species

- Ten snail species are potentially local-endemic to the Pyinyaung limestone range, see **fig. 5** for species names and distribution over the range. Their presence demonstrates the need to implement offsetting measures if biodiversity loss caused by quarrying is to be avoided.
- Six species which are potentially local-endemic to the Pyinyaung limestone range occur within the boundaries of the Apache concession, see **fig. 5**: *Diplommatina crispata* new subsp., *Khasiella pingoungensis*, *Bradybaena schanorum*, *Chloritis anserina*, *Pseudonenia shanica*, *Anauchen* new sp.
- *Anauchen* new sp., presently only known from the APACHE-concession, is likely to bre distributed beyond the concession boundaries as well. Therefore, the species is best regarded as a local-endemic. Nevertheless, its range may be so limited, that the activities on the Apache site reduce its range to an extent that it would trigger the IUCN Red List Criterion EN.
- Considering the distribution of the local-endemic species, the part of the Pyinyaung limestone range North of the concession (sectors A, B, C, and part of D) is most suitable for offsetting, see **fig. 3b**. This is because several local-endemic species occur exclusively in the APACHE-concession and/or further North: *Dicharax* sp., *Sinoennea* new sp., *Anauchen* new sp. None have been found restricted to the South part of the range (sectors E and F).
- However, our collecting the southernmost end of the range was insufficient; more local-endemic which occur restricted to the South part of the Pyinyaung limestone range species may occur in the least disturbed parts of it, see **fig. 3b**.

1.1.3 – Species new to science

- Four species and subspecies potentially local-endemic to the Pyinyaung limestone Range are probably new to science: *Diplommatina crispata* new subsp., *Plectotropis* new sp., *Sinoennea* new sp., *Anauchen* new sp.
- Two of these are found within the APACHE-concession: *Diplommatina crispata* new subsp., and *Anauchen* new sp. (see fig. 5).

1.1.4 - Uniqueness of the fauna of the Pyinyaung limestone range

Above, we demonstate the uniqueness of the Pyinyaung limestone range though the presence of potentially local-endemic species. Below, we show that the fauna as a whole is different from the fauna of some collecting sites in its surroundings.

- Comparison of the snail faunas of the Pyinyaung limestone range and the limestones East of Kalaw shows fundamental differences, with a DSC[1] of 0.39 only (see **fig. 6**). This shows that:
- Strong gradients exist in the fauna composition in the region. It is likely that each limestone area, like the Pyinyaung limestone range, has a fauna different from that of surrounding limestone ranges.
- A consequence is that the fauna of each limestone area in the region, including the Pyinyaung limestone range, includes a number of unique elements: local-endemic species.

1.1.5 – A North-South gradient in the fauna composition of the Pyinyaung limestone range

- The overall composition of the snail fauna of the northern end of the Pyinyaung limestone range (sectors C and D) differs from the fauna of the southern end (sectors E and F, established in spite of insufficient collecting of the southern sectors): DSC=0.73.
- This means that the cumulative effect of all economic activity along the Pyinyaung limestone range may lead to biodiversity loss, even if the part of the limestone range to the North of the concession is protected by the APACHE offsetting program.
- Again, this statement may gain weight once the southernmost part of the range is more thoroughly checked for local-endemic species.

1.1.6 – Fauna composition versus altitude in the North part of the Pyinyaung limestone (sectors C and D).

- The snail fauna on:
    - the North-facing slopes bordering the gorges South of the sectors B and C and on
    - the West slopes and the crest of the sectors C and D of the limestone range
- are different (DSC=0.75, see **fig. 6**). This difference is proportionally reflected in the distribution of the local-endemic species: 7 out of 10 occur in both, whereas 2 (*Dioryx pingoungensis* and *Sinoennea* sp.) prefer the lowlands and 1 (Anauchen sp.) is restricted to high grounds.
- We only incompletely sampled the crest of sector C. However, we observed that these parts have a general environment similar to that of the crest of sector D (including the APACHE-quarry), but are less degraded by ongoing logging and bushfires. We therefore assume that the crest of sector C has a fauna similar to that of the crest of sector D, but possibly more varied.
- This makes sector C (and probably sector B and A as well) attractive areas for offset purposes:
    - the fauna of large parts is similar to that of sector D, including the APACHE-concession;
    - the levels of environmental degradation are lower;
    - and the different faunas of the North-facing slopes, not represented in sector D or further South in the limestone range, are a bonus.

[1] Dice Similarity Coefficient = Dsc = $2|x \cap y|/|x|+|y|$, in which x and y are the number of species found in two localities. Values between 0 and 1; high values denote similarity.
In this particular case the low value is partly caused by asymmetry of the two sets (79 species collected in the Pyinyaung limestone range, versus 33 East of Kalaw; see **fig. 6**. Nevertheless, no fewer than 11 species have been found East of Kalaw which we did not find on the Pyinyaung limestone range.
The other DSC values on this page are based on approximately symmetrical datasets

1.1.7 – Indicators of disturbance

Where the vegetation, indifferent of the bedrock type, has been degraded to almost pure stands of bamboo, or where bushfires have destroyed the topsoil, only few snail species survive. We have not sampled such sites separately because the effects of environmental degradation are not the primary goal of the survey.

We found no more than one species that indicate disturbance:

- *Achatina fulica* (Achatinidae), an agricultural pest species introduced from Africa, on fallow land near sampling site 11.

Near-absence of intensively farmed agricultural land in the vicinity of the limestone range may explain the small number of disturbance-indicators and introduced species.

Many regard *Paropeas (Allopeas) gracile* and *P. (A.) clavulinus* as introduced. A while ago, shells of these species were found in 40.000 years old archeological deposits, which casts some doubt on their status.

1.2 – Other organisms observed

1.2.1 – Reptiles

We photographed three lizard species. Lee Grismer identified two as *Calotes emma* (2 individuals), and *C. versicolor*. Both are common and widespread.

1.2.2 - Mammals

We observed an unidentified monkey species near sampling site 17. We were not able to make photographs.

1.2.3 – Plants

Contrary to the true tropics, the flora includes large numbers of non-woody species, some of which will prove to be limestone restricted, and a smaller fraction to be local-endemic. A comprehensive Flora to identify Myanmar plants is not yet written; identification of local-endemics and site-endemics will have to be done as proposed in the quotation. This survey was at the height of the dry season, and little was flowering, but nevertheless we found:

- Possibly *Ornithoboea* (Gesneriaceae) or related genus on sampling site 6. A few young plants, not flowering, on rocks. *Ornithoboea* is a small genus with several endangered local-endemic species
- *Amorphophallus*, or similar genus (Araceae) on various sampling sites. A large genus including numerous local-endemic species. We found tubers, taken out with soil samples. The tubers will be sent to a specialist, but results cannot be expected shortly.

1.3 – Offsetting areas and groundwater management

At present, the groundwater table sinks at 2.5 cm/year (information from APACHE). Further degradation of the vegetation, and removal of the karstified surface of the limestone range, may impede replenishment of the groundwater reservoir. Offset areas may slow this process down, or even stop it.

Explanation: Little rainwater runs off the slopes of limestone hills. Most seeps into rock fissures, and directly feeds the groundwater reservoir. Indicators of underground water movement in the limestone range are resurgent wells near sampling sites 11 (with cold water; see **fig. 2a, 3b**) and 17 (with hot water). Both are on the on the North edge of a stream bed cutting through the limestone range; the position of stream beds and wells are determined by fault lines crossing the limestone range.

1.4 – Small-scale (economic) activities involving resources from the limestone range

1.4.1 – Teak logging

On sampling site 8, see **fig. 2**, sector D immediately North of the concession, we observed locals logging medium-sized regrowth teak trees. The logging is illegal (APACHE). On the lower slopes, all usable trees are gone, on the upper slopes logging is in progress. The logs are sawn into planks on the spot, and the planks are dragged out by hand. Google Earth shows that similar logging is ongoing along all the sectors of the limestone range, particularly along its West flank, much less along the East flank. We generally mapped areas where logging trails are visible as 'not suitable for offsetting' in **fig 3b**. Although the damage per tree extracted is minimal (no loss of organic matter more than the sawn timber taken out, and very narrow skidding tracks), the exploitation is on such a scale that it results in degradation of the vegetation. This is also because the loggers often set fire to the undergrowth.

Particularly from site 8, not only villagers take produce, but also people coming in from other areas (APACHE). Elsewhere, recent logging is restricted to the lower, non-limestone slopes of the range, although a first cut of teak trees seems to have been taken everywhere.

1.4.2 – Bamboo cutting

Stems are taken out in large numbers from the most degraded parts of the vegetation, where the bamboo grows thickest. The harvest feeds a thriving local industry, producing fences, matting etc. We cannot find much harm in this exploitation.

1.4.3 – Limestone and firewood for lime production

Lime kilns are found to the East of Pyinyaung village (between sector D and E) and on the limestone plateau of sector F. We find these have extensive impact on the surroundings:

- Limestone is taken from small quarries around the foot of the hills. When extraction from a quarry becomes too labor-intensive or too dangerous, a new quarry is started elsewhere at the foot of the hill. Associated bushfires cause further damage.
- A kiln is fired for four days for a load of lime, using a large quantity of wood in large logs. Scented smoke from some kilns indicates the use of species of some Dipterocarpaceae.

1.4.4 – Bushfires

Bushfires are started by all taking produce for the limestone hills and others, during the dry season, 'to chase the snakes away'. The fires are left uncontrolled, and slowly smolder and occasionally flare up for days, destroying the leaf litter and organic soil layer, but leaving the bamboo and trees unaffected.

This practice is damaging to the environment: it destroys the soil fauna and the seed bank from which the woodland regenerates. It favours bamboo, the dominant species in one of the last stages of degradation, and it leaves mineral laterite soils without any organic top layer and therefore with slim chances to recover.

1.5 – Further arguments for the sectors A to C, and part of sector D as offsetting sites

See **fig. 3a and b**. Next to cement plants quarrying parts of sector D and E, points from where incursions into the limestone range take place are:

- Agricultural land to the North of sector A (not visited, source: Google Earth).
- Kubyin village to the West of the gorge between sector C and D (small-scale timber extraction from the lower slopes).

- Pyinyaung village (limestone for lime production, wood to fire the lime kilns, teak, bamboo). From here, not only villagers take produce, but also people coming in from other areas.
- Various paths and tracks into the South half of sector D (limestone, teak, firewood, bamboo).
- Sector E, particularly the central limestone plateau (limestone for lime production, wood to fire the limes kilns.

Once recognized in the field, traces of these activities can be seen on Google Earth.
The parts where the vegetation is least disturbed appear most suitable for offsetting purpose. The population pressure around these remote parts is lowest; there is little industrial activity, and therefore fewer stakeholders to negotiate with. The least disturbed parts are:

- Sector A, South part (not visited, source: Google Earth).
- Sector B (not visited, source: (Google Earth).
- Sector C. Access to part of the range is difficult (a track to the West of the range can only be negotiated with a truck, with difficulty, during the dry season) and the population pressure is low (Kubyin village at its South end, with 60 families, and a small settlement of a few houses at its North end). On the NW- flank of sector C (sampling locality 10) we found the least immature (= nowhere near mature) teak woodlands in the area, where we spotted 12 different species of epiphytic orchids growing in abundance.
- Sector D, North end, as well as large parts to the South of the APACHE concession.

More disturbed, but still acceptable as a second choice for offsetting purposes are:

- Sector D, parts to the North of the Apache concession. This is progressively degraded by extraction of teak.
- Parts of sector E.

1.6 – Management of offsetting areas

(The following is without knowledge of stakeholders and their relations) The main economic activity in the least disturbed areas is teak extraction. Teak forests can regenerate after logging. If APACHE would use the goodwill created locally by its extensive social programs to involve all stakeholders, the following could be done to avoid slow degradation of potential offset areas:

- Create a buffer zone around the offset area, including the lower non-limestone slopes of the range.
- Grant exclusive logging rights in parts of the buffer zone to the inhabitants of the nearby villages, provided that they re-plant young trees for every tree taken.
- Expand the plant nursery in the APACHE concession, to provide young teak trees free of charge.
- Convince the local people not to burn the undergrowth

1.7 – Final notes

1.7.1 - Suitable high-Ca limestone areas with low biodiversity value on the Shan Plateau

Fig. 1 (based on Google Earth images, not checked with geological maps) gives an impression of the extent of outcropping limestone in part of the Shan Province. Underground limestone, covered with a thin layer of laterite soil, occurs in large parts of the Shan Plateau (observed along the road from Heho to Kalaw). At first impression, the biodiversity value of these limestone areas seems much lower than that of the (sparsely) forested limestone ranges in the Shan foothills, including the APACHE concession. Further expansion of limestone-based industry into the Shan Plateau would be preferable from biodiversity point of view.

1.7.2 – Safety in the lime kilns

People in the limestone kilns often work on bare feet, and without protection against the alkaline lime dust. A particularly distressing sight was a small girl, sitting in the lime dust and helping her

mother sieving the lime powder. We wonder if APACHE could extend their social program to inform the kiln workers about health risks and provide minimal protective clothing.

2 – The survey

2.1 – Introduction

The survey is conducted for ERM (Environmental Resources Management**)**, Thailand office (David Nicholson), on behalf of Shwe Taung Development (APACHE CEMENT). APACHE needs to assess the impact on the local biodiversity of their limestone quarry between Pyinyaung and Kubyin, Mandalay Province, Myanmar, following the conditions pertaining to biodiversity conservation laid down in IFC PS6 (2012).

To explore the various options for mitigation and/or offsetting the impact of the development, they wish to gather information on the local biodiversity, particularly where it concerns the presence of species endemic to the quarry area and/or its immediate surroundings.

The quarry will destroy a small (3.4 km^2) and sharply delimited section of a set of parallel limestone ranges of close to 300 km long and, in places, up to 50 km wide (**fig. 1**). Thus, the positioning of the quarry is in line with the recommendation in Vermeulen & Whitten 1999:

An exploitation site should be located in the largest limestone area. … The site should never extend over the entire area, but always leave a substantial part alone.

This is because species tend to occupy suitable environment to the limits. For many limestone-restricted species, this means that they will expand their range up to the boundaries of the limestone hill on which they live. Therefore, quarrying a part of a large limestone hill (and leaving the rest untouched) is less likely to lead to extinction of species than quarrying a small hill in its entirety.

Species, which occur restricted to a specific environment of limited extent on or in a limestone hill (for instance, a well in a cave) do not benefit from this recommendation.

To avoid net loss of biodiversity because of the APACHE development, *impact mitigation* would be relevant in case species are discovered with such a limited area of distribution that they occur restricted (on a world-wide scale!) to the quarry area. If no such species are found, *impact offsetting* is likely to be more effective.

The client has pre-selected 2 potential offset sites: the limestone range to the north of the concession, and the limestone range to the south of the concession, see **fig. 3**.

We compare the biodiversity richness of the concession and the offset sites, to determine if the offset sites can compensate for biodiversity losses at the concession. We also check for potential site-endemic species, which would, in the course of the development, make necessary mitigating measures. More specifically:

- Are there species that are likely to occur restricted to the APACHE concession, or to the area immediately around the concession?
- Are there species in and around the APACHE concession that, if reviewed for the IUCN Red List, would possibly be classified as CR, or EN (IUCN Species Survival Commission, 2012)?
- Is the fauna composition of the concession and the offset sites similar, or do we observe a gradient?
- Do we find indicators of environmental disturbance in the fauna?

Not directly related to the above is the client's next question:

- Are there any species that are new to science?

2.2 – Scope and area covered by the survey

We use land snails (Mollusca: Gastropoda) as indicator group; see chapter 3.

We sample each sampling site following a fixed procedure. This will ensure that all sampling sites receive an equal amount of attention, and that the samples of each site are representative for the site.

We sample in the following order:

- Sampling sites in the concession.
- Sampling sites in the potential offset areas north of the concession.
- Sampling sites in the potential offset areas south of the concession.
- Sampling sites elsewhere.

Sampling elsewhere is necessary for reference purposes. Many species with a scientific name are known from one or two localities only; their actual distribution range is unknown. Therefore, we adapt our strategy to the incomplete documentation of the fauna, by sampling easily accessible sites on public land or sites of potential interest in the wide surroundings as far as time allows. The absence on such sites of assumedly local-endemic or a site-endemic species found in the concession or the potential offset areas may not prove the assumption, but at least supports it.

2.3 – Limitations

The local snail fauna is part of a fauna province covering most of India, Myanmar, as well as parts of Laos and Thailand. It includes some 1500 known species, described in numerous, mainly pre-1900 publications. Only few groups of land snails have been revised in recent years, with clear and detailed illustrations of the species.

Moreover, Myanmar is situated on the very East flank of former British India, bordering Laos where the French wielded the colonial scepter, or tried to. For taxonomy, this is relevant: both colonial powers independently set to describe the fauna of their dominions, without any attempt to come to a synthesis. This led to two very different taxonomies, a British and a French one, on species level, and even on generic level. The most basic consequence is that any species may have two scientific names, and that their synonymy has so far gone undetected.

Thailand, also bordering Myanmar, but never subjected by any colonial power, is comparatively terra incognita. Only the last two decades, Dr. S. Panha undertook systematic exploration of the Thai fauna. He still struggles with the existence of two disparate taxonomies and a general lack of synsthesis, for which reason he concentrates on a few families that have been largely overlooked by earlier explorers (for instance Vertiginidae).

The existence of two taxonomies has consequences for our attempts to accord a range size category (see below) to the species we find. For instance, we may think a species identified with British literature is endemic to the Shan States, but if we do not check the French literature, we may remain unaware of the fact that it is widespread, under a different name, in Laos and northern Vietnam.

We use the British literature as a primary resource, and we attempt a synthesis between the British and French literature only for species that we suspect to be interesting for our purpose.

Arthropods, particularly those that permanently live in caves, often display distribution patterns on a slightly smaller scale than snails. Because of their high levels of site endemism, with species often known only from a single site globally, consultation of a leading entomologist (Louis Deharveng and team) to determine if the sites harbor such species is highly recommended.

2.4 – Other observations

Aware of the urgent need of the client to identify potential local-endemic and site-endemic species that would trigger the IUCN Red List categories CR and EN because of the development, we, as far as time allows, make photographs of all potentially interesting species of plants and animals, and distribute these to specialists for identification. We also note:

- Potential archaeological sites.
- Caves, investigated by us or not.

We advise on sites that may be worthy of a visit by other specialists.

3 – Land snails as indicator group

Most biodiversity inventories concentrate on the vertebrate fauna (amphibians, reptiles, birds, fishes, mammals), and/or on selected plant groups. They have little value for comparative studies about biodiversity and its distribution:

- The numbers of species are too small for statistic value.
- The number of site-endemics and local-endemics is small.

However, vertebrates are important, because they appeal to people in general, and the infrequent cases of site endemism help to make a strong case for protection.

Ninety percent of all biodiversity, including that of tropical limestone hills, consists of invertebrates (insects, mollusks, spiders, crustaceans, worms etc.). The immense number of invertebrate species and the wide range of techniques necessary to catch these animals makes comprehensive or even representative sampling impossible. However, we have identified groups of organisms that can serve as ***indicator groups*** in limestone areas.

During previous surveys, teams sampled organisms of various indicator groups in limestone areas, specifically land snails and arthropods. This is because the species of these two groups may show similar patterns of distribution, but on a different scale. They give two datasets that complement each other, and synthesis yields a representative image of the biodiversity:

- Land snail species are often local-endemics or regional-endemics. Site-endemic species do occur, but not in large numbers. Distribution patterns of land snail species primarily yield differences in the fauna composition of larger units: groups of hills, or regions with limestone hills, and secondarily about biodiversity values of single hills.
- Arthropods count more site-endemic species among their numbers. These primarily provide information on the biodiversity value of single hills, or elements of single hills such as caves, and secondarily about larger units.

Technically, land snails as an indicator group have an advantage over arthropods:

- Snails are easy to sample.

- The samples are easy to process.
- Snail taxonomy is less overwhelming in terms of numbers of species that arthropod taxonomy. The field of study is such that the specialist will only rarely need to consult other specialists, which often takes a lot of time.
- Snails occur in sufficiently large numbers of species in limestone areas to render statistics derived from species lists significant.

Next to being an indicator of biodiversity richness, snails can also show human impact on a site:

- A depauperate fauna including only few species where many may reasonably be expected.
- Presence of only widespread species.
- Presence of introduced species.
- Skewing of the fauna on the site: the presence of very large numbers of individuals of species that elsewhere occur in small numbers only.

4. Endemic species and how we recognize them

Species with a very limited area of distribution are called *endemic species*. In this report, we categorize each species by the size of its area of distribution. We distinguish the following categories, adapted from Vermeulen & Whitten (1999: 14):

- A ***site-endemic*** species has a range of up to about 100 km^2, but may have a range not exceeding 100 m^2 in extreme cases (e.g. a fish species found in a single cave well). *Here, we regard a* ***species occurring restricted to a part of a sector (see fig. 3a) of the Pyinyaung limestone range, a site-endemic species.***
- A ***local-endemic*** species has a range covering 100 to 10.000 km^2. *Here, we regard a* ***species occurring restricted to the limestone range bordering the Shan Plateau local-endemic species (see map 3a, sectors A to F)***.
- A ***regional-endemic*** species has a range covering 10.000 to 100.000 km^2. *Here, we adapt this to categorize* ***species restricted to the central part of Myanmar, East of the Irawaddy River, and including the adjacent mountain ranges of Laos, and Thailand.***
- A ***widespread*** species has a range covering more than1000.000 km^2. *Here, the term is used for* ***species that occur beyond the range outlined above, usually in large parts of India and Indochina, and sometimes in southern China***.
- An ***introduced*** species (introduced by humans) does not add to the biodiversity value of a hill, but is often indicative of environmental disturbance.

When sampling the fauna of a hill, we concentrate on the presence of site-endemic and local-endemic species. These are most vulnerable to human impact. A bushfire swiping through the vegetation of a limestone hill, or a quarry, can wipe out the site-endemic fauna of the hill.

We attach special biodiversity value to site-endemic and local-endemic species which have no near relatives in the region, or no extant close relatives at all (they represent an old evolutionary lineage all by themselves). Examples are a snail species in Vietnam, of which the nearest extant relatives live in Europe. Another example is the Gingko tree, the last extant species of a group of plants that was widespread in the geological past.

There is hardly any absolute proof that a species is a true site-endemic or local-endemic. Even if all surrounding land is searched extensively and without success, a population of an assumedly site-endemic or local-endemic species may eventually turn up miles away. We use the following indicators to classify a species as a potential site-endemic or local-endemic species:

- The species is restricted to an environment that has unusual or extreme properties, which forces organisms to adapt to it to survive.
- The species is restricted to a discrete and isolated unit of an environment as above.
- The species belongs to a taxonomic group that includes numerous site endemic species.
- The species is recorded in literature as a site endemic.
- The species is new to science and not recorded anywhere, neither in literature, nor in collections (but only if the species belongs to a taxonomically well-known group).
- The species is found in only a single sample, of many samples taken in a wide area around that sample.
- The species is neither one of the well-known widespread species, nor an introduced species. Some widespread species may occur in small, isolated populations. If not recognized as a widespread species, such a population may be mistaken for a site-endemic species.

5 – Limestone biodiversity

The environment on limestone bedrock is often extreme: high levels of exposure to sun, rain and wind on exposed rock surfaces, contrasting with extremely sheltered, eternally dark caves with minimal fluctuations in temperature and humidity. Soils, if present, typically consist of the insoluble fraction of the limestone rock. They are thin, have little capacity to retain fertility or water, and often they are alkaline. In addition, ore bodies geologically associated with the limestone may cause high levels of poisonous metals.

Organisms colonizing these environments have two options: perishing, or adapting to the environment, and often to specific niches in the environment. Evolution, working indiscriminately and permanently on all life, leads then to the formation of new species well adapted to limestone environments.

Geologically speaking, limestone hills are the fossil remnants of marine reefs, built up by organisms growing vertically because they need light. Therefore, limestone bodies often have a much more limited horizontal extent than other sedimentary rock types. The capacity of a living reef to spread horizontally is limited by the depth of the surrounding water. If the water is too deep, light cannot reach the seabed, and reef-building organisms cannot settle. When, often after aeons of burial, the reefs are denuded by erosion, they usually stand as separate limestone hills in the landscape, with sediments of different nature in between.

Newly evolved species colonizing those limestone hills, once adapted to limestone environment and, as a result, no longer able to live elsewhere, are likely to find themselves trapped on a single or a few hills. They are isolated from their nearest relatives which, in the past, colonized more distant limestone hills, and which evolved into different new species.

As a result, limestone areas worldwide are extraordinarily rich in biodiversity, particularly in species with an extremely limited area of distribution: limestone areas are factories producing large numbers of species.

6 - Methods

6.1 - Where we collect

In order not to lose information that may be relevant later, we sample different surface environments separately (a forested slope, a sunny cliff, a deep cleft in the rock).

Underground environments (caves of all sizes down to small cracks in the rock, but also deep-soil deposits in rock crevices) may be home to often minute (0.7 – 2 mm) snail species hardly visible to the naked eye. We therefore take 'blind' samples in suitable places. We try to laboratory-process such samples in the field (microscope!) because, quite often, a second sampling is necessary when the first sampling reveals the presence of cave species, but does not yield sufficient material. Only when 'blind' samples indeed reveal cave-adapted species, we keep them separate from surface samples of the same spot.

Generally, we exclude aquatic snails from our survey, except for species of some families (Hydrobiidae s.l., for instance) which include large numbers of local-endemic and site-endemic species elsewhere. These aquatic snails are often found in small streams and (underground) wells in limestone areas. If we find such environments, we take 'blind' samples again, because the species are generally minute.

6.2 – Taking samples.

Quick and representative sampling is only possible if we target empty shells rather than living animals. Empty shells are in most cases sufficient for identification, except in some genera where the whole animal is needed for the purpose. In addition, slugs and semi-slugs (snails without a shell or with a small shell respectively) will be under-represented. This is compensated by the abundant presence of the very small species in our samples, which are very difficult to spot in the field.

The following procedure produces a representative sample of the snail fauna on a sampling site:

- Shells over 6 mm long are handpicked.
- We collect smaller species by taking ***soil-samples***, small amounts (a few handfuls) of soil from as many different microhabitats at a sampling site as possible.

Microhabitats and thanatocoenoses[2] we pay special attention to are:

- 'Deathtraps' below slightly overhanging limestone cliffs. Snails falling from the top of the cliff may bounce towards the rock face. Sheltered from rain, this is often very dry, so that the animals die, leaving well-preserved shells in loose sediment.
- Soil accumulated around the root systems of plants growing on cliff faces.
- Accumulations of organic soil in rock crevices.
- Leaf litter at the foot of limestone outcrops.
- Litter samples from sites where empty shells may accumulate (e.g. drift material over sediment-covered sinkholes, flood-marks of small streams).

Flood-marks of streams may also contain shells. We sample these, too, but we keep them as separate samples, because it is not certain that the shells found are actually living nearby: they may have washed in from elsewhere.

We continue gathering material on a sampling site until we have some 15-20 l of soil (two buckets full). Some handfuls will be poor in individuals and species (but may include species that do not occur in other handfuls); others will be very rich. All material together taken from a sampling site will yield a representative picture of the fauna of the locality under investigation.

[2] *death assemblage*. Groupings of remnants of organisms which may not have been associated during life, often originating from different habitats and brought together by rain, wind or predators.

When sampling a soil deposit, we remove any coarse leaf litter lying on top. Then we scrape together and bag the uppermost few centimeters of soil. Soil deposits in the above-mentioned 'deathtraps' and other thanatocoenoses are collected as a whole.

6.3 – Field-processing of samples

Field processing aims at separating an enriched fraction from the soil sample. Usually, this fraction is far less than half of the original sample in volume and down to a tenth of it in weight. This facilitates transfer to the home laboratory, and time-effective extraction of the fauna from the samples.

Field processing is done by flotation of the soil, pouring the soil in water and skimming off the floating fraction, including most of the shells. After drying, we separate the sample over a cascade of increasingly fine sieves. Each fraction will contain particles of approximately similar size, which ensures that no species are missed when extracting the shells under a microscope. We extract the coarse fractions during the survey as far as time permits. We pack the fine fractions for transfer to the home laboratory.

6.4 – Further processing in the home laboratory

Back in our home countries, the fine fractions are extracted under a dissecting microscope. The coarsest fractions can be picked with the naked eye, for the finer fractions, a dissecting microscope is needed.

Per locality, we separate the shells into species. We identify the species making use of literature and a reference collection.

7 – The area and its biodiversity

Fig. 1 shows the distribution of outcropping limestone in the wide surroundings of the concession, the west part of the Shan Plateau. Most conspicuous is the approximately 300 km long band with numerous outcrops from North to South. These limestones are bordering the Shan Plateau; the outcrops to the West are part of a series of hill ranges forming the plateau foothills.

The outcrops to the East are part of the Shan plateau itself. Here, the limestones are largely buried under a layer of red laterite soils. They are outcropping only locally, often as rounded hills, or where streams have cut through the laterite cover into the limestone bedrock, or where steep cliffs occur which are probably remnants of former landscapes.

The foothills to the West are largely covered with deciduous and some evergreen woodland. Traces of human impact abound but some of the woodland seems to be rather mature. The limestones to the East, on the plateau itself, are largely stripped of natural vegetation, apparently are not suitable for agriculture, and are only locally reforested with pine trees. Locally, they are also quarried, probably for burning lime. Most likely, their biodiversity value is very low.

Therefore, from a biodiversity point of view, the limestones on the plateau would be the best choice for any limestone-based industry, or at least a better choice than the forested limestones to the west, in the foothills

(*The above is based on analysis of Google Earth images, without checking other sources such as geological maps; the analysis will be checked during the field survey*).

8 – Snail sampling: results

Fig. 2 shows the sampling sites. We sampled 4 sites within the concession (all representative), 4 to the North of the concession (3 representative), 6 to the South of the concession (2 representative), and 3 to the East of the concession (2 representative). Altogether, we sampled 11 sites so thoroughly that the results give a good impression of the fauna of the site.

8.1 – list of sampling sites

8.1.1 – Sites along the road from Heho to the concession

Site 2017.01. Date 13/02/2017. Coordinates: 20°41'34.14"N 96°44'48.08"E. Alt.: 1280 m asl.
Shan Prov., along NH4 from Heho to Kalaw, hill range W of Innkhaung.
Limestone hillslope with much degraded, herbaceous vegetation and patches of shrub. Samples from near limestone boulders. Hand-picked shells and soil samples (*1/2 bucketful, sampling representative*).
General observations: In spite of degradation, probably caused by cattle (goats?), some apparently limestone restricted plant species are extant (Gesneriaceae).

Site 2017.2. Date 13/02/2017. Coordinates: 20°37'31.91"N 96°36'29.20"E. Alt.: 1350 m asl.
Shan Prov., along NH4 3.8 km NE of Kalaw.
Limestone cliff, degraded vegetation at foot largely burnt. Samples from sediment pockets at the foot of the cliff. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).

Site 2017.03. Date 13/02/2017. Coordinates: 20°39'0.23"N 96°35'58.92"E. Alt.: 1370 m asl.
Shan Prov., along NH4 3.8 km NE of Kalaw.
Limestone cliff, with degraded vegetation including some shrubs at the foot. Samples from sediment pockets at the foot of the cliff. Hand-picked shells and soil samples (*1/2 bucketful, sampling incomplete*).

8.1.2 – Sites in concession area

Site 2017.04. Date 14/02/2017. Coordinates: 20°52'17.39"N 96°24'31.02"E. Alt.: 750 m asl.
Mandalay Prov., STC-APACHE concession, S side.
Small peak in limestone crest. Slopes rocky, with bamboo thickets, small trees and some climbers. Sampling from rock ledges and crevices. The sample includes yellow, shell-containing deposits in tubular cavities in a boulder pushed aside for road construction. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).
General remarks: Hibernating tubers of *Amorphophallus* sp. (Araceae) present, possibly a limestone-restricted species. Also undergrowth climbing Caprifoliaceae with small purple flowers, possibly a potentially limestone restricted species

Site 2017.05. Date 14/02/2017. Coordinates: 20°52'36.04"N 96°24'30.81"E. Alt.: 720 m asl.
Mandalay Prov., STC-APACHE concession, N side.
Transverse depression in limestone ridge. Bottom with laterite cover and locally outcrops. Sampling from soil around and in between outcrops. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).
General observations: all teak of usable size logged out long ago; only rotten stumps and some planks remaining. S-facing slope with bamboo thickets and small trees. (N-facing slope destroyed by quarrying).

Site 2017.06. Date 15/02/2017. Coordinates: 20°52'9.80"N 96°24'31.73"E. Alt.: 750 m asl.
Mandalay Prov., STC-APACHE concession, S side.

Depression in crest of limestone ridge, the N-facing slope with some evergreen vegetation and bamboo thickets. Sampling from among limestone boulders, at the foot of cliffs and from small cave. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).
General observations: All usable teak trees logged out long ago. *Amischotolype*, or *Pollia* (Commelinaceae), an unidentified Acanthaceae ,and a Campanulaceae, all not flowering and potential limestone endemics, grow at the bottom of the depression, otherwise invaded by roadside weeds through the new quarry road. On a rockface we found young plants of, possibly, *Ornithoboea* (Gesneriaceae), another limestone endemic.

Site 2017.07. Date 15/02/2017. Coordinates: N 20°52'12.90"N 96°24'15.20"E. Alt.: 630 m asl.
Mandalay Prov., STC-APACHE concession, W side.
Dolomite bedrock. Rocky W-facing slope with predominant bamboo thickets and some small trees. Snail sampling at foot of rock outcrops. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).
General observations: All medium-sized Teak trees were logged long ago; only rotting stumps and some planks remaining. Extensive traces of more recent undergrowth bushfire, destroying the soil, but apparently leaving the canopy unaffected.
2 plant species potentially limestone-restricted: an undergrowth climbing Caprifoliaceae with small purple flowers, and an herbaceous species of the same family.

8.1.3 – Sites to the North of the concession area

Site 2017.08. Date 16/02/2017. Coordinates: 20°52'55.69"N 96°24'27.91"E. Alt.: 730 m asl.
Mandalay Prov., Pyinyaung area, just N of STC-APACHE concession.
Dolomite outcropping in and around transverse depression in N-S ridge. Bamboo thickets with small trees; all large Teak logged out. Sampling at foot of rock outcrops and cliffs on N and E facing slopes. Hand-picked shells and soil samples (*2 bucketsful, sampling representative*).
General observations: Lower slopes, around explosives depots, mainly bamboo thickets, with only young teak trees left here and there. Upper slope with second-cut logging in progress; bamboo thickets predominant. Saprophytic orchid (*Gastrodia* sp., only underground tuber seen) on N-facing slope.

Site 2017.09. Date 18/02/2017. Coordinates: 20°55'52.52"N 96°23'54.59"E. Alt.: 270 m asl.
Shan Prov., Pyinyaung area, gorge trough limestone range 4.5 km N of Kubyin village.
Stream cutting E-W gorge through limestone ridge. N-facing slope with steep cliffs, overgrown with partly evergreen woodland. Sampling at the foot of outcrops and from crevices, above flood mark. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).
General observations: S-facing slope rocky, with small deciduous trees with bamboo thickets in between. Some evergreen climbers near base only. Orchid (*Cymbidium* sp.) in tree.
Streambed with a rather species-rich herbaceous flora (a.o. Lamiaceae, Acanthaceae, Gentianaceae), probably with widespread species only.
Landscape picturesque, with steep rock faces. During the dry season, the streambed in the gorge connects people living East of the limestone range to the world: motorbikes frequently pass by, track also suitable for trucks.

Site 2017.10. Date 18/02/2017. Coordinates: 20°55'9.19"N 96°23'44.59"E. Alt.: 470 m asl.
Mandalay Prov., Pyinyaung area, W flank of limestone range c. 3.1 km N of Kubyin village.
Topographic base of limestone formation, approx. half-way up W-facing hillslope. Outcrops overgrown with bamboo thickets and small trees. Sampling at the foot of outcrops and from crevices. Hand-picked shells and soil samples (*1/4 bucketful, sampling incomplete*).
General observations: Below the limestone base a steep, W-facing, exposed, sunny slope on sandstone/conglomerate bedrock with open-canopy regrowth half-grown Teak woodland, and subordinate bamboo thickets. Traces of logging long ago present, second cut logging on lower slope.

Teak trees on higher slope with 12 species of orchids (*Ascocentrum* sp.; *Bulbophyllum* 2 sp.; *Cleisostoma subulatum* aff.; *Cleisostoma* sp.; *Dendrobium* 4 sp.; *Oberonia* sp.; (?) *Micropera* sp.; *Trichoglottis* sp.).

Site 2017.11. Date 19/02/2017. Coordinates: 20°53'56.34"N 96°24'22.05"E. Alt.: 300 m asl.
Mandalay Prov., Pyinyaung area, gorge through limestone range E of Kubyin village.
Stream cutting E-W gorge through limestone ridge. N-facing slope with steep cliffs, overgrown with partly evergreen woodland with some mature trees. Sampling at the foot of outcrops and from crevices. Hand-picked shells and soil samples (*2 bucketsful, sampling representative*).
General observations: S-facing slope rocky, with bamboo thickets and small deciduous trees, some evergreen vegetation near base only. Unidentified orchid in tree. A resurgent well, 1 m above the streambed, indicates permanent water circulation inside the hill, and possible presence of cave systems. Streambed with a rather species-rich herbaceous flora (a.o. Lamiaceae, Acanthaceae), probably with widespread species only.
Landscape more picturesque than site 9; extensive travertine deposits somewhat higher up the slope may indicate that the gorge was formed by a collapsing cave system. During the dry season, the streambed in the gorge connects people living East of the limestone range to the world: motorbikes and even trucks frequently pass by.

8.1.4 – Sites to the South of the concession area

Site 12. Date 19/02/2017. Coordinates: 20°40'53.84"N 96°26'38.25"E . Alt.: 630 m asl.
Mandalay Prov., Pyinyaung area, limestone plateau 2.6 km SE of Yeboo village.
Limestone plateau with numerous quarries and degraded vegetation (bamboo thickets). Collecting in bamboo thickets with only few trees left. Hand-picked shells and soil samples (*1/2 bucketful, sampling incomplete*).
General observations: The plateau is gutted by numerous small limestone quarries; the woody vegetation has largely disappeared into the lime kilns. The vegetation on the surrounding hills is less depleted, but could not be reached for representative sampling.

Site 2017.13. Date 19/02/2017. Coordinates: 20°45'49.21"N 96°25'19.98"E. Alt.: 650 m asl.
00 Prov., Mandalay Prov., Pyinyaung area, 6.9 km SSE of Pyinyaung.
Limestone plateau surrounded by hills. Vegetation degraded to bamboo thickets with only few trees left. Hand-picked shells and soil samples (*1/2 bucketful, sampling incomplete*).
General observations: a pattern of tracks crisscrosses the plateau to extract firewood and bamboo. A few small quarries are present at the topographic base of the limestone.

Site 2017.14. Date 19/02/2017. Coordinates: 20°49'29.33"N 96°24'56.22"E. Alt.: 330 m asl.
Mandalay Prov., Pyinyaung area, E entrance of gorge in limestone range E of Pyinyaung.
Slope overgrown with dense secondary growth. Bedrock sandstone/shale, with large limestone boulders rolled down from upper slope. Sampling from leaf litter on steep slope of a gulley. Hand-picked shells and soil samples (*1 bucketful, sampling representative*).

Site 2017.15. Date 19/02/2017. Coordinates: 20°49'31.40"N 96°24'32.50"E. Alt.: 300 m asl.
Mandalay Prov., Pyinyaung area, gorge in limestone range E of Pyinyaung.
Stream cutting E-W gorge through limestone ridge. N-facing slope, remnants of caves in roadside quarry, with some ochre-colored cave soil. Blind sample of the cave soil (*a few litres*).

Site 2017.16. Date 19/02/2017. Coordinates: 20°49'35.98"N 96°24'33.47"E. Alt.: 320 m asl.
Mandalay Prov., Pyinyaung area, gorge in limestone range E of Pyinyaung.
Stream cutting E-W gorge through limestone ridge. N-facing slope, remnants of caves high up in roadside quarry, with abundant red laterite soil spilling over into the quarry. Blind sample of laterite soil (*1/4 bucketful*).

Site 2017.17. Date 19/02/2017. Coordinates: 20°49'42.23"N 96°24'34.62"E. Alt.: 320 m asl. Mandalay Prov., Pyinyaung area, gorge in limestone range E of Pyinyaung.
Stream cutting E-W gorge through limestone ridge. S-facing slope with thin deciduous woodland and many bamboo thickets. Limestone cliff near the base of the slope, with various shallow caves at the foot of the cliffs. Sampling at the foot of the cliff; hand-picked shells and soil samples (*1 bucketful; sampling representative*).
General observations: Caves present, used as a place of worship.

8.2 – The list of snail species

Fig. 4 lists all the species we have sampled or noted, per sampling site.

The first four columns give taxonomic information about the species.

1. Name of the family to which the species belongs.

2. The species name, consisting of two parts, "*Cyclophorus volvulus*": the first is the generic name, the second the specific name. Several species cannot be identified down to species level. These are listed with a generic name only, "*Kaliella*", with "sp." added, or "**new sp.**" if we have already established that the species is new to science. Where necessary to avoid confusion, we add an informal identifier in column 4.

3. Author of the species and the year of its original description.

4. Informal identifier/additional information. If relevant, the fourth column gives some key characters uniquely to identify a species.

Column 5 gives the range size category of the species, see chapter 4.

The other columns give the distribution of each species over the sampling sites, which are shown on the map in **fig. 2**, and listed in chapter 8.1.

8.3 – Presence of site-endemic and local-endemic species

8.3.1 – Site-endemic species

We did not find any potentially site-endemic species in the APACHE-concession area, nor elsewhere in the Pyingyaung limestone range. Therefore, we found no species that would require impact mitigation measures to survive the quarrying.

Generally speaking, it is unlikely that true site-endemic snail species are present in the APACHE concession.

Site-endemic species which occur restricted to a part of a continuous limestone range (such as the Pyinyaung limestone range) are usually found in extreme environments of limited spatial extent, such as caves, or waterbodies in or outside caves.

- We have not seen suitable caves of any size in the area. The caves that we have seen include a few remnant cavities E of Pyinyaung village. 'Blind' sediment samples (sampling sites 15

and 16) from these cavities did not contain potentially site-endemic species. Another cave E of Pyinyaung (sampling site 17) is used as a place of worship and carefully cleaned.

- We found two resurgent wells. The well in the gorge East of Kubyin village (near sampling site 9) did not contain potentially site-endemic species; the well in the gorge E of Pyinyaung village (near sampling site 17) is too hot to contain any snail fauna.

Explanation: Limestone-restricted species tend to occupy all suitable habitat available and accessible. For surface species this usually means that they occupy a patchwork of sites up to the circumference of the limestone hill. For above-ground aquatic species, as well as underground terrestrial or aquatic species, this means that they occupy a cave or water body, i.e. an area so small that it could entirely be destroyed by quarrying.

8.3.2 – Local-endemic species

Fig. 5 lists the 10 species which are potentially endemic to the Pyinyaung limestone range (Range Size Category 2). Some occur along the entire length of the range, from North to South (like *Bradybaena schanorum*), others are restricted to part of the range (like *Pseudonenia shanica*).

Some have a range so limited that they could be listed as site-endemic species (*Dicharax* sp., *Plectotropis* new sp., *Sinoennea* new sp., *Anauchen* new sp.). However, as argued above, site-endemic species in continuous limestone ranges are usually adapted to spatially limited areas with extreme environmental properties . All the species mentioned above are rock-, soil-, or vegetation dwellers, not limited in their movements by any obvious environmental constraint. Eventually, they are likely to be found elsewhere on the range, and therefore we list them as local-endemics.

Probably, *Anauchen* new sp., at present only known from the APACHE-concession, is distributed beyond the concession boundaries as well. Therefore, the species is best regarded as a local-endemic. Nevertheless, its range may be so limited, that the activities on the Apache site reduce its range to an extent that it would trigger the IUCN Red List Criterion EN.

Several local-endemic species occur exclusively in the North part of the Pyinyaung range (the APACHE-concession and further North: *Dicharax* sp., *Sinoennea* new sp., *Anauchen* new sp. We have not found local-endemic species restricted to the South part of the range (from Pyinyaung Southwards).

From this point of view, the part of the Pyinyaung limestone range North of the concession is more suitable for offsetting purposes.

However, it should be kept in mind that the southernmost end of the range (sampling sites 12 and 13) have not been representatively sampled. Local endemics may lurk in the South in places with less degraded environment not visited by us, see **fig. 3b**.

The presence of 10 snail species potentially endemic to the Pyinyaung limestone range shows that offsetting may be effective to reduce biodiversity loss caused by quarrying activities along the limestone range.

8.4 – Presence of species new to science

Sixteen species could not be identified down to species level with reasonable certainty. Eight of these are probably new to science.

Four of the local-endemic species are probably new to science, two of these are found in the concession: Diplommatina crispata new subsp., and Anauchen new sp.

The number of unidentifiable species is surprisingly low. This is because the existing literature adequately covers a representative part of the local fauna.

8.5 – Differences in the fauna composition

For the calculations in this chapter, Introduced species (RSC=5) have been omitted from the species list in **fig. 4.** We calculate similarity between sampling sites, or groups of sampling sites, making use of the DSC[3]. The results are given in the tables in **fig. 6**. The DSC is sensitive to sets of unequal size (we try as much as we can to standardize sampling procedures to ensure that a low number of species on a site reflects true faunal poverty and not incomplete collecting). Below, we add a note where the DSC is affected by asymmetrical collecting on the compared sampling sites.

8.5.1 - Uniqueness of the fauna of the Pyinyaung limestone range

To compare the faunas of the Pyinyaung limestone range and surrounding limestone areas we sampled three sites between Kalaw and Heho (sampling sites 1, 2, and 3). In spite of the asymmetric nature of our collecting effort (the environment on the three sites is heavily degraded, and our collecting on one site was cursory), it is evident that the fauna on these sites differs fundamentally from the fauna on the Pyinyaung limestone: DSC = 0.39 only, with 11 species on the three sites which we did not find on the Pyinyaung limestone range.

We are confident that strong gradients exist in the fauna composition of the limestone hills in the region. Each limestone area has a fauna different from that of surrounding limestone areas. As a consequence, the rates of endemism will be high...

…even though we have no knowledge of the fauna composition on the Southwards continuation of the Pyinyaung limestone range, or on the extensive limestone areas to the East (see **fig. 1**),

The Pyinyaung limestone range, too, has a fauna different from that of surrounding ranges, which includes a number of unique elements (local-endemic species).

8.5.2 – A North-South gradient in the fauna composition of the Pyinyaung limestone range

We compare the cumulative fauna of the sampling sites:

- in the concession (sampling sites 4+5+6+7),
- to the North of the concession (sampling sites 8+9+10+11),
- to the South of the concession (sampling sites 12 +13+14+16+17).

Differences in set size probably reflect true differences in species richness except for the southernmost end of the range, where sampling sites 12 and 13 are probably not representative for the local fauna because of the heavily degraded environment. We had no opportunity to find alternative sampling sites. Sampling site 16 yielded only a single shell, but this is compensated by the representative sampling of sites 14 and 17, nearby.

The sites are compared in pairs, which yields a DSC ranging from 0.73 to 0.77.

[3] Dice Similarity Coefficient = $Dsc = 2|x \cap y|/|x|+|y|$, in which x and y are the number of species found in two localities. Values between 0 and 1; high values denote similarity.

A North-South gradient is present in the composition, with the DSC ranging from 0.73 to 0.77 between the compared pairs (see **fig. 6**): the fauna of the South end of the range is significantly different from the fauna of the North end of the range.

This means that the cumulative effect of all economic activity along the Pyinyaung limestone range may lead to biodiversity loss, even if the part of the limestone range to the North of the concession is protected by the APACHE offsetting program.

Again, this statement may gain weight once the southernmost part of the range is more thoroughly checked for local-endemic species.

8.5.3 – Fauna composition versus altitude in the North part of the Pyinyaung limestone range, including the concession.

We compare the cumulative fauna of the following sampling sites in the concession as well as to the North of the concession:

- Sampling sites below 400 m alt., on sheltered, North-facing slopes overgrown with partly evergreen woodland, bordering the gorges cutting through the limestone range near Kubyin and N of Kubyin (sampling sites 9+11).
- Sampling sites above 400 m alt., on sun-exposed or slightly sheltered West- or N-facing slopes overgrown with largely deciduous woodland with often a marked dominance of bamboo thickets on the flanks and the top area of the limestone range (sampling sites 4+5+6+7+8+10)…

The DSC=0.75, see **fig. 6**, shows that the faunas are different. This difference is proportionally reflected in the distribution of the local-endemic species: 7 out of 10 occur in both, whereas 2 (*Dioryx pingoungensis* and *Sinoennea* sp.) prefer the lowlands and 1 (*Anauchen* sp.) is restricted to high grounds.

Unfortunately our attempts to sample the high grounds of the limestone range well to the North of the concession succeeded only partly (sampling site 10, incomplete collecting), without opportunity to try a second time. The path up to sampling site 10, however, leads through woodland very similar to the woodland in and around the concession, but in general somewhat less disturbed, at least without any traces of logging in progress. Besides, the woodland supports a reasonably diverse orchid flora of 12 different species.

We provisionally conclude that the higher parts of the limestone range North of the concession are suitable for offsetting purposes, in the sense that they probably harbor a fauna similar to that of the concession, or richer in species. The two North-facing slopes bordering the gorges cutting through the range, with a different fauna, add to the biodiversity diversity and are a bonus.

10 – References

Google Earth Pro. Accessed in 2014-2016.

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Vermeulen JJ, & Whitten AJ 1999. Biodiversity and cultural heritage in the management of limestone resources. Lessons from East Asia. Directions in Development Series, World Bank, Washington, USA, p. i-x & 1-120.

Figures

Fig. 1 – Karst in the western Shan plateau

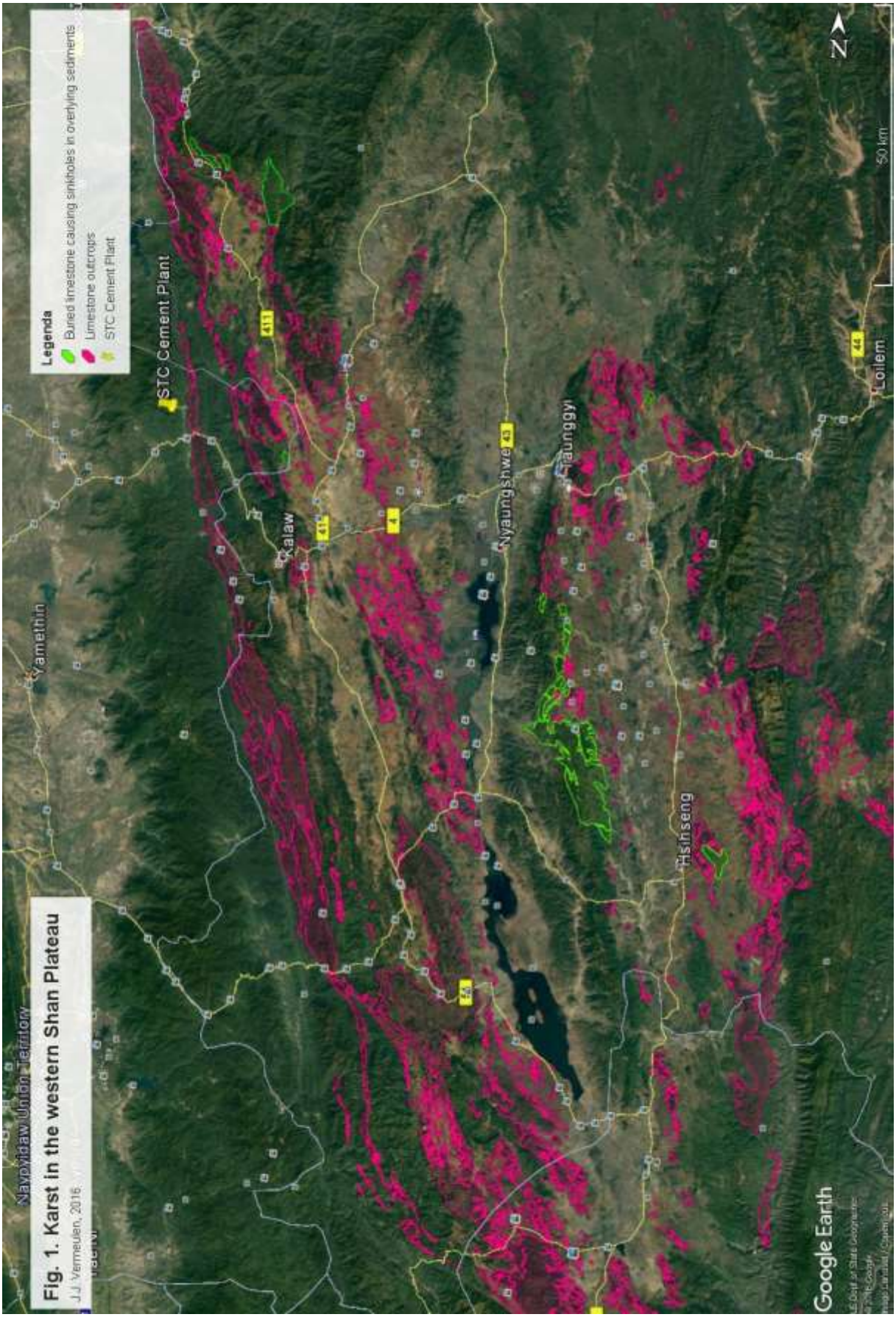


Fig. 2a – Sampling sites – Pyinyaung and further North

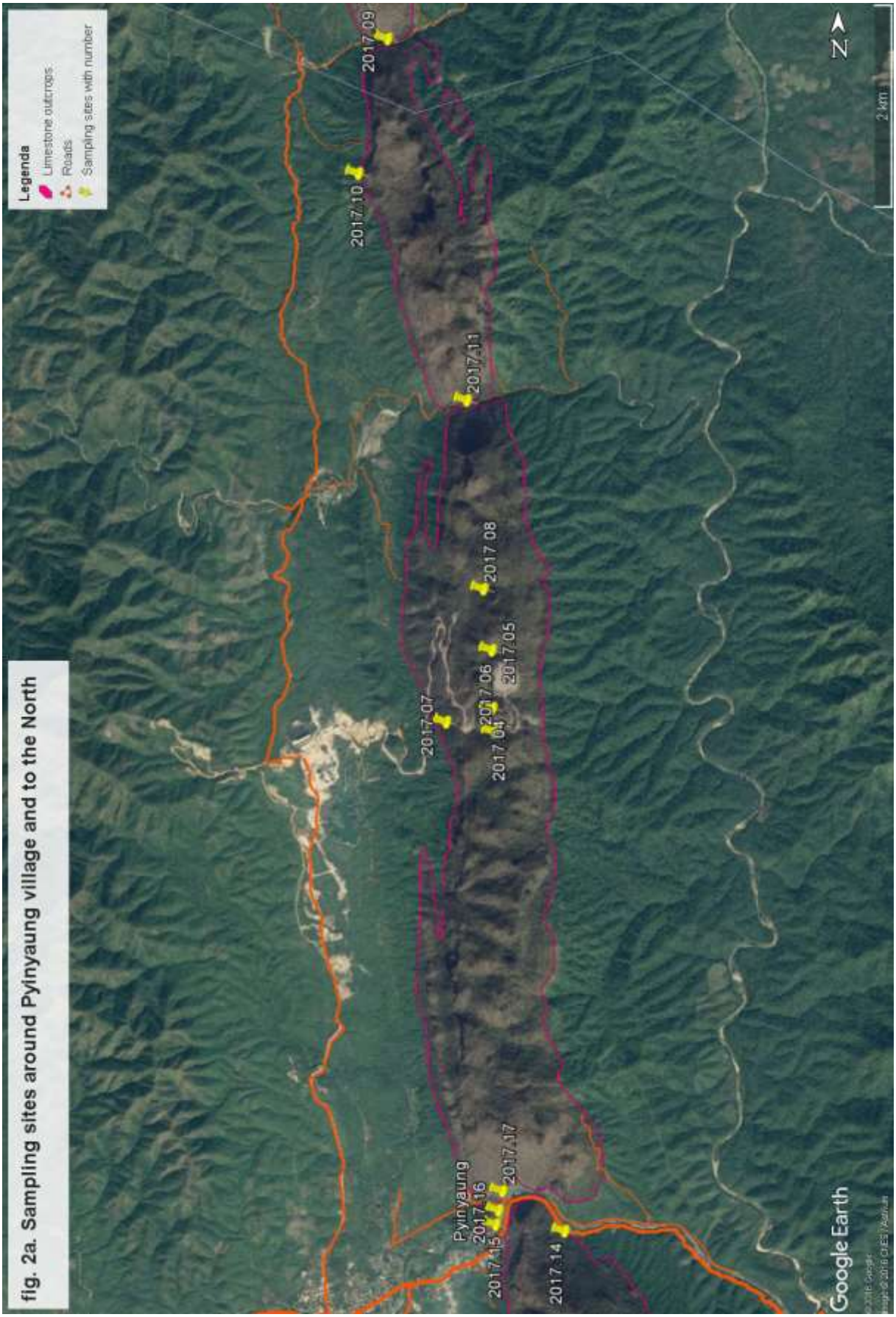


fig. 2a. Sampling sites around Pyinyaung village and to the North

Fig. 2b – Sampling sites – South of Pyinyaung

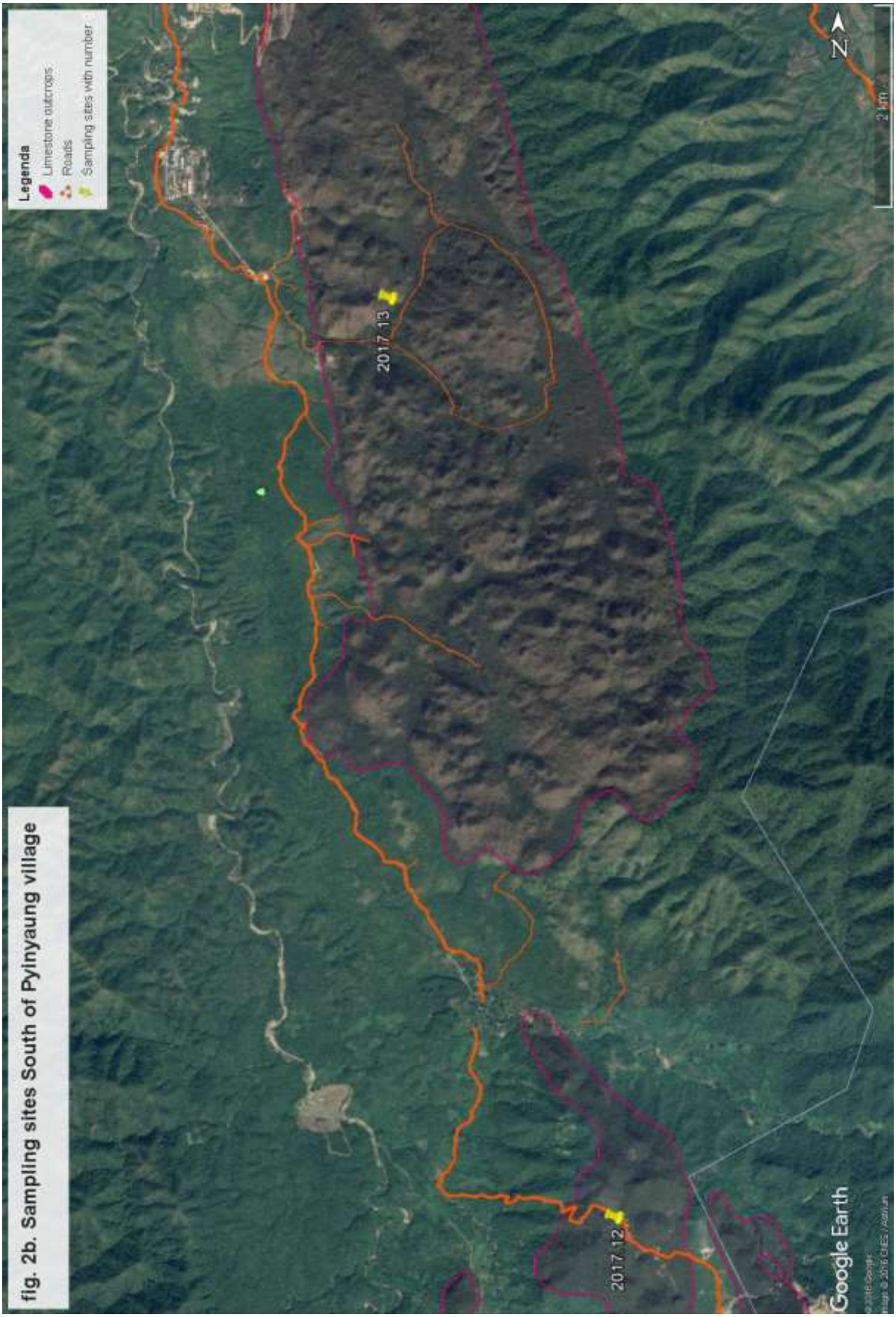


Fig. 2c – Sampling sites – East of Kalaw

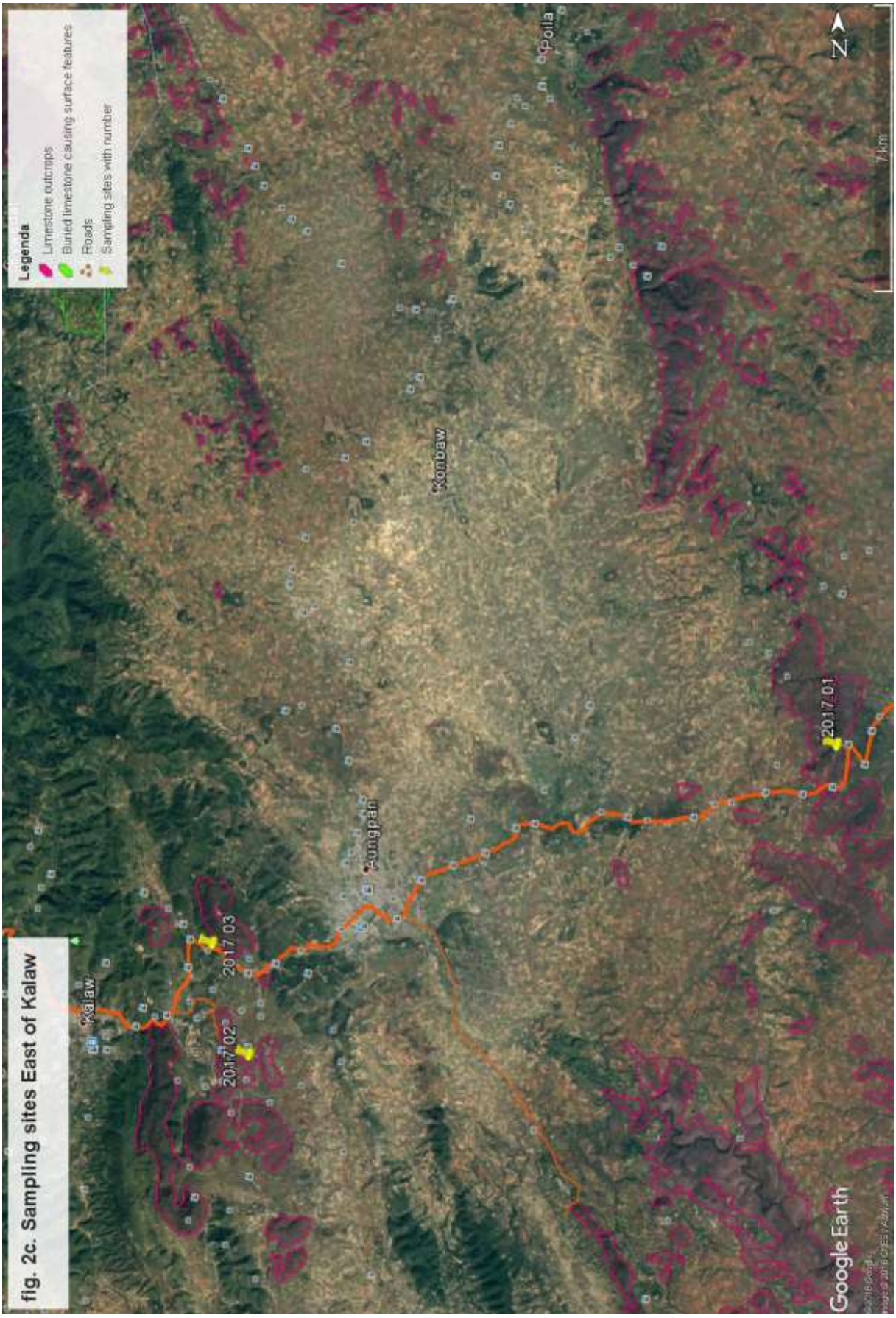


Fig. 3a – Division of the limestone range in sectors

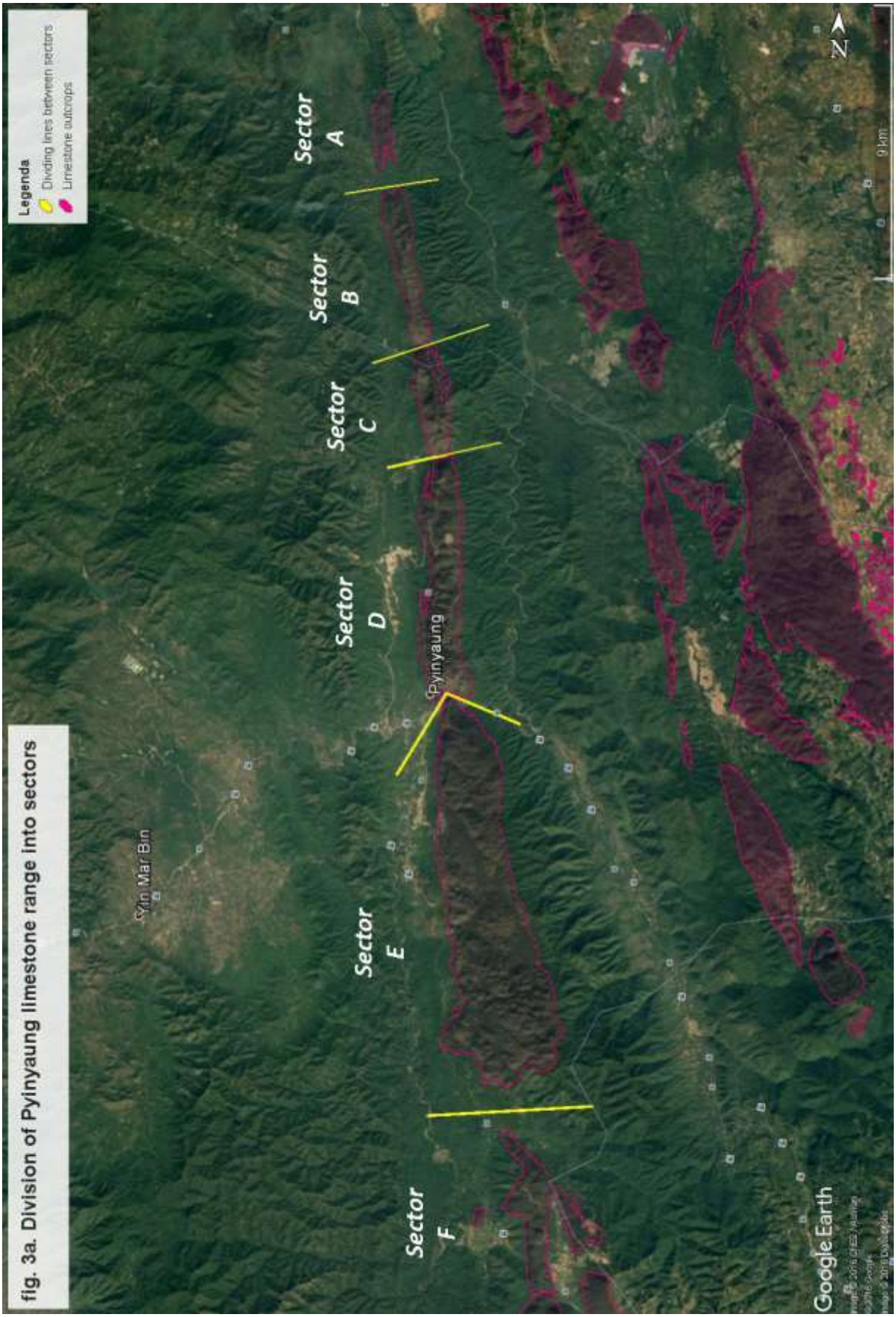
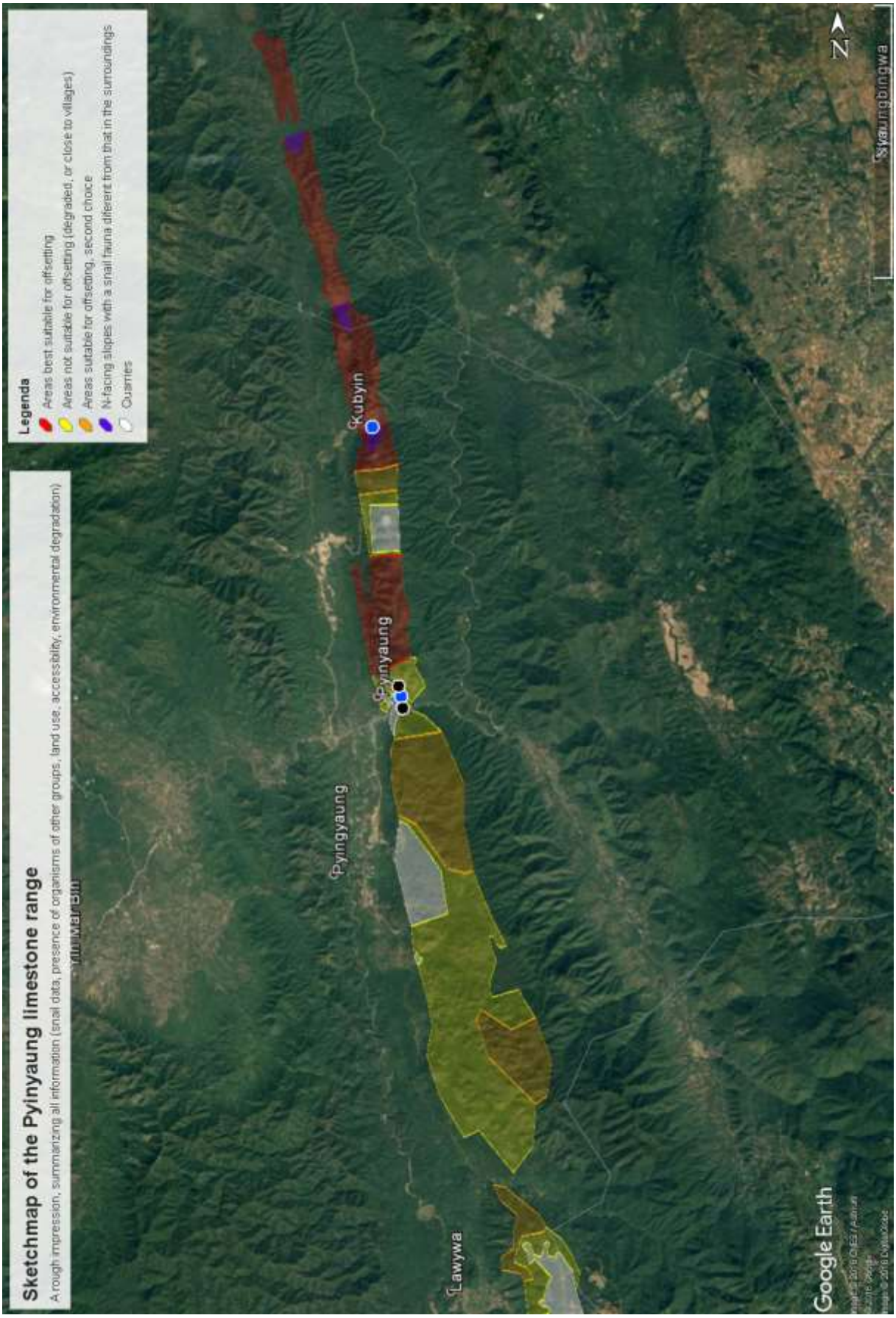


fig. 3a. Division of Pyinyaung limestone range into sectors

Fig. 3b – Sketchmap summarizing information



Blue dots: karst wells - Black dots: caves or remnants of caves

Fig. 4 – List of the snail species recorded

FAMILY	SPECIES	AUTHOR, YEAR	INFORMAL IDENTIFYERS	RSC	9	10	11	8	4	5	6	7	16	17	14	12	13	1	2	3
RSC = Range Size Category: 1=site-endemic; 2=local-endemic; 3=regional-endemic; 4=widespread; 5=introduced Localities 4 to 17 arranged from North to South					N of concession				Concession				S of concession					Heho to Kalaw		
Assimineidae	***Acmella hyalina***	(Theob. & Stol., 1872)		3	1									1						
Cyclophoridae	***Alycaeus pyramidalis***	Benson, 1856	RSC based on assumed synonymy with *A. jagori*	4	1	1	1	1	1	1	1	1		1			1			
	Alycaeus (?) ***rubinus***	Godwin Austen, 1893	Shells smaller than in lit., >5 mm high	4		1			1	1		1		1						
	Cyclophorus aurantiacus	(Schumacher, 1817)		4											1					
	Cyclophorus crassilabella	Godwin Austen, 1888		3	1	1		1	1	1	1	1	1				1	1		
	Cyclophorus malayanus	(Benson, 1852)		4	1	1	1	1	1	1	1									
	Cycloryx graphicus	(Blanford, 1862)		4											1		1			
	Dicharax armillatus	(Benson, 1856)		3	1	1	1	1	1	1	1	1		1			1		1	
	Dicharax ataranensis	(Godwin Austen, 1914)		3	1			1									1			
	Dicharax sp.			2			1	1												
	Dioryx pingoungensis	(Godwin Austen, 1914)		2			1								1					
	Japonia leporina	(Blanford, 1865)		3	1		1	1	1	1	1				1	1	1			
	Japonia tomotrema	(Benson, 1857)		4	1															
	Pterocyclos insignis	Theobald, 1865		3	1		1	1	1	1		1		1						
	Scabrina (?) ***calyx***	(Benson, 1857)	Larger than in lit.: d=>15 mm	3											1			1	1	
Diplommatinidae	***Diplommatina insignis***	(Godwin Austen, 1870	Sinistral, r.ribs close	4						1	1			1				1	1	1
	Diplommatina scalaroidea	Theobald, 1870	Sinistral, r.ribs distant	3	1	1	1	1	1	1	1	1								
	Diplommatina (?) ***nana***	Blanford, 1865	Less ventricose than in lit.	4	1		1			1		1			1		1			
	Diplommatina labiosa	Blanford 1868	Dextral, medium, 2 palatales	4	1		1													
	Diplommatina crispata **new subsp.**	Stoliczka, 1871	Spire higher than in type	2			1	1			1	1		1	1	1				
Helicinidae	***Aphanoconia gratulata***	(Sowerby 1866)		3	1		1													
Hydrocenidae	***Georissa pyxis***	(Benson, 1856)		3	1		1	1	1	1	1			1			1			
Pupinidae	***Pseudopomatias peguensis***	(Theobald, 1864)		3	1															
	Pupina artata	Benson, 1856		4	1		1		1	1		1			1	1				
Achatinidae	***Achatina fulica***	(Bowdich, 1822)	(NOT VOUCHERED)	5			1													
Ariophantidae	***Austenia*** (?) ***nagaensis***	(Godwin Austen, 1880)		4												1				
	Durgella (?) ***assamica***	Godwin Austen 1881		?	1		1		1	1				1	1	1	1			
	Durgella levicula	(Benson, 1859)	(Panha fig. 4.2)	4	1	1	1	1	1	1	1	1		1	1					
	Euplecta langkaensis	Preston, 1909		3	1	1	1	1	1	1	1	1		1	1	1	1	1		1
	Girasia (?) ***dikrangensis***	(Godwin Austen, 1888)		4			1				1						1			
	Khasiella pingoungensis	(Godwin Austen, 1888)		2	1	1	1	1	1	1	1	1			1	1	1			
	Macrochlamys (?) ***causia***	(Benson, 1859)		3	1															
	Macrochlamys chaos	Blanford, 1904		3	1															1
	Macrochlamys consepta	(Benson, 1860)	Labiate	3	1	1	1	1						1	1		1	1		
	Macrochlamys hypoleuca	(Blanford, 1865)		4			1		1		1	1			1		1			
	Macrochlamys molecula	(Benson, 1859)		4			1				1					1	1			1
	Macrochlamys (?) ***perpaula***	(Benson, 1859)		4				1	1	1	1				1	1	1	1	1	1
	Macrochlamys salwinensis	Godwin Austen 1907		3				1		1		1		1						
	Macrochlamys spreta	Blanford, 1904		3	1	1	1	1	1	1	1	1		1	1	1		1		
	(?) ***Macrochlamys*** sp.		Subglobose, reticulate sc.	3	1		1	1	1	1	1	1		1			1			1
	Megaustenia sp.			?	1	1	1	1	1	1	1	1		1	1	1	1			
	(?) ***Microcystina*** sp. 1		Minute, white	?						1		1								
	(?) ***Microcystina*** sp. 2		Minute, corneous, possibly *M sinica*	?				1												
Bradybaenidae	***Bradybaena pilidion***	(Benson, 1860)		3										1		1				
	Bradybaena scalpturita	(Benson, 1857)		3		1												1		
	Bradybaena schanorum	(Moellendorff 1899)		2	1	1	1	1	1	1		1		1		1	1			
	Bradybaena zoroaster	(Theobald, 1859)		3	1		1	1	1	1	1									
	Cathaica **new sp.**		flat, wide umb.	2															1	
	Plectotropis (?) ***diplogramme***	(Von Moellendorff, 19	Smaller than in lit.	?														1		
	Plectotropis emensa	(Godwin Austen, 1888)		3								1		1	1					1
	Plectotropis tapeina	(Benson, 1836)		4	1	1	1	1	1	1	1	1		1	1		1		1	
	Plectotropis **new sp.**		Like *P. Perplanata* , but flatter	2	1	1														
Camaenidae	***Chloritis anserina***	(Theobald, 1866)		2	1	1	1	1	1	1	1	1					1			
	Ganesella capitium	(Benson, 1848)		4											1	1				
Clausiliidae	***Phaedusa arakana***	(Stoliczka, 1872)		3															1	
	Phaedusa burmanica	(Gude, 1909)		3			1	1	1	1	1	1		1			1			
	Pseudonenia nicobarica	(Gude, 1909)	larger than type (30 vs 24 mm)	3	1															
	Pseudonenia shanica	(Godwin Austen, 1888)		2	1	1	1			1		1		1						
Endodontidae	***Philalanka*** sp.			3	1		1	1	1	1	1	1		1		1	1	1		1
Enidae	***Ena vicaria***	(Blanford, 1870)		4															1	1
Euconulidae	***Kaliella barrakporensis***	(Pfeiffer, 1852)		4			1							1				1	1	1
	Kaliella calculosa	(Gould 1852)		4	1															
	Kaliella microconus	(Mousson, 1865)		4																1
Ferussaciidae	***Caecilioides balanus***	(Reeve, 1850)	RSC based on assumed synonymy with *C. caledonica*	4										1						
Plectopylinidae	***Chersaecia kengtungensis***	(Gude, 1914)		3	1	1	1		1	1				1	1	1	1		1	
	Plectopylis **(?) new sp.**		As *P. Leucochila* , but long.parietals approaching	3		1	1	1			1	1								
Punctidae	***Paralaoma halyi***	(Jousseaume, 1894)		4															1	
Pyramidulidae	***Pyramidula rupestris***	(Draparnaud, 1801)		4															1	1

Streptaxidae	***Haploptychius burmanicus***	(Blanford, 1864)		3				1			1								
	Sinoennea new sp.		aff. *S. Woodthorpei* , but 1	2	1														
Subulinidae	***Curvella pusilla***	(Benson, 1865)		3				1									1		
	Curvella sp.		As *C. pusilla* , but more slender	?	1														
	Glessula crassilabris	(Benson, 1836)		4			1			1	1						1		
	Glessula gemma	(Reeve, 1850)		4	1		1	1	1	1	1	1		1	1	1	1	1	
	Opeas innocens	Preston, 1910	Very small & slender	3	1		1	1	1	1			1	1	1	1		1	1
	Paropeas clavulinus	(Pot. & Mich., 1822)		4	1		1	1	1	1	1		1			1			
	Paropeas gracilis	(Hutton, 1834)		4	1		1												
	Prosopeas walkeri	(Benson, 1863)		3														1	
Trochomorphidae	***Videna castra***	(Benson, 1852)		4										1	1	1			
	Videna percompressa	(Blanford, 1869)		3	1	1	1	1	1	1	1					1			
Vertiginidae	***Acinolaemus*** new sp.			3	1		1	1	1	1	1		1				1	1	1
	Anauchen new sp.			2					1	1									
	Gastrocopta avanica	(Benson, 1863)		4				1		1								1	1
	Gyliotrachela bensoniana	(Blanford, 1863)		3		1	1	1					1						
	Nesopupa malayana	(Issel, 1874)		4	1								1						
	Paraboysidia salwiniana	(Theobald, 1871)		3	1	1	1		1	1	1								
	Paraboysidia sp. 1, new sp.		3 mm high	2														1	1
	Paraboysidia sp. 2		2,5 mm high	2														1	
	Ptychopatula evezardi	(Blanford, 1875)		4				1		1							1		1
	Ptychopatula orcula	(Benson, 1850)		4													1	1	1
	Pupisoma lignicola	(Stoliczka, 1873)		3		1	1	1		1	1	1		1		1			
			Total # species per locality		46	24	46	39	33	41	34	31	1	33	24	20	31	16	18	18
			Among these, # potential local-endemic species		6	5	7	5	4	5	3	5	0	3	3	3	3	0	3	1
			Fraction locally endemic species		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Locality number		9	10	11	8	4	5	6	7	16	17	14	12	13	1	2	3

Fig. 5 – Local endemic species of the Pyinyaung limestone range, and their distribution

SPECIES	AUTHOR, YEAR	INFORMATION ON RSC-STATUS	RSC	9	10	11	8	4	5	6	7	16	17	14	12	13
Local-endemic species (RSC=2) of the Pyinyaung limestone range only Localities 4 to 17 arranged from North to South				N of concession				Concession				S of concession				
Dicharax sp.		No known records in collections	2			1	1									
Dioryx pingoungensis	(Godwin Austen, 1914	Recorded in literature from Pyinyaung only	2			1								1		
Diplommatina crispata new subsp.	Stoliczka, 1871	A local form of a widespread complex species	2			1	1			1	1		1	1	1	
Khasiella pingoungensis	(Godwin Austen, 1888	Recorded in literature from Pyinyaung only. May prove to be more widespread	2	1	1	1	1	1	1	1	1			1	1	1
Bradybaena schanorum	(Moellendorff 1899)	Recorded in literature from Kalaw only	2	1	1	1	1	1	1		1		1		1	1
Plectotropis new sp.		No known records in collections	2	1	1											
Chloritis anserina	(Theobald, 1866)	Recorded in literature from `Shan States` only, without precise locality data	2	1	1	1	1	1	1	1	1					1
Pseudonenia shanica	(Godwin Austen, 1888	Recorded in literature from Pyinyaung only	2	1	1	1			1		1		1			
Sinoennea new sp.		No known records in collections	2	1												
Anauchen new sp.		No known records in collections	2					1	1							
# local-endemic species per locality				6	5	7	5	4	5	3	5	0	3	3	3	3

Fig 6 – Similarities between sampling sites

# species shared	N of concession	concession	S of concession	Pyinyaung lst range	E of Kalaw	low alt. (see text)	high alt. (see text)
N of concession	**67**	44	44				
concession		**48**	38				
S of concession			**54**				
Pyinyaung lst range				**79**	22		
E of Kalaw					**33**		
low alt. (see text)						**58**	43
high alt. (see text)							**56**

Dice Similarity Coefficient	N of concession	concession	S of concession	Pyinyaung lst range	E of Kalaw	low alt. (see text)	high alt. (see text)
N of concession		0,77	0,73				
concession			0,75				
S of concession							
Pyinyaung lst range					0,39		
E of Kalaw							
low alt. (see text)							0,75
high alt. (see text)							

FLORA REPORT of APACHE CEMENT FACTORY, PYI-NYAUNG

February, 2017

Introduction

Flora survey group conducted the survey start from 31st January to 7th February 2017 in the area of limestone; mudstone sites, factory area, and residential areas of the factory.

During the survey we made (136) plots on (5) transects wherever possible to get assessments.

We could record 250 species as inventory of the area, among them 22 IUCN listed species and 10 invasive species. According to the included plant`s association, it could be categorized as deciduous and mixed evergreen forests, mixed broad-leaved deciduous forest and bamboo

Deciduous Forest

Mixed Evergreen Forest

Mixed Broad-leaved Deciduous Forest


Bamboo Forest


Dry Deciduous Forest

Objectives

- Identify main vegetation types including IUCN listed Species
- Invasive alien species
- Vegetative Maps and subsequently ground truth the above

Participants

Team Leader: Dr Win Myint, Ecologist

Taxonomist: U Nyo Maung,

Taxonomist: Dr Ei Ei Phyoe,

GIS/RS and Biotanist: U Tun Thura

Taxonomist assistant: U Thein Phyoe Aung

Survey Method

The Global Positioning System was used to navigate and mark the coordinates of the sample plots to know the species population for vegetation identification. In order to obtain essential data for species composition in the area and sample plots of 100 mx 100m, along line were set up. The species identification was carried out by using key to families of plants and relevant literature and was confirmed by literatures.

Random Transect Method

Sampling individual sites were built to get representative individual plant species, and plants collection was carried out.

Mapping

Location maps are set by the method based on the landsat 8 settilte image (LC 81330462017037LGN00), WGS 1984, coordinate system to determine the forests of the areas. Vegetion index is categorized by NDVI (Normalize Different Vgetative Index) as low medium and height indexes.

Data Analysis

After field survey, data entry is made in excel work sheet. Identify the collected data matching with the type specimens, checking their recorded characteristic features and confirm by plant taxonomic websites of internet, after getting the inventory check list, match by the IUCN Red Data book categories, invasive species list and decides the vegetation types of the area according to the dominant plants species from representative areas. Eventually the results of forest types are developed on the maps depend on their coordinations.

IUCN Red List of Threatened Species

Recorded species are evaluated for their threats status according to the IUCN Red Data book categories. The Red Data book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them. The distribution of the Red Data categorized species is mentioned by their GPS positions.

Invasive Species

Collected species are evaluated by the list of forest invasive species of Myanmar.

Equipments

Equipments used for plotting and locating transects are compass and measuring tapes and other necessary equipment's are digital camera for photographic documentation, laptop computer for data storage, GPS for positioning and navigation, maps. For specimen collection, the following accessories will be needed, 10x hand lens for magnifying, permanent marker for marking, field note books for data entry.

I. Lime Stone Area

Table.1. Species List of Lime Stone Area

No.	Scientific Name	Common Name	Family Name	Habits
1	*Abelmoschus moschatus*	Taw-yon-pa-de	Malvaceae	S
2	*Acacia catechu* Willd.	Sha	Mimosaceae	T
3	*Acacia pennata* (L.) Willd.	Su-yit	Mimosaceae	Cl/Cr
4	*Achyranthes* aspera L.	Kyet-mauk-su-pyan	Amaranthaceae	H
5	*Acmella calva* (DC.) R.K. Jansen	Pe-le-nyin	Asteraceae	H
6	*Adenostemma viscosum*	Not known	Asteraceae	H
7	*Adina cordifolia* Hook. f.	Hnaw	Rubiaceae	T
8	*Aeginetia pedunculata* Wall.	Kauk-hlaing-di-yaing	Orobanchaceae	H
9	*Aegle marmelos* L.	Ok-shit	Rutaceae	T
10	*Ageratum conyzoides* L.	Khwe-thay-pan	Asteraceae	H
11	*Ajuga lupulina*	Not known	Lamiaceae	H
12	*Alangium chinense* (Lour.)Harms.	Hmaik	Alangiaceae	T
13	*Albizia lebbek* (L.)Benth.	Taung-ko-kko	Mimosaceae	T
14	*Albizia lebbekoides* (DC.) Benth.	Taung-ma-gyi	Mimosaceae	T
15	*Alternanthera sessilis* (L.) R.Br.	Pa-zun-sa-yaing	Amaranthaceae	H
16	*Amaranthus aspera*	Not known	Amaranthaceae	H
17	*Amaranthus gracilis* Desf.	Hin-nu-nwe-yaing	Amaranthaceae	H
18	*Anisomeles indica*	Not known	Lamiaceae	H
19	*Anogeissus acuminata* Wall.	Yon	Combretaceae	T
20	*Anthocephalus morindaefolius* Korth.	Ma-u-let-tan-shae	Rubiaceae	T
21	*Antidesma velutinum*Tul.	Kin-pa-lin	Euphorbiaceae	ST
22	*Aporusa dioica* (Roxb.) Mull.Arg.	Thit-khauk	Euphorbiaceae	T
23	*Argyreia nervosa*	Not known	Convolvulaceae	Cl/Cr
24	*Argyreia roxburghii* Choisy	Not known	Convolvulaceae	Cl/Cr
25	*Armillaria mellea* (VahlFr.) Kummer.	Not known	Physalacriaceae	M
26	*Bambusa bambos* (L.)Voss	Kya-khat-wa	Poaceae	B
27	*Bambusa polymorpha* Munro	Kya-thaung-wa	Poaceae	B
28	*Bauhinia malabarica* Roxb.	Pha-lan/Chin-byit	Caesalpiniaceae	T
29	*Bauhinia ornata* Kurz	Myauk-hle-kha	Caesalpiniaceae	Cl/Cr
30	*Bauhinia* sp.	Swe-daw-nwee	Caesalpiniaceae	Cl/Cr
31	*Bidens pilosa*	Hmwe-sok	Asteraceae	H
32	*Blechnum orientale*	Not known	Blechnaceae	F
33	*Bliospermum axillare* Blume	Hnat-cho	Euphorbiaceae	H
34	*Blume balsamifera* DC..	Phon-ma-thein	Asteraceae	S
35	*Blumea balsamifera*	Not known	Asteraceae	H
36	*Boehmeria* sp.	Not known	Urticaceae	S
37	*Bombax anceps* Pierre	Ko-khe	Bombacaceae	T
38	*Bombax ceiba* L.	Let-pan	Bombacaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
39	*Bombax insigne* Wall.	De-du	Bombacaceae	T
40	*Bridelia retusa* L.	Seik-chee	Euphorbiaceae	ST
41	*Buchanania lazan* Spreng.	Lun-pho	Anacardiaceae	T
42	*Buddleja asiatica*	Pon-ma-gyi	Buddlejaceae	S
43	*Butea superba* Roxb.	Pauk-nwee	Fabaceae	Cl/Cr
44	*Caesalpinia decapetala (Roth.)Alston*	Suk-yan-bo /Kyant-sa-su-pin	Caesalpiniaceae	Cl/Cr
45	*Cajanus cajan*	Pe-sin-ngone	Fabaceae	S
46	*Callicarpa arborea* Roxb.	Kyun-na-lin	Verbenaceae	ST
47	*Callicarpa longifolia*	Kun-na-lin-thay	Verbenaceae	ST
48	*Callicarpa nudiflora*	Kyun-na-lin	Verbenaceae	T
49	*Calotropis gigantea*	Ma-yoe	Apocynaceae	S
50	*Calycopteris floribunda* Lam.	Gyut-nwe	Combretaceae	Cl/Cr
51	*Canscora diffusa* (Vahl) R.Br.	Kyauk-pan	Gentianaceae	H
52	*Careya arborea* Roxb.	Ban-bwe	Lecythidaceae	T
53	*Cassia fistula* L.	Ngu	Caesalpiniaceae	T
54	*Cassia timoriensis* DC.	Not known	Caesalpiniaceae	ST
55	*Cayratia trifolia*	Not known	Vitaceae	CL
56	*Celosia argentea* L.	Taw-kyet-mauk	Amaranthaceae	S
57	*Centratherum punctatum*	Not known	Asteraceae	H
58	*Cephalostachyum pergracile* Munro	Tin-wa	Poaceae	B
59	*Chloris barbata*	Not known	Poaceae	G
60	*Chromolaena odorata* (L.) R.M. King & H Robinson	Bi-zet	Asteraceae	S
61	*Chukrasia velutina* Roem.	Yin-ma	Meliaceae	T
62	*Cissampelos pareira* L.	Not known	Menispermaceae	Cl/Cr
63	*Clematic fasiculiflora* L.	Khwa-nyo	Ranunculaceae	CL
64	*Congea tomentosa* Roxb.	Tha-ma-ga-nwee	Verbenaceae	Cl/Cr
65	*Corchorus aestuans* L.	Byauk-o	Tiliaceae	S
66	*Corchorus capsularis* L.	Gon-shaw/Khwe-la-but	Tiliaceae	S
67	*Crassocephalum crepidioides* (Benth.) S. Moor.	Pan-zauk-htoe	Asteraceae	H
68	*Cratoxylum neriifolium* Kurz.	Be-bya	Hypericaceae	ST
69	*Cratoxylum polyanthum*Korth.	Be-bya	Hypericaceae	ST
70	*Crotalaria mucronata* L.	Taw-paik-san	Fabaceae	S
71	*Crotalaria multiflora* L.	Not known	Fabaceae	H
72	*Croton oblongifolius* Roxb.	Tha-yin-gyi	Euphorbiaceae	ST
73	*Crypteronia pubescens* Blume	A-nan-pho	Crypteroniaceae	T
74	*Cryptolepis buchanani* Rome.& Schult	Na-sha-gyi	Asclepiadaceae	Cl/Cr
75	*Curcuma aurantiaca*	Ma-la	Zingiberaceae	H
76	*Cymbidium aloifolium* (L.)Sw.	Thit-tet-lin-nae	Orchidaceae	E
77	*Dactyloctenium aegyptium*	Lay-gwa-myet	Poaceae	G
78	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	T
79	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
80	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	ST
81	*Dalbergia volubilis* Roxb.	Daung-ta-laung	Fabaceae	ST
82	*Dendrocalamus longispathus* (Kurz) Kurz	Wa-net	Poaceae	B
83	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	B
84	*Derris* sp.	Not known	Fabaceae	Cl/Cr
85	*Desmodium heterophyllum* (Willd.)DC.	Not known	Fabaceae	S
86	*Desmodium pulchellum* Benth.	Taung-da-min	Fabaceae	S
87	*Dillenia parviflora* Griff	Kyet-zin-byun	Dilleniaceae	T
88	*Dillenia pentagyna* Roxb.	Zin-byun	Dilleniaceae	T
89	*Dinochloa maclellandii* Kurz	Ba-du-ma-wa/Wa-nwee	Poaceae	B
90	*Dioscorea bulbifera*	Myauk-u	Dioscoreaceae	Cl/Cr
91	*Dioscorea cylindrica* Burm.	Kywe-thon-ywet	Dioscoreaceae	Cl/Cr
92	*Dioscorea pentaphylla* L.	Kywe-ngar-ywet	Dioscoreaceae	Cl/Cr
93	*Dioscorea sativa* L.	Kauk-yin-nwee	Dioscoreaceae	Cl/Cr
94	*Diospyros kika* L.f.	Te	Ebenaceae	T
95	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae	T
96	*Duabanga grandiflora*	Myauk-ngo	Lythraceae	T
97	*Ehretia acuminata* R.Br	Taung-poe-lu-lin	Boraginaceae	T
98	*Elephantopus scaber* L.	Not known	Asteraceae	H
99	*Entada scandens* Benth.	Doe-nwee	Mimosaceae	Cl/Cr
100	*Erythrina stricta* Roxb.	Ka-thit	Fabaceae	T
101	*Euphorbia antiquorum* L.	Tazaung-gyi	Euphorbiaceae	ST
102	*Euphorbia hypericifolia* L.	Kywe-kyaung-hmin-se	Euphorbiaceae	H
103	*Evolvulus nummularius* L.	Kyauk-kwe	Convolvulaceae	Cl/Cr
104	*Ficus hispida* L.	Kha-aung	Moraceae	ST
105	*Ficus lacor* Buch.-Ham.	Nyaung-gyin	Moraceae	T
106	*Ficus microcarpa*	Not known	Moraceae	S
107	*Ficus obtusifolia* Roxb.	Nyaung-gyat	Moraceae	T
108	*Flacourtia cataphracta* Roxb.	Na-ywe	Flacourtiaceae	T
109	*Flemingia congesta* Roxb.	Kye-hmi	Fabaceae	S
110	*Gardenia coronaria* Buch.-Ham.	Yin-gat-gyi	Rubiaceae	T
111	*Getonia floribunda* Roxb.	Kywet-nwee	Combretaceae	Cl/Cr
112	*Glochidion* sp.	Hta-min-sok	Euphorbiaceae	ST
113	*Goniothalamus laoticus*	Not known	Annonaceae	ST
114	*Grewia laevigata* Vahl	Kyet-ta-yaw	Tiliaceae	ST
115	*Harrisonia perforata* Merr.	Su-gyin	Simaroubaceae	S
116	*Hemigraphis brunelloides* (Lam.) Bremek.	Not known	Acanthaceae	S
117	*Hibiscus macrophyllus*	Taung-phet-wun	Malvaceae	T
118	*Hiptage benghalensis* (L.) Kurz	Bein-new	Malpighiaceae	ST
119	*Holarrhena pubescens* Wall. ex G. Don	Let-htok-gyi	Apocynaceae	ST
120	*Homalium tomentosum* Benth	Myauk-chaw	Flacourtiaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
121	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	S
122	*Ipomoea quamoclit* L.	Myet-lay-ni	Convolvulaceae	Cl/Cr
123	*Justicia procumbens*L.	Not known	Acanthaceae	S
124	*Justicia* sp.(1)	Not known	Acanthaceae	H
125	*Justicia* sp.(2)	Not known	Acanthaceae	S
126	*Kleinhovia hospita* L.	O-tein/Pashu-phet-wun	Sterculiaceae	T
127	*Lagerstroemia parviflora* Roxb.	Zaung-pa-lae	Lythraceae	T
128	*Lagerstroemia speciosa* (L.) Pers.	Pyin-ma	Lythraceae	T
129	*Lagerstroemia tomentosa* Presl.	Le-sa	Lythraceae	T
130	*Lannea coromandelica* (Houtt.) Merrr.	Na-be	Anacardiaceae	T
131	*Lathyrus latifolius*	Not known	Fabaceae	S
132	*Leea hirta* Banks	Naga-mauk-phyu	Leeaceae	S
133	*Leea rubra* Blume.	Naga-mauk-ni	Leeaceae	S
134	*Lepidagathis semiherbacea* (Clarke) Nees	Not known	Acanthaceae	H
135	*Leptadenia reticulata* Wight & Arn.	Gon-kha	Asclepiadaceae	Cl/Cr
136	*Leucaena leucocephala* (Lam.) De.Wit	Baw-za-gaing	Mimosaceae	ST
137	*Lindenbergia philippensis* Benth.	Not known	Scrophulariaceae	H
138	*Lindenbergia urticaefolia* Lehm.	Not known	Scrophulariaceae	H
139	*Loranthus pulverulentus* Wall.	Kyi-paung	Loranthaceae	E
140	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	H
141	*Ludwigia octovalvis*	Lay-nyin-gyi	Onagraceae	H
142	*Luffa aegyptiaca* Mill.	Tha-but-kha	Cucurbitaceae	Cl/Cr
143	*Mangifera sylvatica* Roxb.	Taung-tha-yet	Anacardiaceae	T
144	*Markhamia stipulata* (Wall.) Seem.ex K.Schum.	Ma-hlwa	Bignoniaceae	ST
145	*Melanorrhoea usitata* Wall.	Sit-se	Anacardiaceae	T
146	*Merremia hederacea* Hallier f.	Nwe-shoke	Convolvulaceae	Cl/Cr
147	*Merremia vitifolia* (Burm.f.) Hallier. f.	Kyet-hinga-lae-new	Convolvulaceae	Cl/Cr
148	*Microcos paniculata* L.	Mya-ya	Meliaceae	ST
149	*Millettia extensa* Benth.	Win-u	Fabaceae	Cl/Cr
150	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae	T
151	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae	H
152	*Mitragyna rotundifolia* (Roxb.) Kuntze	Bin-ga	Rubiaceae	T
153	*Moghania macrophylla* Runtze	Not known	Fabaceae	S
154	*Morinda tinctoria* Roxb.	Ni-ba-sae	Rubiaceae	S
155	*Mucuna pruriens* (L.)DC.	Khwe-lae-ya	Fabaceae	Cl/Cr
156	*Musa* sp.	Taw-nga-pyaw	Musaceae	H
157	*Nauclea orientalis* L.	Ma-u	Rubiaceae	T
158	*Operculina turpethum* (L.) Silva Mansa	Kyar-hin-nwe	Convolvulaceae	Cl/Cr
159	*Oroxylum indicum* (L.) Kurz.	Kyaung-sha	Bignoniaceae	ST
160	*Oxalis corniculata* L.	Hmo-chin	Oxalidaceae	H
161	*Paederia foetida* L.	Pe-bok-nwee	Rubiaceae	CL

No.	Scientific Name	Common Name	Family Name	Habits
162	*Pennisetum purpureum* Schum.	Yon-sa-myet	Poaceae	G
163	*Phyllanthus albizzioides* (Kurz)Hook.f.	Shit-sha	Euphorbiaceae	T
164	*Phyllanthus emblica* L.	Zi-phyu	Euphorbiaceae	ST
165	*Polygonum chinense* L.	Maha-gar-kyan-sit	Polygonaceae	H
166	*Potamogeton natans* L.	Floating-leaf Pondweed	Potamogetonaceae	Aq
167	*Prema pyramidata* Wall.	Kyun-na-lin/Kyun-pho	Verbenaceae	T
168	*Pteris vittata*	Brake Fern	Pteridaceae	F
169	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	T
170	*Pterospermum semisagittatum* Buch.-Ham.	Na-gye	Sterculiaceae	T
171	*Pueraria lobata* var. *montana*	Not known	Fabaceae	CL
172	*Salvia regla*	Not known	Lamiaceae	S
173	*Salvia* sp.	Not known	Lamiaceae	S
174	*Salvia splendens*Ker Gawl.	Not known	Lamiaceae	H
175	*Samadera indica* Gaertn.	Ka-di	Simaroubaceae	ST
176	*Schleichera oleosa* (Lour.) Oken	Gyo	Sapindaceae	T
177	*Scoparia dulcis* L.	Dana-thu-kha	Scrophulariaceae	H
178	*Senna hirsuta* (L.) Irwin & Barneby	Ka-thaw-hmwe-htu	Caesalpiniaceae	S
179	*Senna timoriensis* (DC.)(DC.) H. S. Irwin & Barneby	Taw-ma-zeli	Caesalpiniaceae	T
180	*Senna tora* (L.*)* Roxb	Dan-gwe	Caesalpiniaceae	S
181	*Sesbania paludosa* Roxb.	Nyan	Fabaceae	S
182	*Setaria lutescens* Hubb.	Yon-sa	Poaceae	G
183	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	T
184	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	T
185	*Sida acuta* Burm f.	Ta-byet-si	Malvaceae	S
186	*Smilax aspericaulis* Wall ex A. D.C.	Sein-na-baw-thay	Smilaceae	CL
187	*Smilax macrophylla* Roxb.	Sein-na-baw-gyi	Smilaceae	CL
188	*Spermacoce mauritiana*	Not known	Rubiaceae	H
189	*Spondias pinnata* (L. f.) Kurz.	Taw-gwe	Anacardiaceae	T
190	*Sterculia foetida* L.	Let-khok	Sterculiaceae	T
191	*Sterculia ornata* Wall. ex Kurz	Don-shaw	Sterculiaceae	T
192	*Sterculia versicolor* Wall.	Shaw-phyu	Sterculiaceae	T
193	*Stereospermum colais* (Buch.-Ham. ex Dillwyn) Mabb.	Than-thay	Bignoniaceae	T
194	*Stereospermum suaveolens* (Roxb.) DC.	Kywe-ma-gyo-lein	Bignoniaceae	T
195	*Strobilanthes auriculata*	Not known	Acanthaceae	S
196	*Strobilanthes rufescens* T. Anders.	Not known	Acanthaceae	H
197	*Strychnos nux-blanda* A.W. Hill	Ka-baung	Loganiaceae	ST
198	*Tadehagi triquetrum* (L.)H. Ohashi	Lauk-thay	Fabaceae	S
199	*Tectona grandis* L. f.	Kyun	Verbenaceae	T
200	*Terminalia alata* (Heyne) Roth	Htauk-kyant	Combretaceae	T
201	*Terminalia pyrifolia* Kurz	Lein-pin	Combretaceae	T
202	*Tetrameles nudiflora* R. Br.	Baing	Datiscaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
203	*Tetrastigma planicaule*	Not known	Vitaceae	Cl/Cr
204	*Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb.	Kyi-hnok-thi	Acanthaceae	Cl/Cr
205	*Thunbergia laurifolia* Lindl.	Kyi-hnok-thi	Acanthaceae	Cl/Cr
206	*Thyrsostachys oliveri* Gamble	Tha-net-wa	Poaceae	B
207	*Tinospora nudiflora* Kurz	Sin-don-ma-nwee	Menispermaceae	Cl/Cr
208	*Trema orientalis* (L.) Blume	Khwe-sha	Ulmaceae	ST
209	*Trichosanthes cordata* Roxb.	Kyi-ah	Cucurbitaceae	CL
210	*Tristaniopsis burmanica* (Griff.)P.G. Wilson & J.T. Waterh.	Taung-tha-bye	Myrtaceae	T
211	*Triumfetta bartramia* L.	Ket-si-ne-thay	Tiliaceae	S
212	*Urena lobata* L.	Ket-si-ne-gyi	Malvaceae	S
213	*Utricularia* sp.	Bladderwort	Lentibularaceae	Aq
214	*Uvaria cordata* Schum. & Thonn.	Tha-but-gyi	Annonaceae	ST
215	*Vangueria spinosa* Roxb.	Magyi-bauk	Rubiaceae	S
216	*Ventilago maderaspatana* Benth.	Ta-yaw-nyo	Rhamnaceae	Cl/Cr
217	*Vernonia arborea*	Not known	Asteraceae	S
218	*Vitex peduncularis* Wall.	Phet-le-zin	Verbenaceae	T
219	*Vitex pubescens* Vahl	Kyet-yoe	Verbenaceae	T
220	*Vitis discolour*	Ta-bin-taing-mya-nan-phyu	Vitaceae	Cl/Cr
221	*Vitis repens*	Ta-bin-taing-mya-nan-ni	Vitaceae	Cl/Cr
222	*Wrightia arborea* (Dennst.) Mabb.	Let-htok-thein	Apocynaceae	ST
223	*Xylia xylocarpa* (Roxb.)Taub.	Pyin-ka-doe	Mimosaceae	T
224	*Zanthoxylum budrunga* Wall.	Ma-yanin-kyet-su	Rutaceae	T
225	*Ziziphus glabra* Roxb.	Taw-zi-nwee/Paung-bet	Rhamnaceae	Cl/Cr
226	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae	ST

Aq=Aquatic, B=Bamboo, CL=Climber, Cl/Cr=Climber/Creeper, E=Epiphyte, F=Fern, G=Grass, H=Herbs, M=Mushroom, S=Shrubs, ST=Small Tree, T=Tree

Table.2. IUCN red list in Lime Stone Area (2016.3)

No.	Scientific Name	Common Name	Family Name	IUCN criteria
1	*Bauhinia ornata* Kurz	Myauk-hle-kha	Caesalpiniaceae	LC ver 3.1
2	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	NT ver 3.1
3	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae	EN A1cd ver 2.3
4	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	LC ver 3.1
5	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	LCver 3.1
6	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae	LR/lc ver 2.3
7	*Holarrhena pubescens* Wall. ex G. Don	Let-htok-gyi	Apocynaceae	LC ver 3.1
8	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	LC ver 3.1
9	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	LC ver 3.1
10	*Ludwigia octovalvis*	Lay-nyin-gyi	Onagraceae	LC ver 3.1

11	*Lathyrus latifolius*	Not known	Fabaceae	LC ver 3.1
12	*Mangifera sylvatica* Roxb.	Taung-tha-yet	Anacardiaceae	LR/lc ver 2.3
13	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae	DD ver 3.1
14	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae	LC ver 3.1
15	*Pennisetum purpureum* Schum.	Yon-sa-myet	Poaceae	LC ver 3.1
16	*Potamogeton natans* L.	Floating-leaf Pondweed	Potamogetonaceae	LC ver 3.1
17	*Pteris vittata*	Brake Fern	Pteridaceae	LC ver 3.1
18	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	VU A1d ver 2.3
19	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	LR/lc ver 2.3
20	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	LR/lc ver 2.3
21	*Tadehagi triquetrum* (L.)H. Ohashi	Lauk-thay	Fabaceae	LC ver 3.1
22	*Tetrameles nudiflora* R. Br.	Baing	Datiscaceae	LR/lc ver 2.3
23	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae	LC ver 3.1
DD=Data Deficient, EN=Endangered, LC=Least Concern, LR/lc=Lower Risk/least concern, NT=Near Threatened, VU=Vulnerable				

Dalbergia cultrata Grah.

Millettia ovalifolia Kurz

Tetrameles nudiflora R. Br.

Mimosa pudica L.

Dalbergia rimosa Roxb.

Shorea siamensis (Kurz) Miq.

Dendrocalamus membranaceus Munro

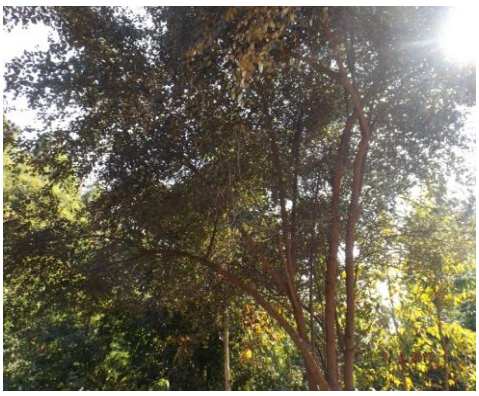
Dipterocarpus tuberculatus Roxb.

Holarrhena pubescens Wall. ex G.Don

Homonoia riparia Lour.

Dalbergia oliveri Gamble

*Pterocarpus indicus*Willd.



Ziziphus jujuba Lam

Potamogeton natans L

Shorea obtusa Wall

Pteris vittata

Pennisetum purpureum Schum.

Mangifera sylvatica Roxb.

Table.3. Invasive Species List Lime Stone Area

No	Scientific Names	Familiy	Common Names	Origin
1	*Ageratum conyzoides* L.	Asteraceae	Khwe-thay-pan	Tropical America
2	*Bidens pilosa*	Asteraceae	Hmwe-sok	Tropical America
3	*Caesalpinia decapetala (Roth.)Alston*	Caesalpinaceae	Suk-yan-bo /Kyant-sa-su-pin	Tropical Asia
4	*Chromolaena odorata* (L.) R.M. King & H Robinson	Asteraceae	Bi-zet	Central America, South America
5	*Hiptage benghalensis* (L.) Kurz	Malpighiaceae	Bein-new	Tropical America
6	*Leucaena leucocephala* (Lam.) De.Wit	Mimosaceae	Baw-za-gaing	Hawaii
7	*Mimosa pudica* L.	*Mimosaceae*	Hti-ka-yone	South America. Mexico, Amazon. Tropical America
8	*Oroxylum indicum* (L.) Kurz.	*Bignoniaceae*	Kyaung-sha	India
9	*Paederia foetida* L.	Rubiaceae	Pe-bok-nwee	Asia
10	*Ziziphus jujuba* Lam.	Rhamnaceae	Zi	China

Leucaena leucocephala (Lam.) De.Wit

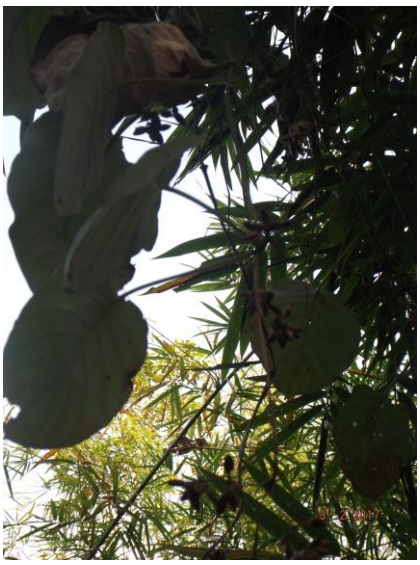
Ziziphus jujuba Lam.

Ziziphus jujuba Lam.

Oroxylum indicum (L.) Kurz.

Chromolaena odorata L.

Mimosa pudica L.



Paederia foetida L.

Bidens pilosa

Ageratum conyzoides L.

Table.4. Plant Association, Vegetation Types, and Red List Species according to their coordinations

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
Association I. *Schleichera oleosa* (Lour.) Oken, *Adina cordifolia* Hook. f.,, and *Dendrocalamus membranaceus* Munro,	640	APL-1	*Dendrocalamus membranaceus* Munro, *Thyrsostachys oliveri* Gamble, *Cephalostachyum pergracile* Munro,*Bambusa polymorpha* Munro	*Schleichera oleosa* (Lour.) Oken, *Adina cordifolia* Hook. f., *Samadera indica* Gaertn., *Stereospermum suaveolens* (Roxb.) DC., *Terminalia alata* (Heyne) Roth, *Albizia lebbekoides* (DC.) Benth., *Anogeissus acuminata* Wall., *Anthocephalus morindaefolius* Korth., *Bombax insigne* Wall., *Croton oblongifolius* Roxb., *Dalbergia oliveri* Gamble, *Dillenia pentagyna* Roxb., *Harrisonia perforata* Merr., *Lagerstroemia tomentosa* Presl., *Tectona grandis* L. f.	Deciduous Forest	*Mangifera sylvatica* Roxb., *Millettia ovalifolia* Kurz	2017-02-02 8:25:35AM	96.404893	20.869484
	665	APL-2				*Dalbergia oliveri Gamble,Dendrocalamus membranaceus Munro*	2017-02-02 8:41:01AM	96.404949	20.868524
	705	APL-3				*Dalbergia oliveri Gamble, Dendrocalamus membranaceus Munro, Shorea obtusa* Wall.,	2017-02-02 9:05:57AM	96.405544	20.867816
	718	APL-4				*Dalbergia cultrata Grah.*	2017-02-02 9:34:29AM	96.406062	20.867064
	677	APL-5				*Dendrocalamus membranaceus Munro*	2017-02-02 9:56:00AM	96.406578	20.866301
	643	APL-6					2017-02-02 10:23:27AM	96.407261	20.865663
	639	APL-7				*Tetrameles nudiflora* R. Br.	2017-02-02 10:36:44AM	96.408239	20.865816
	646	APL-8				*Dendrocalamus membranaceus Munro*	2017-02-02 10:47:31AM	96.409245	20.866258
	644	APL-9				*Dendrocalamus membranaceus Munro*	2017-02-02 11:06:06AM	96.410258	20.866395
	641	APL-10				*Dalbergia oliveri Gamble, Dendrocalamus membranaceus Munro*	2017-02-02 11:17:55AM	96.411260	20.866320
Association II. *Tectona grandis* L. f., *Terminalia alata* (Heyne)	590	APL-11	*Dendrocalamus membranaceus* Munro, *Bambusa bambos* (L.)Voss,	*Tectona grandis* L. f., *Terminalia alata* (Heyne) Roth, *Acacia catechu* Willd.,*Croton oblongifolius* Roxb.,	Mixed Broad-leaved Deciduous Forest	*Dalbergia oliveri* Gamble, *Shorea siamensis* (Kurz) Miq., *Dendrocalamus membranaceus* Munro	2017-02-02 11:44:11AM	96.411847	20.867084

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
Roth, and *Dendrocalamus membranaceus* Munro,	616	APL-12	*Thyrsostachys oliveri* Gamble	*Buchanania lazan* Spreng.,*Schleichera oleosa* (Lour.) Oken, *Shorea siamensis* (Kurz) Miq.,*Adina cordifolia* Hook. f., *Anogeissus acuminata Wall.,Bauhinia malabarica* Roxb.,*Bombax ceiba* L.,*Stereospermum suaveolens* (Roxb.) DC.		*Dalbergia oliveri* Gamble, *Shorea siamensis* (Kurz) Miq., *Dendrocalamus membranaceus* Munro	2017-02-02 11:54:58AM	96.411689	20.867927
	618	APL-13				*Dendrocalamus membranaceus* Munro, *Millettia ovalifolia* Kurz	2017-02-02 12:24:54PM	96.411506	20.868810
	631	APL-14				*Pterocarpus indicus*Willd.	2017-02-02 12:41:49PM	96.411173	20.869597
	650	APL-15					2017-02-02 12:58:46PM	96.410832	20.870485
	566	APL-16					2017-02-03 8:12:36AM	96.403377	20.877603
	566	APL-17					2017-02-03 8:20:11AM	96.403407	20.878699
	575	APL-18				*Dendrocalamus membranaceus* Munro	2017-02-03 8:27:17AM	96.403914	20.879477
	589	APL-19				*Dendrocalamus membranaceus* Munro, *Shorea obtusa* Wall.	2017-02-03 8:35:08AM	96.404919	20.880737
	597	APL-20				*Shorea obtusa* Wall.	2017-02-03 8:43:10AM	96.405066	20.881647
Association III. *Xylia xylocarpa* (Roxb.)Taub., *Croton oblongifolius* Roxb. and *Dendrocalamus membranaceus* Munro,	607	APL-21	*Dendrocalamus membranaceus* Munro, *Thyrsostachys oliveri* Gamble	*Xylia xylocarpa* (Roxb.)Taub., *Croton oblongifolius* Roxb., *Bombax insigne* Wall., *Tectona grandis* L. f., *Terminalia alata* (Heyne) Roth, *Schleichera oleosa* (Lour.) Oken, *Acacia catechu* Willd., *Chukrasia velutina* Roem., *Harrisonia perforata* Merr., *Lannea coromandelica* (Houtt.) Merrr., *Samadera indica* Gaertn., *Shorea siamensis* (Kurz) Miq.,	Deciduous Forest	*Shorea obtusa* Wall., *Dalbergia cultrata* Grah.	2017-02-03 8:51:07AM	96.405605	20.882413
	634	APL-22				*Dendrocalamus membranaceus* Munro, *Shorea siamensis* (Kurz) Miq., *Dalbergia rimosa* Roxb.	2017-02-03 9:00:59AM	96.406543	20.882641
	671	APL-23				*Dendrocalamus membranaceus* Munro, *Shorea siamensis* (Kurz) Miq.	2017-02-03 9:13:36AM	96.407484	20.882734

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	702	APL-24				*Dendrocalamus membranaceus* Munro	2017-02-03 9:27:06AM	96.408504	20.882351
	734	APL-25				*Dendrocalamus membranaceus* Munro	2017-02-03 9:40:41AM	96.408260	20.881470
	757	APL-26				*Dendrocalamus membranaceus* Munro	2017-02-03 9:58:36AM	96.408687	20.880636
	804	APL-27				*Dalbergia rimosa* Roxb.	2017-02-03 10:09:26AM	96.408598	20.879663
	816	APL-28				*Millettia ovalifolia* Kurz	2017-02-03 10:31:24AM	96.408622	20.878761
	797	APL-29				*Dendrocalamus membranaceus* Munro	2017-02-03 10:45:03AM	96.408796	20.877880
	742	APL-30				*Dendrocalamus membranaceus* Munro	2017-02-03 10:59:13AM	96.408819	20.876972
Association IV. *Acacia catechu* Willd., *Harrisonia perforata* Merr. and *Dendrocalamus membranaceus* Munro,	738	APL-31	*Dendrocalamus membranaceus* Munro, *Bambusa bambos* (L.)Voss	*Acacia catechu Willd., Harrisonia perforata* Merr.,*Tectona grandis* L. f., *Terminalia alata* (Heyne) Roth, *Trema orientalis* (L.) Blume, *Xylia xylocarpa* (Roxb.)Taub., *Croton oblongifolius* Roxb., *Shorea siamensis* (Kurz) Miq., *Adina cordifolia* Hook. f.,*Bombax insigne* Wall., *Chukrasia velutina* Roem., *Phyllanthus emblica* L, *Spondias pinnata* (L. f.) Kurz.	Dry Deciduous Forest		2017-02-03 11:09:47AM	96.408668	20.876077
	750	APL-32				*Shorea siamensis* (Kurz) Miq.	2017-02-03 11:18:00AM	96.409670	20.875214
	740	APL-33				*Shorea siamensis* (Kurz) Miq.	2017-02-03 11:21:13AM	96.409965	20.874139
	717	APL-34					2017-02-03 11:26:25AM	96.408544	20.872726
	613	APL-35				*Dendrocalamus membranaceus* Munro, *Holarrhena pubescens* Wall. ex G. Don	2017-02-03 1:10:06PM	96.403684	20.871978
	569	APL-36				*Dendrocalamus membranaceus* Munro	2017-02-03 1:26:22PM	96.402791	20.872282
	512	APL-37				*Dendrocalamus membranaceus* Munro	2017-02-03 1:44:30PM	96.401805	20.872472
	486	APL-38					2017-02-03 1:54:44PM	96.401488	20.871437
	469	APL-39					2017-02-03 2:01:38PM	96.401227	20.869555

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	449	APL-40				*Dendrocalamus membranaceus* Munro, *Mimosa pudica* L., *Homonoia riparia*	2017-02-03 2:06:41PM	96.400988	20.867468
Association V. *Harrisonia perforata* Merr., *Mitragyna rotundifolia* (Roxb.) Kuntze and *Bambusa bambos* (L.)Voss,	431	APL-41	*Bambusa bambos* (L.)Voss, *Dinochloa maclellandii* Kurz, *Thyrsostachys oliveri* Gamble	*Harrisonia perforata* Merr., *Mitragyna rotundifolia* (Roxb.) Kuntze, *Tectona grandis* L. f., *Strychnos nux-blanda* A.W. Hill, *Cratoxylum neriifolium* Kurz., *Acacia catechu* Willd., *Anthocephalus morindaefolius* Korth., *Bombax ceiba* L., *Bombax insigne* Wall., *Cassia fistula* L., *Lagerstroemia speciosa* (L.) Pers., *Lagerstroemia tomentosa* Presl., *Phyllanthus emblica* L., *Schleichera oleosa* (Lour.) Oken, *Shorea siamensis* (Kurz) Miq., *Trema orientalis* (L.) Blume	Dry Deciduous Forest		2017-02-03 2:13:15PM	96.400109	20.865858
	423	APL-42				*Tadehagi triquetrum* (L.)H. Ohashi	2017-02-03 2:15:54PM	96.398960	20.865830
	414	APL-43				*Dalbergia rimosa* Roxb.	2017-02-03 2:29:12PM	96.399346	20.864798
	424	APL-44					2017-02-03 2:39:27PM	96.400090	20.863871
	418	APL-45					2017-02-03 2:47:34PM	96.399702	20.862906
	398	APL-46					2017-02-03 2:55:58PM	96.399336	20.862013
	373	APL-47					2017-02-03 3:03:36PM	96.398438	20.861299
	359	APL-48				*Pterocarpus indicus*Willd., *Potamogeton natans* L.	2017-02-03 3:11:16PM	96.397372	20.860686
	342	APL-49					2017-02-03 3:19:21PM	96.395859	20.860922
	748	APL50				*Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.	2017-02-06 7:45:29AM	96.408779	20.871521
Association VI *Tectona grandis* L. f., *Lagerstroemia tomentosa* Presl. and *Thyrsostachys oliveri* Gamble	745	APL51	*Thyrsostachys oliveri* Gamble, *Dendrocalamus membranaceus* Munro, *Bambusa polymorpha* Munro, *Cephalostachyum pergracile* Munro, *Dendrocalamus*	*Tectona grandis* L. f., *Lagerstroemia tomentosa* Presl., *Terminalia alata* (Heyne) Roth, *Anogeissus acuminata* Wall., *Croton oblongifolius* Roxb., *Pterocarpus indicus*Willd., *Bombax insigne* Wall., *Acacia catechu* Willd., *Harrisonia*	Mixed Broad-leaved Deciduous Forest	*Shorea siamensis* (Kurz) Miq., *Pterocarpus indicus*Willd.	2017-02-06 7:59:45AM	96.409335	20.870601
	721	APL52				*Pterocarpus indicus*Willd.	2017-02-06 8:13:51AM	96.409860	20.871484
	650	APL53				*Dendrocalamus membranaceus* Munro,*Pterocarpus indicus*Willd.	2017-02-06 8:34:18AM	96.405896	20.869794

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	674	APL54	*longispathus* (Kurz) Kurz	*perforata* Merr., *Shorea siamensis* (Kurz) Miq., *Xylia xylocarpa* (Roxb.)Taub.		*Dendrocalamus membranaceus* Munro,*Pterocarpus indicus*Willd.	2017-02-06 8:43:20AM	96.407114	20.869651
	701	APL55				*Dendrocalamus membranaceus* Munro,*Pterocarpus indicus*Willd.	2017-02-06 8:56:06AM	96.408429	20.869592
	734	APL56				*Dendrocalamus membranaceus* Munro, *Pterocarpus indicus*Willd.	2017-02-06 9:11:27AM	96.408598	20.868645
	754	APL57					2017-02-06 9:47:59AM	96.408206	20.868031
	617	APL58				*Pterocarpus indicus*Willd., *Shorea siamensis* (Kurz) Miq., *Dendrocalamus membranaceus* Munro	2017-02-06 10:43:58AM	96.403676	20.872599
	607	APL59				*Pterocarpus indicus*Willd., , *Dendrocalamus membranaceus* Munro	2017-02-06 10:48:23AM	96.403286	20.873623
	581	APL60					2017-02-06 12:24:27PM		
Associattion VII *Acacia catechu* Willd., *Terminalia alata* (Heyne) Roth and *Dendrocalamus longispathus* (Kurz) Kurz	558	APL61	*Dendrocalamus longispathus* (Kurz) Kurz, *Dendrocalamus membranaceus* Munro,	*Acacia catechu* Willd., *Terminalia alata* (Heyne) Roth, *Anogeissus acuminata* Wall., *Croton oblongifolius* Roxb., *Stereospermum suaveolens* (Roxb.) DC., *Mitragyna rotundifolia* (Roxb.) Kuntze, *Harrisonia perforata* Merr., *Pterocarpus indicus*Willd., *Tectona grandis* L. f., *Trema*	Dry Deciduous Forest		2017-02-06 12:28:27PM	96.402453	20.877251
	564	APL62					2017-02-06 12:33:28PM	96.402870	20.879042
	555	APL63					2017-02-06 12:36:54PM	96.401951	20.879462
	546	APL64				*Dalbergia oliveri* Gamble, *Dendrocalamus membranaceus* Munro	2017-02-06 12:39:46PM	96.402576	20.879150
	535	APL65				*Dendrocalamus*	2017-02-06	96.401925	20.877930

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
				orientalis (L.) Blume		*membranaceus* Munro	12:43:17PM		
	521	APL66				*Dendrocalamus membranaceus* Munro,*Pterocarpus indicus*Willd.	2017-02-06 12:47:01PM	96.401896	20.876315
	509	APL67				*Dendrocalamus membranaceus* Munro,*Pterocarpus indicus*Willd.	2017-02-06 12:49:57PM	96.401483	20.874709
	488	APL68				*Dendrocalamus membranaceus* Munro	2017-02-06 12:58:05PM	96.401372	20.873494
	459	APL69				*Pterocarpus indicus*Willd., *Holarrhena pubescens* Wall. ex G. Don	2017-02-06 1:14:06PM	96.401197	20.872367
	451	APL70				*Dalbergia cultrata* Grah.	2017-02-06 1:30:26PM	96.400266	20.872026
Association VIII *Tectona grandis* L. f., *Xylia xylocarpa* (Roxb.)Taub and *Bambusa polymorpha* Munro	452	APL71	*Bambusa polymorpha* Munro, *Dendrocalamus longispathus* (Kurz) Kurz, *Cephalostachyum pergracile Munro,*	*Tectona grandis* L. f., *Xylia xylocarpa* (Roxb.)Taub., *Harrisonia perforata* Merr., *Acacia catechu* Willd., *Cratoxylum polyanthum* Korth, *Anogeissus acuminata* Wall., *Cratoxylum neriifolium* Kurz.,*Mitragyna rotundifolia* (Roxb.) Kuntze, *Phyllanthus emblica* L., *Spondias pinnata* (L. f.) Kurz., *Strychnos nux-blanda* A.W. Hill, *Trema orientalis* (L.) Blume,	Mixed Broad-leaved Deciduous Forest	*Dalbergia oliveri* Gamble	2017-02-06 1:35:25PM	96.399856	20.872851
	440	APL72				*Mangifera sylvatica* Roxb.	2017-02-06 1:39:35PM	96.398710	20.872710
	439	APL73				*Mangifera sylvatica* Roxb.	2017-02-06 1:44:10PM	96.397910	20.873414
	419	APL74					2017-02-06 1:47:37PM	96.397588	20.874721
	402	APL75				*Holarrhena pubescens* Wall. ex G. Don	2017-02-06 1:52:13PM	96.397295	20.875878
	392	APL76				*Shorea obtusa* Wall., *Pterocarpus indicus*Willd.	2017-02-06 1:58:18PM	96.396193	20.876336
	388	APL77				*Dalbergia cultrata* Grah., *Homonoia riparia*	2017-02-06 2:01:03PM	96.395405	20.876518
	361	APL78				*Dalbergia rimosa* Roxb.	2017-02-06 2:09:53PM	96.394297	20.876300

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	355	APL79				*Pterocarpus indicus*Willd.	2017-02-06 2:13:15PM	96.393457	20.875567
	347	APL80				*Pterocarpus indicus*Willd.	2017-02-06 2:17:47PM	96.392880	20.874745
	338	APL81					2017-02-06 2:21:25PM	96.392436	20.873933
APL=Apache Lime Stone									

II. Mud Stone Area

Table.5. Species List of Mud Stone Area

No.	Scientific Name	Common Name	Family Name	Habits
1	*Acacia arabica* Willd.	Pok-thin-thwa/Su-phyu	Mimosaceae	ST
2	*Acacia catechu* Willd.	Sha	Mimosaceae	T
3	*Acacia concinna* (Willd.) DC.	Taw-kin-mon-chin	Mimosaceae	Cl/Cr
4	*Acacia intsia* Willd.	Su-pok-gyi	Mimosaceae	CL
5	*Acacia pennata* (L.) Willd.	Su-yit	Mimosaceae	Cl/Cr
6	*Acmella calva* (DC.) R.K. Jansen	Pe-le-nyin	Asteraceae	H
7	*Aegle marmelos* L.	Ok-shit	Rutaceae	T
8	*Ageratum conyzoides* L.	Khwe-thay-pan	Asteraceae	H
9	*Albizia lebbek* (L.)Benth.	Taung-ko-kko	Mimosaceae	T
10	*Albizia lebbekoides* (DC.) Benth.	Taung-ma-gyi	Mimosaceae	T
11	*Amaranthus aspera*	Not known	Amaranthaceae	H
12	*Anogeissus acuminata* Wall.	Yon	Combretaceae	T
13	*Anthocephalus morindaefolius* Korth.	Ma-u-let-tan-shae	Rubiaceae	T
14	*Antidesma velutinum*Tul.	Kin-pa-lin	Euphorbiaceae	ST
15	*Aporusa dioica* (Roxb.) Mull.Arg.	Thit-khauk	Euphorbiaceae	T
16	*Argyreia nervosa*	Not known	Convolvulaceae	Cl/Cr
17	*Argyreia roxburghii* Choisy	Not known	Convolvulaceae	Cl/Cr
18	*Bambusa bambos* (L.)Voss	Kya-khat-wa	Poaceae	B
19	*Bambusa polymorpha* Munro	Kya-thaung-wa	Poaceae	B
20	*Bambusa tulda* Roxb.	Thaik-wa	Poaceae	B
21	*Bauhinia malabarica* Roxb.	Pha-lan/Chin-byit	Caesalpiniaceae	T
22	*Bauhinia* sp.	Swe-daw-nwee	Caesalpiniaceae	Cl/Cr
23	*Bliospermum axillare* Blume	Hnat-cho	Euphorbiaceae	H
24	*Boehmeria grandifolia*	Not known	Urticaceae	S
25	*Bombax ceiba* L.	Let-pan	Bombacaceae	T
26	*Bombax insigne* Wall.	De-du	Bombacaceae	T
27	*Bridelia retusa* L.	Seik-chee	Euphorbiaceae	ST
28	*Buchanania lazan* Spreng.	Lun-pho	Anacardiaceae	T
29	*Buddleja asiatica*	Pon-ma-gyi	Buddlejaceae	S
30	*Butea superba* Roxb.	Pauk-nwee	Fabaceae	Cl/Cr
31	*Caesalpinia decapetala (Roth.)Alston*	Suk-yan-bo /Kyant-sa-su-pin	Caesalpiniaceae	Cl/Cr
32	*Callicarpa nudiflora*	Kyun-na-lin	Verbenaceae	T
33	*Calotropis gigantea*	Ma-yoe	Apocynaceae	S
34	*Careya arborea* Roxb.	Ban-bwe	Lecythidaceae	T
35	*Cassia fistula* L.	Ngu	Caesalpiniaceae	T
36	*Cayratia trifolia*	Not known	Vitaceae	CL
37	*Centratherum punctatum*	Not known	Asteraceae	H
38	*Cephalostachyum pergracile* Munro	Tin-wa	Poaceae	B

No.	Scientific Name	Common Name	Family Name	Habits
39	*Chromolaena odorata* (L.) R.M. King & H Robinson	Bi-zet	Asteraceae	S
40	*Chukrasia velutina* Roem.	Yin-ma	Meliaceae	T
41	*Congea tomentosa* Roxb.	Tha-ma-ga-nwee	Verbenaceae	Cl/Cr
42	*Cosmos caudatus*	Sein-chel	Asteraceae	H
43	*Costus specious* Sm.	Pha-lan-taung-hmwe	Costaceae	H
44	*Crassocephalum crepidioides*	Pan-Zauk-htoe	Asteraceae	H
45	*Cratoxylum neriifolium* Kurz.	Be-bya	Hypericaceae	ST
46	*Cratoxylum polyanthum*Korth.	Be-bya	Hypericaceae	ST
47	*Croton oblongifolius* Roxb.	Tha-yin-gyi	Euphorbiaceae	ST
48	*Cryptolepis buchanani* Rome.& Schult	Na-sha-gyi	Asclepiadaceae	Cl/Cr
49	*Cucumis maderaspatanus*	Not known	Cucurbitaceae	Cl/Cr
50	*Curcuma aurantiaca*	Ma-la	Zingiberaceae	H
51	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	T
52	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae	T
53	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	ST
54	*Dalbergia volubilis* Roxb.	Daung-ta-laung	Fabaceae	ST
55	*Dendrocalamus longispathus* (Kurz) Kurz	Wa-net	Poaceae	B
56	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	B
57	*Derris* sp.	Not known	Fabaceae	Cl/Cr
58	*Dillenia parviflora* Griff	Kyet-zin-byun	Dilleniaceae	T
59	*Dillenia pentagyna* Roxb.	Zin-byun	Dilleniaceae	T
60	*Dinochloa maclellandii* Kurz	Ba-du-ma-wa/Wa-nwee	Poaceae	B
61	*Dioscorea bulbifera*	Myauk-u	Dioscoreaceae	Cl/Cr
62	*Dioscorea pentaphylla* L.	Kywe-ngar-ywet	Dioscoreaceae	Cl/Cr
63	*Diospyros kika* L.f.	Te	Ebenaceae	T
64	*Diospyros montana* Roxb.	Gyok	Ebenaceae	T
65	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae	T
66	*Ehretia acuminata* R.Br	Taung-poe-lu-lin	Boraginaceae	T
67	*Elephantopus scaber* L.	Not known	Asteraceae	H
68	*Entada scandens* Benth.	Doe-nwee	Mimosaceae	Cl/Cr
69	*Eugenia balsamea* Wight	Ye-tha-bye	Myrtaceae	T
70	*Ficus hispida* L.	Kha-aung	Moraceae	ST
71	*Ficus microcarpa* L.	Tha-phan	Moraceae	S
72	*Ficus obtusifolia* Roxb.	Nyaung-gyat	Moraceae	T
73	*Ficus racemosa* L.	Ye-tha-phan	Moraceae	ST
74	*Flacourtia cataphracta* Roxb.	Na-ywe	Flacourtiaceae	T
75	*Flemingia macrophylla* (Willd.) Merr.	Pha-lan-phyu	Fabaceae	S
76	*Gardenia coronaria* Buch.-Ham.	Yin-gat-gyi	Rubiaceae	T
77	*Getonia floribunda* Roxb.	Kywet-nwee	Combretaceae	Cl/Cr
78	*Glochidion eriocarpum*	Not known	Euphorbiaceae	S
79	*Grewia laevigata* Vahl	Kyet-ta-yaw	Tiliaceae	ST
80	*Harrisonia perforata* Merr.	Su-gyin	Simaroubaceae	S

No.	Scientific Name	Common Name	Family Name	Habits
81	*Heterophragma adenophyllum* Seem.	Phet-than	Bignoniaceae	ST
82	*Hibiscus macrophyllus*	Taung-phet-wun	Malvaceae	T
83	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	S
84	*Ipomoea angustifolia* Jacq.	Not known	Convolvulaceae	Cl/Cr
85	*Ipomoea quamoclit* L.	Myet-lay-ni	Convolvulaceae	Cl/Cr
86	*Ipomoea triloba*	Not known	Convolvulaceae	Cl/Cr
87	*Kleinhovia hospita* L.	O-tein/Pashu-phet-wun	Sterculiaceae	T
88	*Lagerstroemia macrocarpa* Kurz	Pyin-ma-ywet-gyi	Lythraceae	T
89	*Lagerstroemia speciosa* (L.)Pers.	Pyin-ma-ywet-thay	Lythraceae	T
90	*Lagerstroemia tomentosa* Presl.	Lae-sa	Lythraceae	T
91	*Lannea coromandelica* (Houtt.) Merrr.	Na-be	Anacardiaceae	T
92	*Lathyrus latifolius*	Not known	Fabaceae	S
93	*Leea hirta* Banks	Naga-mauk-phyu	Leeaceae	S
94	*Leea rubra* Blume.	Naga-mauk-ni	Leeaceae	S
95	*Lepidagathis semiherbacea* (Clarke) Nees	Not known	Acanthaceae	H
96	*Leptadenia reticulata* Wight & Arn.	Gon-kha	Asclepiadaceae	Cl/Cr
97	*Lespedeza bicolor* var. *japonica*	Not known	Fabaceae	S
98	*Leucaena leucocephala* (Lam.) De.Wit	Baw-za-gaing	Mimosaceae	ST
99	*Lindenbergia philippensis* Benth.	Not known	Scrophulariaceae	H
100	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	H
101	*Mallotus philippensis* (Lam.)Muell.Arg.	Taw-thi-din	Euphorbiaceae	ST
102	*Mangifera sylvatica* Roxb.	Taung-tha-yet	Anacardiaceae	T
103	*Markhamia stipulata* (Wall.) Seem.ex K.Schum.	Ma-hlwa	Bignoniaceae	ST
104	*Melanorrhoea usitata* Wall.	Sit-se	Anacardiaceae	T
105	*Merremia vitifolia* (Burm.f.) Hallier. f.	Kyet-hinga-lae-new	Convolvulaceae	Cl/Cr
106	*Microcos paniculata* L.	Mya-ya	Meliaceae	ST
107	*Millettia extensa* Benth.	Win-u	Fabaceae	Cl/Cr
108	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae	T
109	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae	H
110	*Mitragyna rotundifolia* (Roxb.) Kuntze	Bin-ga	Rubiaceae	T
111	*Morinda tinctoria* Roxb.	Ni-ba-sae	Rubiaceae	S
112	*Mucuna pruriens* (L.)DC.	Khwe-lae-ya	Fabaceae	Cl/Cr
113	*Oroxylum indicum* (L.) Kurz.	Kyaung-sha	Bignoniaceae	ST
114	*Oxystelma esculentum* R.Br.	Kauk-yo-nwee	Asclepiadaceae	Cl/Cr
115	*Paederia foetida* L.	Pe-bok-nwee	Rubiaceae	CL
116	*Phoenix paludosa* Roxb.	Thin-baung	Arecaceae	ST
117	*Phyllanthus albizzioides* (Kurz)Hook.f.	Shit-sha	Euphorbiaceae	T
118	*Phyllanthus emblica* L.	Zi-phyu	Euphorbiaceae	ST
119	*Pseudoxytenanthera parvifolia* (Brandis ex Gamble)T.Q.Nguyen	Thaiktu-hmyintu	Poaceae	B
120	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	T
121	*Pterospermum semisagittatum* Buch.-Ham.	Na-gye	Sterculiaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
122	*Ricinus communis* L.	Kyet-su	Euphorbiaceae	ST
123	*Samadera indica* Gaertn.	Ka-di	Simaroubaceae	ST
124	*Schleichera oleosa* (Lour.) Oken	Gyo	Sapindaceae	T
125	*Senna hirsuta* (L.) Irwin & Barneby	Ka-thaw-hmwe-htu	Caesalpiniaceae	S
126	*Setaria lutescens* Hubb.	Yon-sa	Poaceae	G
127	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	T
128	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	T
129	*Sida acuta* Burm f.	Ta-byet-si	Malvaceae	S
130	*Smilax aspericaulis* Wall ex A. D.C.	Sein-na-baw-thay	Smilaceae	CL
131	*Smilax macrophylla* Roxb.	Sein-na-baw-gyi	Smilaceae	CL
132	*Spermacoce mauritiana*	Not known	Rubiaceae	H
133	*Spondias pinnata* (L. f.) Kurz.	Taw-gwe	Anacardiaceae	T
134	*Sterculia ornata* Wall. ex Kurz	Don-shaw	Sterculiaceae	T
135	*Sterculia versicolor* Wall.	Shaw-phyu	Sterculiaceae	T
136	*Stereospermum colais* (Buch.-Ham. ex Dillwyn) Mabb.	Than-thay	Bignoniaceae	T
137	*Strychnos nux-blanda* A.W.Hill	Kha-baung	Loganiaceae	ST
138	*Tadehagi triquetrum* (L.)H. Ohashi	Lauk-thay	Fabaceae	S
139	*Tectona grandis* L. f.	Kyun	Verbenaceae	T
140	*Terminalia alata* (Heyne) Roth	Htauk-kyant	Combretaceae	T
141	*Tetrameles nudiflora* R. Br.	Baing	Datiscaceae	T
142	*Tetrastigma planicaule*	Not known	Vitaceae	Cl/Cr
143	*Thunbergia laurifolia* Lindl.	Kyi-hnok-thi	Acanthaceae	Cl/Cr
144	*Thyrsostachys oliveri* Gamble	Tha-net-wa	Poaceae	B
145	*Tinospora nudiflora* Kurz	Sin-don-ma-nwee	Menispermaceae	Cl/Cr
146	*Trema orientalis* (L.) Blume	Khwe-sha	Ulmaceae	ST
147	*Tristaniopsis burmanica* (Griff.)P.G. Wilson & J.T. Waterh.	Taung-tha-bye	Myrtaceae	T
148	*Triumfetta bartramia* L.	Ket-si-ne-thay	Tiliaceae	S
149	*Urena lobata* L.	Ket-si-ne-gyi	Malvaceae	S
150	*Uvaria cordata* Schum. & Thonn.	Tha-but-gyi	Annonaceae	ST
151	*Vangueria spinosa* Roxb.	Magyi-bauk	Rubiaceae	S
152	*Ventilago maderaspatana* Benth.	Ta-yaw-nyo	Rhamnaceae	Cl/Cr
153	*Vitex peduncularis* Wall.	Phet-le-zin	Verbenaceae	T
154	*Vitex pubescens* Vahl	Kyet-yoe	Verbenaceae	T
155	*Vitis discolour*	Ta-bin-taing-mya-nan-phyu	Vitaceae	Cl/Cr
156	*Wendlandia tinctoria* DC.	Thit-ni/Hta-min-chauk	Rubiaceae	ST
157	*Xylia xylocarpa* (Roxb.)Taub.	Pyin-ka-doe	Mimosaceae	T
158	*Zanthoxylum budrunga* Wall.	Ma-yanin-kyet-su	Rutaceae	T
159	*Ziziphus glabra* Roxb.	Taw-zi-nwee/Paung-bet	Rhamnaceae	Cl/Cr
160	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae	ST

B=Bamboo, CL=Climber, Cl/Cr=Climber/Creeper, G=Grass, H=Herbs, S=Shrubs, ST=Small Tree, T=Tree

Table.6. IUCN red list in Mud Stone Area (2016.3)

No.	Scientific Name	Common Name	Family Name	IUCN criteria
1	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	NT ver 3.1
2	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	LC ver 3.1
3	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	LCver 3.1
4	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae	LR/lc ver 2.3
5	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	LC ver 3.1
6	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	LC ver 3.1
7	*Lathyrus latifolius*	Not known	Fabaceae	LC ver 3.1
8	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae	DD ver 3.1
9	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae	LC ver 3.1
10	*Pennisetum purpureum* Schum.	Yon-sa-myet	Poaceae	LC ver 3.1
11	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	VU A1d ver 2.3
12	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	LR/lc ver 2.3
13	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	LR/lc ver 2.3
14	*Tetrameles nudiflora* R. Br.	Baing	Datiscaceae	LR/lc ver 2.3
DD=Data Deficient, LC=Least Concern, LR/lc=Lower Risk/least concern, NT=Near Threatened, VU=Vulnerable				

Ludwigia octovalvis

Homonoia riparia

Mimosa pudica L.

*Pterocarpus indicus*Willd.

Dendrocalamus membranaceus Munro

Dipterocarpus tuberculatus Roxb.

Dalbergia cultrata Grah.

Ludwigia hyssopifolia

Shorea siamensis (Kurz) Miq.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥ 70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Version 3.1: IUCN (2001)
The IUCN Council adopted this latest version, which incorporated changes as a result of comments from the IUCN and SSC memberships and from a final meeting of the Criteria Review Working Group, in February 2000.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(d) actual or potential levels of exploitation

Table.7. Invasive Species List Lime Stone Area

No	Scientific Names	Familiy	Common Names	Origin
1	*Ageratum conyzoides* L.	Asteraceae	Khwe-thay-pan	Tropical America
2	*Caesalpinia decapetala (Roth.)Alston*	Caesalpiniaceae	Suk-yan-bo /Kyant-sa-su-pin	Tropical Asia
3	*Chromolaena odorata* (L.) R.M. King & H Robinson	Asteraceae	Bi-zet	Central America, South America
4	*Leucaena leucocephala* (Lam.) De.Wit	Mimosaceae	Baw-za-gaing	Hawaii
5	*Mimosa pudica* L.	Mimosaceae	Hti-ka-yone	"South America. Mexico, Amazon. Tropical America"
6	*Oroxylum indicum* (L.) Kurz.	Bignoniaceae	Kyaung-sha	India
7	*Paederia foetida* L.	Rubiaceae	Pe-bok-nwee	Asia
8	*Ricinus communis* L.	Euphorbiaceae	Kyet-su	India
9	*Ziziphus jujuba* Lam.	Rhamnaceae	Zi	China

Paederia foetida L.

Chromolaena odorata (L.) R.M. King & H Robinson

Caesalpinia decapetala (Roth.)Alston

Ageratum conyzoides L.

Mimosa pudica L.

Ricinus communis L.

Oroxylum indicum (L.) Kurz.

Leucaena leucocephala (Lam.) De.Wit

Table.8. Plant Association, Vegetation Types, and Red List Species according to their coordinations

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
Association I. *Xylia xylocarpa* (Roxb.)Taub., *Mitragyna rotundifolia* (Roxb.) Kuntze and *Bambusa polymorpha* Munro	440	APM-1	*Bambusa polymorpha* Munro,*Thyrsostachys oliveri* Gamble, *Dinochloa maclellandii* Kurz, *Cephalostachyum pergracile* Munro, *Dendrocalamus longispathus* (Kurz) Kurz, *Bambusa bambos* (L.)Voss	*Xylia xylocarpa* (Roxb.)Taub., *Mitragyna rotundifolia* (Roxb.) Kuntze, *Grewia laevigata* Vahl, *Tectona grandis* L. f., *Harrisonia perforata* Merr., *Croton oblongifolius* Roxb., *Strychnos nux-blanda* A.W.Hill, *Vitex pubescens* Vahl, *Lagerstroemia tomentosa* Presl., *Hibiscus macrophyllus*, *Pterocarpus indicus*Willd., *Acacia pennata* (L.) Willd., *Anogeissus acuminata* Wall.	Deciduous Forest		2017-02-04 7:47:04AM	96.379104	20.868413
	460	APM-2				*Dalbergia rimosa* Roxb., *Pterocarpus indicus*Willd.	2017-02-04 7:56:01AM	96.378058	20.868839
	477	APM-3					2017-02-04 8:04:26AM	96.377359	20.869741
	483	APM-4				*Dalbergia oliveri* Gamble	2017-02-04 8:12:03AM	96.376073	20.870653
	468	APM-5				*Dalbergia cultrata* Grah.	2017-02-04 8:30:03AM	96.376202	20.871723
	439	APM-6					2017-02-04 8:55:44AM	96.376809	20.872382
	401	APM-7				*Shorea siamensis* (Kurz) Miq., *Dalbergia rimosa* Roxb.,	2017-02-04 9:15:45AM	96.377427	20.873084
	392	APM-8				*Dalbergia rimosa* Roxb.,*Pterocarpus indicus*Willd.	2017-02-04 9:23:24AM	96.378265	20.872450

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	383	APM-9				*Dalbergia oliveri* Gamble	2017-02-04 9:32:59AM	96.379369	20.872356
	382	APM-10					2017-02-04 9:55:28AM	96.380506	20.872592
	376	APM-11				*Pterocarpus indicusWilld.*, *Tetrameles nudiflora* R. Br., *Shorea obtusa* Wall.	2017-02-04 10:02:48AM	96.381528	20.873290
Association II. *Xylia xylocarpa*(Roxb.)Taub., *Tectona grandis* L. f. **a**nd *Bambusa polymorpha* Munro,	362	APM-12	*Bambusa polymorpha* Munro,*Thyrsostachys oliveri* Gamble, *Dinochloa maclellandii* Kurz, *Cephalostachyum pergracile* Munro, *Dendrocalamus longispathus* (Kurz) Kurz, *Bambusa bambos* (L.)Voss, *Pseudoxytenanthera parvifolia* (Brandis ex Gamble)T.Q.Nguyen, *Bambusa tulda* Roxb.	*Xylia xylocarpa*(Roxb.)Taub., *Tectona grandis* L. f., *Harrisonia perforata* Merr., *Mitragyna rotundifolia* (Roxb.) Kuntze, *Anthocephalus morindaefolius* Korth., *Strychnos nux-blanda* A.W.Hill, *Pterospermum semisagittatum* Buch.-Ham.	Mixed Broad-leaved Deciduous Forest	*Dalbergia cultrata* Grah., *Pterocarpus indicus*Willd., *Shorea obtusa* Wall.	2017-02-04 10:10:50AM	96.382538	20.873666
	353	APM-13				*Pterocarpus indicusWilld.*, *Tetrameles nudiflora* R. Br., *Millettia ovalifolia* Kurz	2017-02-04 10:18:28AM	96.383400	20.874311
	349	APM-14				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.,	2017-02-04 10:26:02AM	96.384434	20.874851
	347	APM-15				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd., *Tetrameles nudiflora* R. Br., *Mangifera sylvatica* Roxb., *Shorea siamensis* (Kurz) Miq., *Shorea obtusa* Wall.	2017-02-04 10:33:29AM	96.385107	20.875549

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	340	APM-16				*Dalbergia cultrata* Grah., *Pterocarpus indicus* Willd., *Homonoia riparia*	2017-02-04 10:46:39AM	96.386005	20.876201
	336	APM-17				*Dalbergia cultrata* Grah., *Pterocarpus indicus* Willd.	2017-02-04 10:55:04AM	96.386412	20.877271
	337	APM-18				*Pterocarpus indicus*Willd., *Shorea obtusa* Wall.	2017-02-04 11:02:57AM	96.386797	20.878228
	336	APM-19				*Dalbergia cultrata Grah., Pterocarpus indicus Willd., Shorea obtusa* Wall.	2017-02-04 11:08:48AM	96.387445	20.879140
	339	APM-20				*Dalbergia cultrata* Grah., *Dalbergia rimosa* Roxb.,	2017-02-04 11:23:03AM	96.388520	20.879090
	346	APM-21				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.,	2017-02-04 11:29:46AM	96.389222	20.878532
	335	APM-22				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.,	2017-02-04 11:37:16AM	96.389630	20.877679
Association III. *Tristaniopsis burmanica* (Griff.)P.G. Wilson & J.T. Waterh., *Tectona grandis* L. f., and *Dinochloa maclellandii*	330	APM-23	*Dinochloa maclellandii* Kurz, *Bambusa polymorpha* Munro,	*Tristaniopsis burmanica* (Griff.)P.G. Wilson & J.T. Waterh., *Tectona grandis* L. f., *Dipterocarpus tuberculatus* Roxb., *Ziziphus glabra* Roxb., *Trema*	Mixed Evergreen Forest	*Dalbergia oliveri* Gamble, *Homonoia riparia, Mangifera sylvatica* Roxb., *Shorea obtusa* Wall., *Millettia ovalifolia* Kurz	2017-02-04 11:47:03AM	96.390627	20.877732

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
Kurz	329	APM-24		*orientalis* (L.) Blume, *Wendlandia tinctoria* DC., *Mitragyna rotundifolia* (Roxb.) Kuntze, *Pterocarpus indicus*Willd., *Harrisonia perforata* Merr., *Anthocephalus morindaefolius* Korth.,*Xylia xylocarpa* (Roxb.)Taub., *Melanorrhoea usitata* Wall., *Shorea obtusa* Wall., *Cratoxylum polyanthum*Korth., *Albizia lebbekoides* (DC.) Benth., *Dalbergia oliveri* Gamble		*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Homonoia riparia*, *Pterocarpus indicus*Willd	2017-02-04 11:58:18AM	96.391085	20.876780
	330	APM-25				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Homonoia riparia*,	2017-02-04 12:04:32PM	96.391166	20.875372
	337	APM-26				*Dalbergia cultrata* Grah., *Shorea obtusa* Wall., *Shorea siamensis* (Kurz) Miq.	2017-02-04 12:15:27PM	96.392290	20.874311
	341	APM-27				*Dalbergia rimosa* Roxb.,*Pterocarpus indicus*Willd.	2017-02-04 12:17:41PM	96.392448	20.873938
	348	APM-28					2017-02-04 12:22:37PM	96.392460	20.872359
	358	APM-29					2017-02-04 12:27:28PM	96.392614	20.871414
	504	APM-30				*Dipterocarpus tuberculatus* Roxb.,Shorea obtusa Wall., Shorea siamensis (Kurz) Miq.	2017-02-05 7:56:55AM	96.375571	20.870139
	528	APM-31				*Dalbergia oliveri* Gamble, *Dipterocarpus tuberculatus* Roxb.,*Shorea obtusa* Wall., *Shorea siamensis* (Kurz) Miq., *Pterocarpus indicus*Willd	2017-02-05 8:07:55AM	96.374747	20.870647

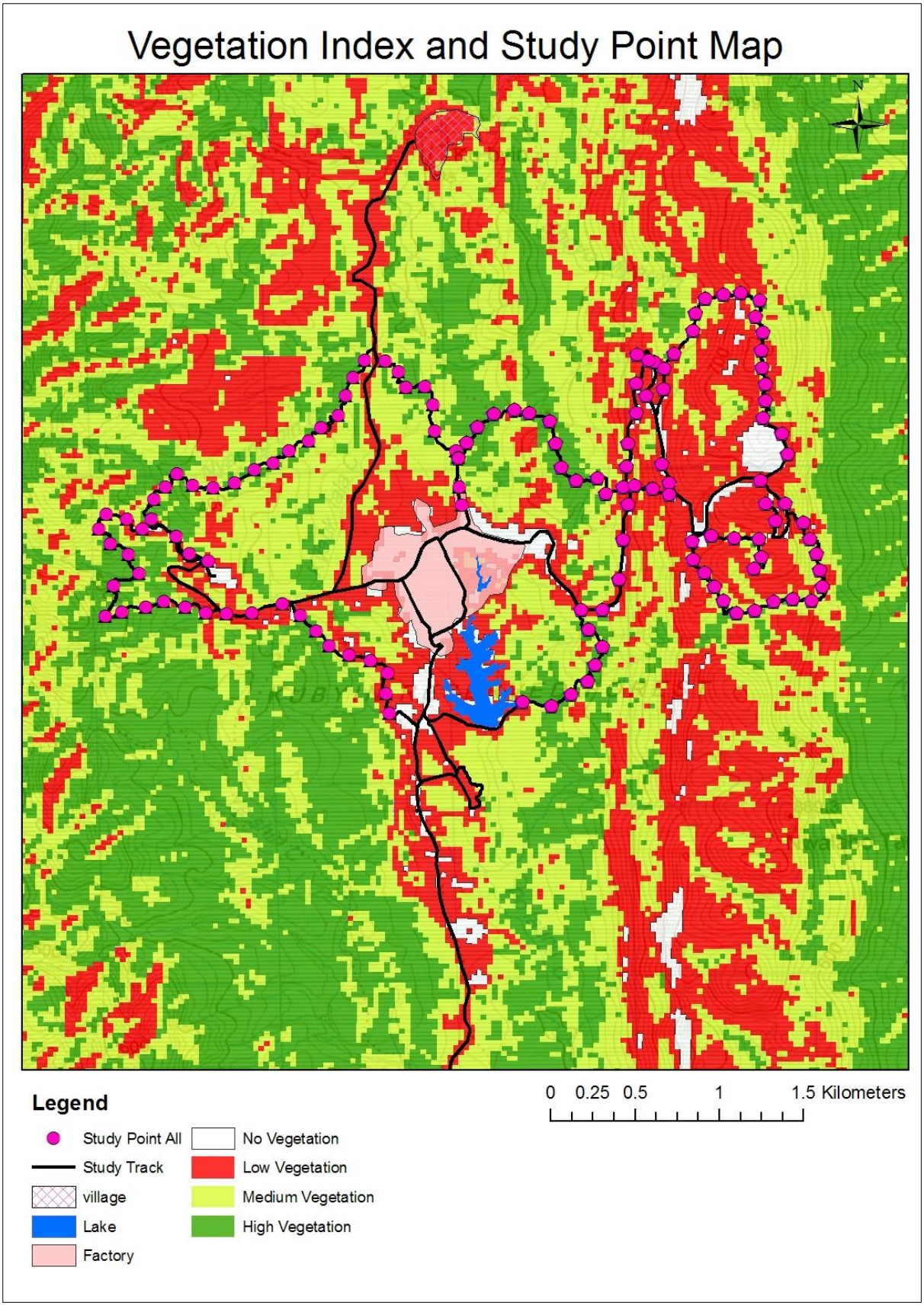
PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	543	APM-32				*Dalbergia oliveri* Gamble, *Dipterocarpus tuberculatus Roxb.,Shorea obtusa Wall., Shorea siamensis (Kurz) Miq.,*	2017-02-05 8:23:04AM	96.373630	20.870909
	549	APM-33				*Dalbergia oliveri* Gamble, *Dalbergia rimosa* Roxb., *Dipterocarpus tuberculatus Roxb.,Shorea obtusa Wall., Shorea siamensis (Kurz) Miq.,Dendrocalamus membranaceus* Munro	2017-02-05 8:36:06AM	96.373262	20.870129
Association IV. *Tectona grandis* L. f., *Xylia xylocarpa* (Roxb.)Taub., and *Thyrsostachys oliveri* Gamble	482	APM-34	*Thyrsostachys oliveri* Gamble, *Bambusa polymorpha* Munro, *Dendrocalamus longispathus* (Kurz) Kurz, *Dendrocalamus membranaceus* Munro, *Dinochloa maclellandii* Kurz	*Tectona grandis* L. f., *Xylia xylocarpa* (Roxb.)Taub., *Dipterocarpus tuberculatus* Roxb., *Dalbergia oliveri* Gamble, *Mitragyna rotundifolia* (Roxb.) Kuntze, *Pterocarpus indicus*Willd., *Harrisonia perforata* Merr., *Trema orientalis* (L.) Blume, *Shorea siamensis* (Kurz) Miq., *Grewia laevigata* Vahl, *Lagerstroemia tomentosa* Presl., *Anthocephalus morindaefolius* Korth., *Phyllanthus albizzioides* (Kurz)Hook.f., *Melanorrhoea usitata* Wall., *Shorea obtusa* Wall.	Mixed Broad-leaved Deciduous Forest	*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd., *Dendrocalamus membranaceus* Munro, *Millettia ovalifolia* Kurz	2017-02-05 9:04:34AM	96.373877	20.869372
	458	APM-35				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd., *Millettia ovalifolia* Kurz	2017-02-05 9:33:39AM	96.374824	20.868780
	442	APM-36					2017-02-05 9:41:02AM	96.375380	20.867756
	461	APM-37				*Pterocarpus indicus*Willd., *Millettia ovalifolia* Kurz	2017-02-05 9:54:36AM	96.374059	20.867108

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	532	APM-38				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd., *Millettia ovalifolia* Kurz	2017-02-05 10:21:15AM	96.373606	20.865480
	515	APM-39				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd., *Dendrocalamus membranaceus* Munro, *Millettia ovalifolia* Kurz	2017-02-05 10:35:13AM	96.374459	20.865723
	481	APM-40				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.,	2017-02-05 10:47:52AM	96.375768	20.865950
	450	APM-41				*Dalbergia cultrata* Grah., *Pterocarpus indicus*Willd., Shorea obtusa Wall., *Dipterocarpus tuberculatus Roxb.,Shorea obtusa Wall., Shorea siamensis (Kurz) Miq.,*	2017-02-05 10:55:26AM	96.376735	20.866259
	443	APM-42				*Dalbergia cultrata* Grah., *Pterocarpus indicus*Willd., *Dipterocarpus tuberculatus* Roxb.	2017-02-05 11:03:29AM	96.377860	20.865964
	422	APM-43				*Dalbergia oliveri* Gamble	2017-02-05 11:24:29AM	96.378946	20.865674

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	400	APM-44				*Pterocarpus indicus*Willd., *Dendrocalamus membranaceus* Munro	2017-02-05 11:29:57AM	96.380064	20.865611
Association V. *Xylia xylocarpa* (Roxb.)Taub., *Tectona grandis* L. f., and *Bambusa polymorpha* Munro	389	APM-45	*Bambusa polymorpha* Munro, *Thyrsostachys oliveri* Gamble, *Dendrocalamus longispathus* (Kurz) Kurz, *Bambusa tulda* Roxb., *Dinochloa maclellandii* Kurz	*Xylia xylocarpa* (Roxb.)Taub., *Tectona grandis* L. f., *Harrisonia perforata* Merr., *Pterocarpus indicus*Willd., *Anthocephalus morindaefolius* Korth., *Trema orientalis* (L.) Blume, *Mitragyna rotundifolia* (Roxb.) Kuntze, *Grewia laevigata* Vahl, *Terminalia alata* (Heyne) Roth, *Lagerstroemia tomentosa* Presl., *Croton oblongifolius* Roxb.	Mixed Broad-leaved Deciduous Forest		2017-02-05 11:35:10AM	96.381425	20.865675
	389	APM-46				*Pterocarpus indicus*Willd.	2017-02-05 11:38:35AM	96.383042	20.866146
	394	APM-47				*Dalbergia cultrata* Grah., *Pterocarpus indicus*Willd.	2017-02-05 11:43:40AM	96.383992	20.865522
	367	APM-48				*Dalbergia cultrata* Grah., *Pterocarpus indicus*Willd.	2017-02-05 11:49:30AM	96.384851	20.864678
	364	APM-49				*Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.	2017-02-05 11:53:57AM	96.385532	20.863907
	371	APM-50				*Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.	2017-02-05 11:58:23AM	96.386608	20.863440
	373	APM-51				*Pterocarpus indicus*Willd.	2017-02-05 12:03:25PM	96.387754	20.863106
	364	APM-52				*Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd.	2017-02-05 12:07:59PM	96.388676	20.862448

PLANT ASSOCIATION	ELEVATION(m)	NAME	BAMBOO SPECIES	DOMINANT TREE SPECIES	VEGETATION TYPE	IUCN red list Species	Comment	POINT_X	POINT_Y
	355	APM-53				*Dalbergia cultrata* Grah., *Dalbergia oliveri* Gamble, *Pterocarpus indicus*Willd., *Tetrameles nudiflora* R. Br.	2017-02-05 12:10:47PM	96.388553	20.861350
	350	APM-54					2017-02-05 12:13:43PM	96.388765	20.860306
APM=Apache Mud Stone									

Map. I. Vegetation Indax and Study Point Map



Map. II. Forest Type and Red list Species Distribution Map

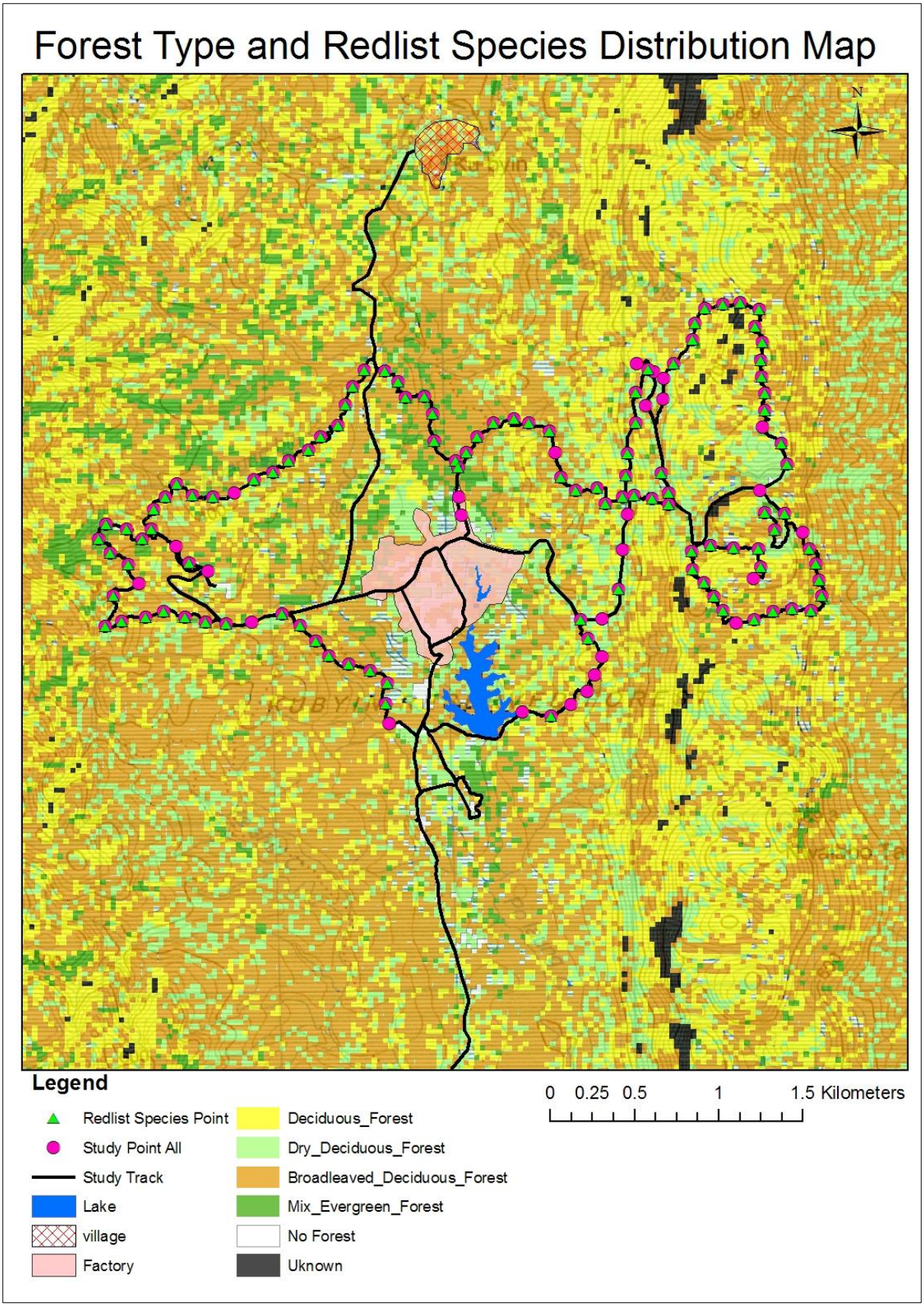


Table.7. Checklist of Lime Stone and Mud Stone Areas

No.	Scientific Name	Common Name	Family Name
1	*Abelmoschus moschatus*	Taw-yon-pa-de	Malvaceae
2	*Acacia arabica* Willd.	Pok-thin-thwa/Su-phyu	Mimosaceae
3	*Acacia catechu* Willd.	Sha	Mimosaceae
4	*Acacia concinna* (Willd.) DC.	Taw-kin-mon-chin	Mimosaceae
5	*Acacia intsia* Willd.	Su-pok-gyi	Mimosaceae
6	*Acacia pennata* (L.) Willd.	Su-yit	Mimosaceae
7	*Achyranthes* aspera L.	Kyet-mauk-su-pyan	Amaranthaceae
8	*Acmella calva* (DC.) R.K. Jansen	Pe-le-nyin	Asteraceae
9	*Adenostemma viscosum*	Not known	Asteraceae
10	*Adina cordifolia* Hook. f.	Hnaw	Rubiaceae
11	*Aeginetia pedunculata* Wall.	Kauk-hlaing-di-yaing	Orobanchaceae
12	*Aegle marmelos* L.	Ok-shit	Rutaceae
13	*Ageratum conyzoides* L.	Khwe-thay-pan	Asteraceae
14	*Ajuga lupulina*	Not known	Lamiaceae
15	*Alangium chinense* (Lour.)Harms.	Hmaik	Alangiaceae
16	*Albizia lebbek* (L.)Benth.	Taung-ko-kko	Mimosaceae
17	*Albizia lebbekoides* (DC.) Benth.	Taung-ma-gyi	Mimosaceae
18	*Alternanthera sessilis* (L.) R.Br.	Pa-zun-sa-yaing	Amaranthaceae
19	*Amaranthus aspera*	Not known	Amaranthaceae
20	*Amaranthus gracilis* Desf.	Hin-nu-nwe-yaing	Amaranthaceae
21	*Anisomeles indica*	Not known	Lamiaceae
22	*Anogeissus acuminata* Wall.	Yon	Combretaceae
23	*Anthocephalus morindaefolius* Korth.	Ma-u-let-tan-shae	Rubiaceae
24	*Antidesma velutinum*Tul.	Kin-pa-lin	Euphorbiaceae
25	*Aporusa dioica* (Roxb.) Mull.Arg.	Thit-khauk	Euphorbiaceae
26	*Argyreia nervosa*	Not known	Convolvulaceae
27	*Argyreia roxburghii* Choisy	Not known	Convolvulaceae
28	*Armillaria mellea* (VahlFr.) Kummer.	Not known	Physalacriaceae
29	*Bambusa bambos* (L.)Voss	Kya-khat-wa	Poaceae
30	*Bambusa polymorpha* Munro	Kya-thaung-wa	Poaceae
31	*Bambusa tulda* Roxb.	Thaik-wa	Poaceae
32	*Bauhinia malabarica* Roxb.	Pha-lan/Chin-byit	Caesalpiniaceae
33	*Bauhinia ornata* Kurz	Myauk-hle-kha	Caesalpiniaceae
34	*Bauhinia* sp.	Swe-daw-nwee	Caesalpiniaceae
35	*Bidens pilosa*	Hmwe-sok	Asteraceae
36	*Blechnum orientale*	Not known	Blechnaceae
37	*Bliospermum axillare* Blume	Hnat-cho	Euphorbiaceae
38	*Bliospermum axillare* Blume	Hnat-cho	Euphorbiaceae
39	*Blumea balsamifera* DC..	Phon-ma-thein	Asteraceae
40	*Boehmeria grandifolia*	Not known	Urticaceae

No.	Scientific Name	Common Name	Family Name
41	*Boehmeria* sp.	Not known	Urticaceae
42	*Bombax anceps* Pierre	Ko-khe	Bombacaceae
43	*Bombax ceiba* L.	Let-pan	Bombacaceae
44	*Bombax insigne* Wall.	De-du	Bombacaceae
45	*Bridelia retusa* L.	Seik-chee	Euphorbiaceae
46	*Buchanania lazan* Spreng.	Lun-pho	Anacardiaceae
47	*Buddleja asiatica*	Pon-ma-gyi	Buddlejaceae
48	*Butea superba* Roxb.	Pauk-nwee	Fabaceae
49	*Caesalpinia decapetala (Roth.)Alston*	Suk-yan-bo /Kyant-sa-su-pin	Caesalpiniaceae
50	*Cajanus cajan*	Pe-sin-ngone	Fabaceae
51	*Callicarpa arborea* Roxb.	Kyun-na-lin	Verbenaceae
52	*Callicarpa longifolia*	Kun-na-lin-thay	Verbenaceae
53	*Callicarpa nudiflora*	Kyun-na-lin	Verbenaceae
54	*Calotropis gigantea*	Ma-yoe	Apocynaceae
55	*Calycopteris floribunda* Lam.	Gyut-nwe	Combretaceae
56	*Canscora diffusa* (Vahl) R.Br.	Kyauk-pan	Gentianaceae
57	*Careya arborea* Roxb.	Ban-bwe	Lecythidaceae
58	*Cassia fistula* L.	Ngu	Caesalpiniaceae
59	*Cassia timoriensis* DC.	Not known	Caesalpiniaceae
60	*Cayratia trifolia*	Not known	Vitaceae
61	*Celosia argentea* L.	Taw-kyet-mauk	Amaranthaceae
62	*Centratherum punctatum*	Not known	Asteraceae
63	*Cephalostachyum pergracile* Munro	Tin-wa	Poaceae
64	*Chloris barbata*	Not known	Poaceae
65	*Chromolaena odorata* (L.) R.M. King & H Robinson	Bi-zet	Asteraceae
66	*Chukrasia velutina* Roem.	Yin-ma	Meliaceae
67	*Cissampelos pareira* L.	Not known	Menispermaceae
68	*Clematic fasiculiflora* L.	Khwa-nyo	Ranunculaceae
69	*Congea tomentosa* Roxb.	Tha-ma-ga-nwee	Verbenaceae
70	*Corchorus aestuans* L.	Byauk-o	Tiliaceae
71	*Corchorus capsularis* L.	Gon-shaw/Khwe-la-but	Tiliaceae
72	*Cosmos caudatus*	Sein-chel	Asteraceae
73	*Costus specious* Sm.	Pha-lan-taung-hmwe	Costaceae
74	*Crassocephalum crepidioides* (Benth.) S. Moor.	Pan-zauk-htoe	Asteraceae
75	*Cratoxylum neriifolium* Kurz.	Be-bya	Hypericaceae
76	*Cratoxylum polyanthum*Korth.	Be-bya	Hypericaceae
77	*Crotalaria mucronata* L.	Taw-paik-san	Fabaceae
78	*Crotalaria multiflora* L.	Not known	Fabaceae
79	*Croton oblongifolius* Roxb.	Tha-yin-gyi	Euphorbiaceae
80	*Crypteronia pubescens* Blume	A-nan-pho	Crypteroniaceae
81	*Cryptolepis buchanani* Rome.& Schult	Na-sha-gyi	Asclepiadaceae

No.	Scientific Name	Common Name	Family Name
82	*Cucumis maderaspatanus*	Not known	Cucurbitaceae
83	*Curcuma aurantiaca*	Ma-la	Zingiberaceae
84	*Cymbidium aloifolium* (L.)Sw.	Thit-tet-lin-nae	Orchidaceae
85	*Dactyloctenium aegyptium*	Lay-gwa-myet	Poaceae
86	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae
87	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae
88	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae
89	*Dalbergia volubilis* Roxb.	Daung-ta-laung	Fabaceae
90	*Dendrocalamus longispathus* (Kurz) Kurz	Wa-net	Poaceae
91	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae
92	*Derris* sp.	Not known	Fabaceae
93	*Desmodium heterophyllum* (Willd.)DC.	Not known	Fabaceae
94	*Desmodium pulchellum* Benth.	Taung-da-min	Fabaceae
95	*Dillenia parviflora* Griff	Kyet-zin-byun	Dilleniaceae
96	*Dillenia pentagyna* Roxb.	Zin-byun	Dilleniaceae
97	*Dinochloa maclellandii* Kurz	Ba-du-ma-wa/Wa-nwee	Poaceae
98	*Dioscorea bulbifera*	Myauk-u	Dioscoreaceae
99	*Dioscorea cylindrica* Burm.	Kywe-thon-ywet	Dioscoreaceae
100	*Dioscorea pentaphylla* L.	Kywe-ngar-ywet	Dioscoreaceae
101	*Dioscorea sativa* L.	Kauk-yin-nwee	Dioscoreaceae
102	*Diospyros kika* L.f.	Te	Ebenaceae
103	*Diospyros montana* Roxb.	Gyok	Ebenaceae
104	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae
105	*Duabanga grandiflora*	Myauk-ngo	Lythraceae
106	*Ehretia acuminata* R.Br	Taung-poe-lu-lin	Boraginaceae
107	*Elephantopus scaber* L.	Not known	Asteraceae
108	*Entada scandens* Benth.	Doe-nwee	Mimosaceae
109	*Erythrina stricta* Roxb.	Ka-thit	Fabaceae
110	*Eugenia balsamea* Wight	Ye-tha-bye	Myrtaceae
111	*Euphorbia antiquorum* L.	Tazaung-gyi	Euphorbiaceae
112	*Euphorbia hypericifolia* L.	Kywe-kyaung-hmin-se	Euphorbiaceae
113	*Evolvulus nummularius* L.	Kyauk-kwe	Convolvulaceae
114	*Ficus hispida* L.	Kha-aung	Moraceae
115	*Ficus lacor* Buch.-Ham.	Nyaung-gyin	Moraceae
116	*Ficus microcarpa*	Not known	Moraceae
117	*Ficus obtusifolia* Roxb.	Nyaung-gyat	Moraceae
118	*Ficus racemosa* L.	Ye-tha-phan	Moraceae
119	*Flacourtia cataphracta* Roxb.	Na-ywe	Flacourtiaceae
120	*Flemingia congesta* Roxb.	Kye-hmi	Fabaceae
121	*Flemingia macrophylla* (Willd.) Merr.	Pha-lan-phyu	Fabaceae
122	*Gardenia coronaria* Buch.-Ham.	Yin-gat-gyi	Rubiaceae

No.	Scientific Name	Common Name	Family Name
123	*Getonia floribunda* Roxb.	Kywet-nwee	Combretaceae
124	*Glochidion eriocarpum*	Not known	Euphorbiaceae
125	*Glochidion* sp.	Hta-min-sok	Euphorbiaceae
126	*Goniothalamus laoticus*	Not known	Annonaceae
127	*Grewia laevigata* Vahl	Kyet-ta-yaw	Tiliaceae
128	*Harrisonia perforata* Merr.	Su-gyin	Simaroubaceae
129	*Hemigraphis brunelloides* (Lam.) Bremek.	Not known	Acanthaceae
130	*Heterophragma adenophyllum* Seem.	Phet-than	Bignoniaceae
131	*Hibiscus macrophyllus*	Taung-phet-wun	Malvaceae
132	*Hiptage benghalensis* (L.) Kurz	Bein-new	Malpighiaceae
133	*Holarrhena pubescens* Wall. ex G. Don	Let-htok-gyi	Apocynaceae
134	*Homalium tomentosum* Benth	Myauk-chaw	Flacourtiaceae
135	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae
136	*Ipomoea angustifolia* Jacq.	Not known	Convolvulaceae
137	*Ipomoea quamoclit* L.	Myet-lay-ni	Convolvulaceae
138	*Ipomoea triloba*	Not known	Convolvulaceae
139	*Justicia procumbens*L.	Not known	Acanthaceae
140	*Justicia* sp.(1)	Not known	Acanthaceae
141	*Justicia* sp.(2)	Not known	Acanthaceae
142	*Kleinhovia hospita* L.	O-tein/Pashu-phet-wun	Sterculiaceae
143	*Lagerstroemia macrocarpa* Kurz	Pyin-ma-ywet-gyi	Lythraceae
144	*Lagerstroemia parviflora* Roxb.	Zaung-pa-lae	Lythraceae
145	*Lagerstroemia speciosa* (L.) Pers.	Pyin-ma	Lythraceae
146	*Lagerstroemia tomentosa* Presl.	Lae-sa	Lythraceae
147	*Lannea coromandelica* (Houtt.) Merrr.	Na-be	Anacardiaceae
148	*Lathyrus latifolius*	Not known	Fabaceae
149	*Leea hirta* Banks	Naga-mauk-phyu	Leeaceae
150	*Leea rubra* Blume.	Naga-mauk-ni	Leeaceae
151	*Lepidagathis semiherbacea* (Clarke) Nees	Not known	Acanthaceae
152	*Leptadenia reticulata* Wight & Arn.	Gon-kha	Asclepiadaceae
153	*Lespedeza bicolor* var. *japonica*	Not known	Fabaceae
154	*Leucaena leucocephala* (Lam.) De.Wit	Baw-za-gaing	Mimosaceae
155	*Lindenbergia philippensis* Benth.	Not known	Scrophulariaceae
156	*Lindenbergia urticaefolia* Lehm.	Not known	Scrophulariaceae
157	*Loranthus pulverulentus* Wall.	Kyi-paung	Loranthaceae
158	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae
159	*Ludwigia octovalvis*	Lay-nyin-gyi	Onagraceae
160	*Luffa aegyptiaca* Mill.	Tha-but-kha	Cucurbitaceae
161	*Mallotus philippensis* (Lam.)Muell.Arg.	Taw-thi-din	Euphorbiaceae
162	*Mangifera sylvatica* Roxb.	Taung-tha-yet	Anacardiaceae
163	*Markhamia stipulata* (Wall.) Seem.ex K.Schum.	Ma-hlwa	Bignoniaceae

No.	Scientific Name	Common Name	Family Name
164	*Melanorrhoea usitata* Wall.	Sit-se	Anacardiaceae
165	*Merremia hederacea* Hallier f.	Nwe-shoke	Convolvulaceae
166	*Merremia vitifolia* (Burm.f.) Hallier. f.	Kyet-hinga-lae-new	Convolvulaceae
167	*Microcos paniculata* L.	Mya-ya	Meliaceae
168	*Millettia extensa* Benth.	Win-u	Fabaceae
169	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae
170	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae
171	*Mitragyna rotundifolia* (Roxb.) Kuntze	Bin-ga	Rubiaceae
172	*Moghania macrophylla* Runtze	Not known	Fabaceae
173	*Morinda tinctoria* Roxb.	Ni-ba-sae	Rubiaceae
174	*Mucuna pruriens* (L.)DC.	Khwe-lae-ya	Fabaceae
175	*Musa* sp.	Taw-nga-pyaw	Musaceae
176	*Nauclea orientalis* L.	Ma-u	Rubiaceae
177	*Operculina turpethum* (L.) Silva Mansa	Kyar-hin-nwe	Convolvulaceae
178	*Oroxylum indicum* (L.) Kurz.	Kyaung-sha	Bignoniaceae
179	*Oxalis corniculata* L.	Hmo-chin	Oxalidaceae
180	*Oxystelma esculentum* R.Br.	Kauk-yo-nwee	Asclepiadaceae
181	*Paederia foetida* L.	Pe-bok-nwee	Rubiaceae
182	*Pennisetum purpureum* Schum.	Yon-sa-myet	Poaceae
183	*Phoenix paludosa* Roxb.	Thin-baung	Arecaceae
184	*Phyllanthus albizzioides* (Kurz)Hook.f.	Shit-sha	Euphorbiaceae
185	*Phyllanthus emblica* L.	Zi-phyu	Euphorbiaceae
186	*Polygonum chinense* L.	Maha-gar-kyan-sit	Polygonaceae
187	*Potamogeton natans* L.	Floating-leaf Pondweed	Potamogetonaceae
188	*Prema pyramidata* Wall.	Kyun-na-lin/Kyun-pho	Verbenaceae
189	*Pseudoxytenanthera parvifolia* (Brandis ex Gamble)T.Q.Nguyen	Thaiktu-hmyintu	Poaceae
190	*Pteris vittata*	Brake Fern	Pteridaceae
191	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae
192	*Pterospermum semisagittatum* Buch.-Ham.	Na-gye	Sterculiaceae
193	*Pueraria lobata* var. *montana*	Not known	Fabaceae
194	*Ricinus communis* L.	Kyet-su	Euphorbiaceae
195	*Salvia regla*	Not known	Lamiaceae
196	*Salvia* sp.	Not known	Lamiaceae
197	*Salvia splendens*Ker Gawl.	Not known	Lamiaceae
198	*Samadera indica* Gaertn.	Ka-di	Simaroubaceae
199	*Schleichera oleosa* (Lour.) Oken	Gyo	Sapindaceae
200	*Scoparia dulcis* L.	Dana-thu-kha	Scrophulariaceae
201	*Senna hirsuta* (L.) Irwin & Barneby	Ka-thaw-hmwe-htu	Caesalpiniaceae
202	*Senna timoriensis* (DC.)(DC.) H. S. Irwin & Barneby	Taw-ma-zeli	Caesalpiniaceae
203	*Senna tora* (L.*)* Roxb	Dan-gwe	Caesalpiniaceae
204	*Sesbania paludosa* Roxb.	Nyan	Fabaceae

No.	Scientific Name	Common Name	Family Name
205	*Setaria lutescens* Hubb.	Yon-sa	Poaceae
206	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae
207	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae
208	*Sida acuta* Burm f.	Ta-byet-si	Malvaceae
209	*Smilax aspericaulis* Wall ex A. D.C.	Sein-na-baw-thay	Smilaceae
210	*Smilax macrophylla* Roxb.	Sein-na-baw-gyi	Smilaceae
211	*Spermacoce mauritiana*	Not known	Rubiaceae
212	*Spondias pinnata* (L. f.) Kurz.	Taw-gwe	Anacardiaceae
213	*Sterculia foetida* L.	Let-khok	Sterculiaceae
214	*Sterculia ornata* Wall. ex Kurz	Don-shaw	Sterculiaceae
215	*Sterculia versicolor* Wall.	Shaw-phyu	Sterculiaceae
216	*Stereospermum colais* (Buch.-Ham. ex Dillwyn) Mabb.	Than-thay	Bignoniaceae
217	*Stereospermum suaveolens* (Roxb.) DC.	Kywe-ma-gyo-lein	Bignoniaceae
218	*Strobilanthes auriculata*	Not known	Acanthaceae
219	*Strobilanthes rufescens* T. Anders.	Not known	Acanthaceae
220	*Strychnos nux-blanda* A.W. Hill	Ka-baung	Loganiaceae
221	*Tadehagi triquetrum* (L.)H. Ohashi	Lauk-thay	Fabaceae
222	*Tectona grandis* L. f.	Kyun	Verbenaceae
223	*Terminalia alata* (Heyne) Roth	Htauk-kyant	Combretaceae
224	*Terminalia pyrifolia* Kurz	Lein-pin	Combretaceae
225	*Tetrameles nudiflora* R. Br.	Baing	Datiscaceae
226	*Tetrastigma planicaule*	Not known	Vitaceae
227	*Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb.	Kyi-hnok-thi	Acanthaceae
228	*Thunbergia laurifolia* Lindl.	Kyi-hnok-thi	Acanthaceae
229	*Thyrsostachys oliveri* Gamble	Tha-net-wa	Poaceae
230	*Tinospora nudiflora* Kurz	Sin-don-ma-nwee	Menispermaceae
231	*Trema orientalis* (L.) Blume	Khwe-sha	Ulmaceae
232	*Trichosanthes cordata* Roxb.	Kyi-ah	Cucurbitaceae
233	*Tristaniopsis burmanica* (Griff.)P.G. Wilson & J.T. Waterh.	Taung-tha-bye	Myrtaceae
234	*Triumfetta bartramia* L.	Ket-si-ne-thay	Tiliaceae
235	*Urena lobata* L.	Ket-si-ne-gyi	Malvaceae
236	*Utricularia* sp.	Bladderwort	Lentibulariaceae
237	*Uvaria cordata* Schum. & Thonn.	Tha-but-gyi	Annonaceae
238	*Vangueria spinosa* Roxb.	Magyi-bauk	Rubiaceae
239	*Ventilago maderaspatana* Benth.	Ta-yaw-nyo	Rhamnaceae
240	*Vernonia arborea*	Not known	Asteraceae
241	*Vitex peduncularis* Wall.	Phet-le-zin	Verbenaceae
242	*Vitex pubescens* Vahl	Kyet-yoe	Verbenaceae
243	*Vitis discolour*	Ta-bin-taing-mya-nan-phyu	Vitaceae
244	*Vitis repens*	Ta-bin-taing-mya-nan-ni	Vitaceae
245	*Wendlandia tinctoria* DC.	Thit-ni/Hta-min-chauk	Rubiaceae

No.	Scientific Name	Common Name	Family Name
246	*Wrightia arborea* (Dennst.) Mabb.	Let-htok-thein	Apocynaceae
247	*Xylia xylocarpa* (Roxb.)Taub.	Pyin-ka-doe	Mimosaceae
248	*Zanthoxylum budrunga* Wall.	Ma-yanin-kyet-su	Rutaceae
249	*Ziziphus glabra* Roxb.	Taw-zi-nwee/Paung-bet	Rhamnaceae
250	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae

Plant Survey Documentorty of Lime Stone Area

Plant Survey Documentorty of Mud Stone Area

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Herpetofaunal Survey of the Pyinyaung Limestone Mining Area

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March 2017

Content

Introduction

Justification for the survey

From 11–12 October 2017, my team surveyed two closely proximate limestone habitats within the APACHE Cement Plant (ACP) mining area that were actively being quarried. During that survey, we found seven species of lizards and four species of frogs. Subsequent genetic and morphological analyses of those samples indicated that three of the lizard species in the family Gekkonidae were new to science: two in the Bent-toed Gecko genus *Cyrtodactylus* and one in the House Gecko genus *Hemidactylus* (Fig. 1). We hypothesized that all three species were habitat specialists restricted to limestone (karst) forests. The collection sites where the species came from are currently being mined by invasive techniques that could extirpate the populations of these three new species from these sites. Thus, it became imperative to assess the overall distribution of these species throughout as much of the Sai Taung Range as practical (Figs. 2, 3) and the mining area in order to determine their habitat specifications. In so doing, the status of other of reptiles and amphibians was also assessed.

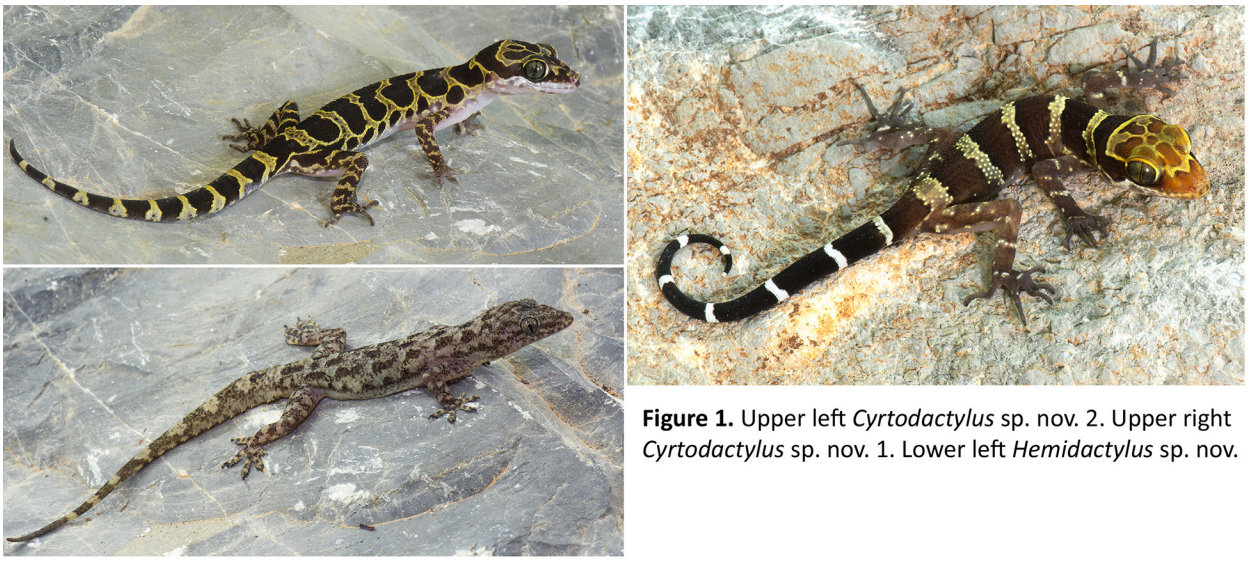

Figure 1. Upper left *Cyrtodactylus* sp. nov. 2. Upper right *Cyrtodactylus* sp. nov. 1. Lower left *Hemidactylus* sp. nov.

Apache Limestone Mine

Site Description

The ACP is situated in the Panlaung Valley which is bordered by the north-south tending limestone Sai Taung Range on the east and the mudstone hills to the west (Fig. 2). ACP is situated immediately north of the Thazi-Kalaw highway that passes through Pyinyaung Village, 3 km south Kubyin Village, 30 km east of the Tharzi Township, 45 km west of Kalaw, 150 km east of Mandalay, and 460 km north of Yangon. Although the total project area is 500.19 hectare (1236 acre), our region of study focused on much of the Sai Taung Range (Fig. 2). This range extends through the Kubyin Reserve Forest within the ecoregion of the Irrawaddy Moist Deciduous Forest, close to the Northern Indochina Subtropical Forest and is approximately 45 km in length.

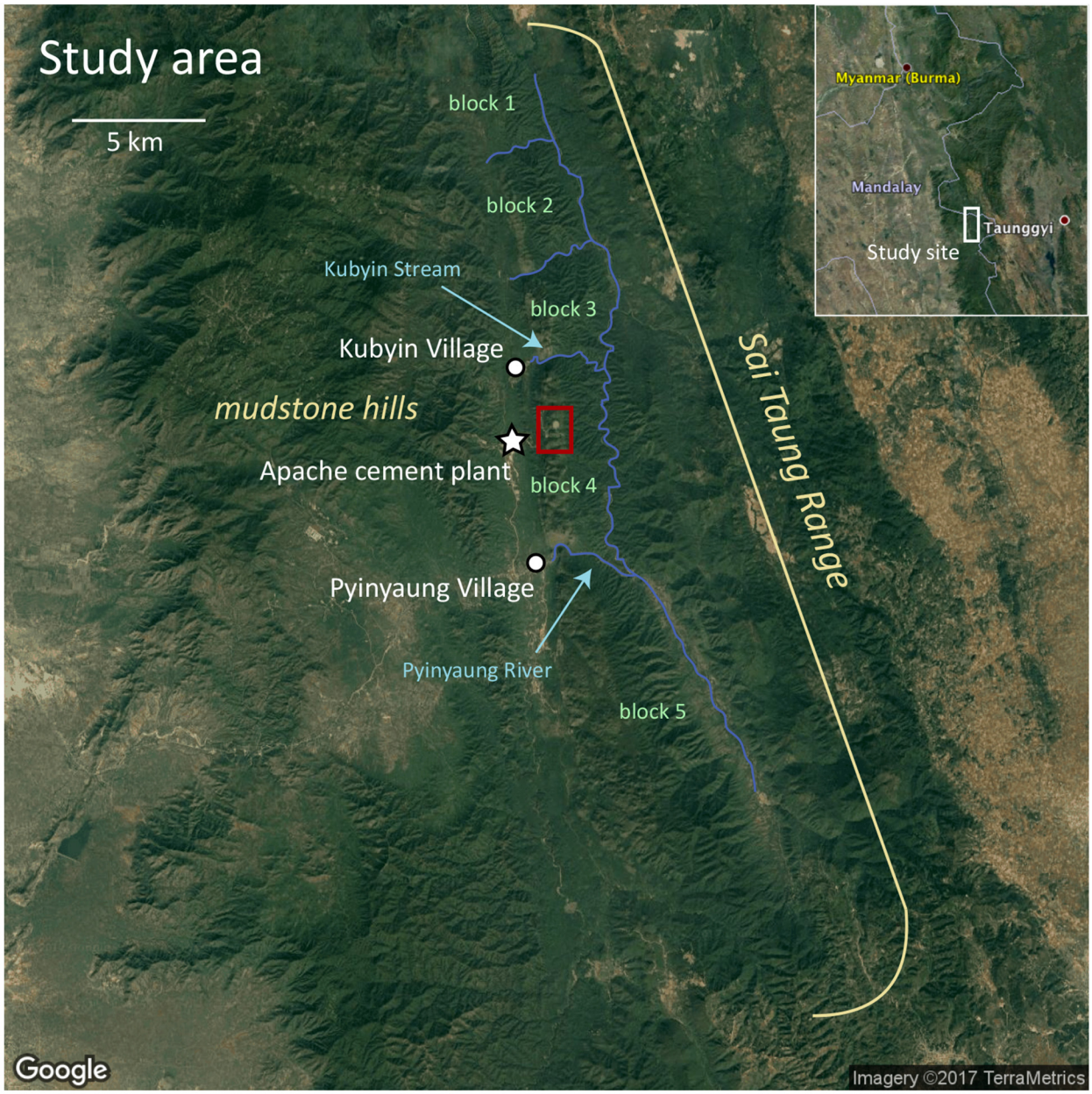

Figure 2. Location map of the Sai Taung Range showing its division into five separate blocks by the transecting river systems. Red rectangle delimits the current mining operations of the APC.

River systems divide the Sai Taung Range into five distinctive blocks. The northern three blocks (blocks 1, 2, and 3) lie north of Kubyin Village and collectively, are approximately 11 km in length. Blocks 3 and 4 are separated by the Kubyin Stream. Block 4 is contained within the APC mining area and is 8 km in length and reaches approximately 795 m in elevation and its southern border with block 5 is bounded by the Pyinyaung River. Block 5 lies southeast of Pyinyaung Village and extends for 25 km to the south. Much of this block lies within the mining concession of the Blue Diamond Cement Co. Given that the focal species are found in these blocks, river systems separating the blocks could potentially pose as effective dispersal barriers to gene flow. Therefore,

it was imperative that at least blocks 3, 4, and 5 be surveyed for the focal species. Time and inaccessibility did not permit the surveying of blocks 1 and 2.

We also concentrated on five survey sites within the mining area in order to ascertain the distribution of populations in immediate threat due to mining activities as well as one site in the mudstone mining area. These sites are mapped in Figure 3.

Methodology

Survey searches

Based on our previous survey, study areas were prioritized by selecting habitats rich in karst rocks, boulders, and cliff faces. The three new species previously discovered are nocturnal, therefore collecting was done primarily at night. Every day, new potential collecting areas were reconnaissanced along the Sai Taung Range during the morning hours from at least 8:30 am until 12 noon by 5–7 people while searching for diurnal species. This way we would know exactly where to search during the night so as to maximize the efficiency of the survey periods. Nighttime surveys were done from the hours of at least 7:30–10:30 pm after which it became too cold for reptiles to be active. Eight sites within blocks 3, 4, and 5 and one in the mudstone hills were selected for study (Table 1; Fig. 3).

Table 1. **Location and data of the March 2017 survey sites.**

Survey site	Mountain block and location	GPS coordinate	Elevation (m)	Site description
site 1	block 3, north of Kubyin Village	20.902777 N 96.403055 E	544	Exposed talus slope with small rocks and sparse vegetative cover.
Site 2	block 4, Apache Cement Co., northern site	20.882601 N 96.407110 E	653	Shallow valley with small rocks and sparse vegetative cover.
Site 3	block 4, Apache Cement Co., blast site	20.876111 N 96.408888 E	731	Deep valley with substantial vegetative cover, large karst faces and boulders.
Site 4	block 4, Apache Cement Co., upper valley site	20.869444 N 96.406111 E	721	Deep valley with substantial vegetative cover, large karst faces and boulders.
Site 5	block 4, Apache Cement Co., lower valley site	20.869444 N 96.408611 E	676	Deep valley with substantial vegetative cover, large karst faces and boulders.
Site 6	block 4, Apache Cement Co., cliff site	20.867289 N 96.404129 E	654	Flat ledge with substantial vegetative cover along the edge of a 100–150 m cliff face.
Site 7	block 5, Pyinyaung River site	20.825277 N 96.413888 E	351	Steep slope with karst cliff faces and moderate vegetative cover.
Site 8	block 5, Blue Diamond site	20.786605 N 96.412945 E	689	Exposed talus slope with small rocks and sparse vegetative cover.
site 9	mudstone hills	20.867777 N 96.374166 E	472	Exposed mudstone slopes with highly disturbed, moderate vegetative cover.

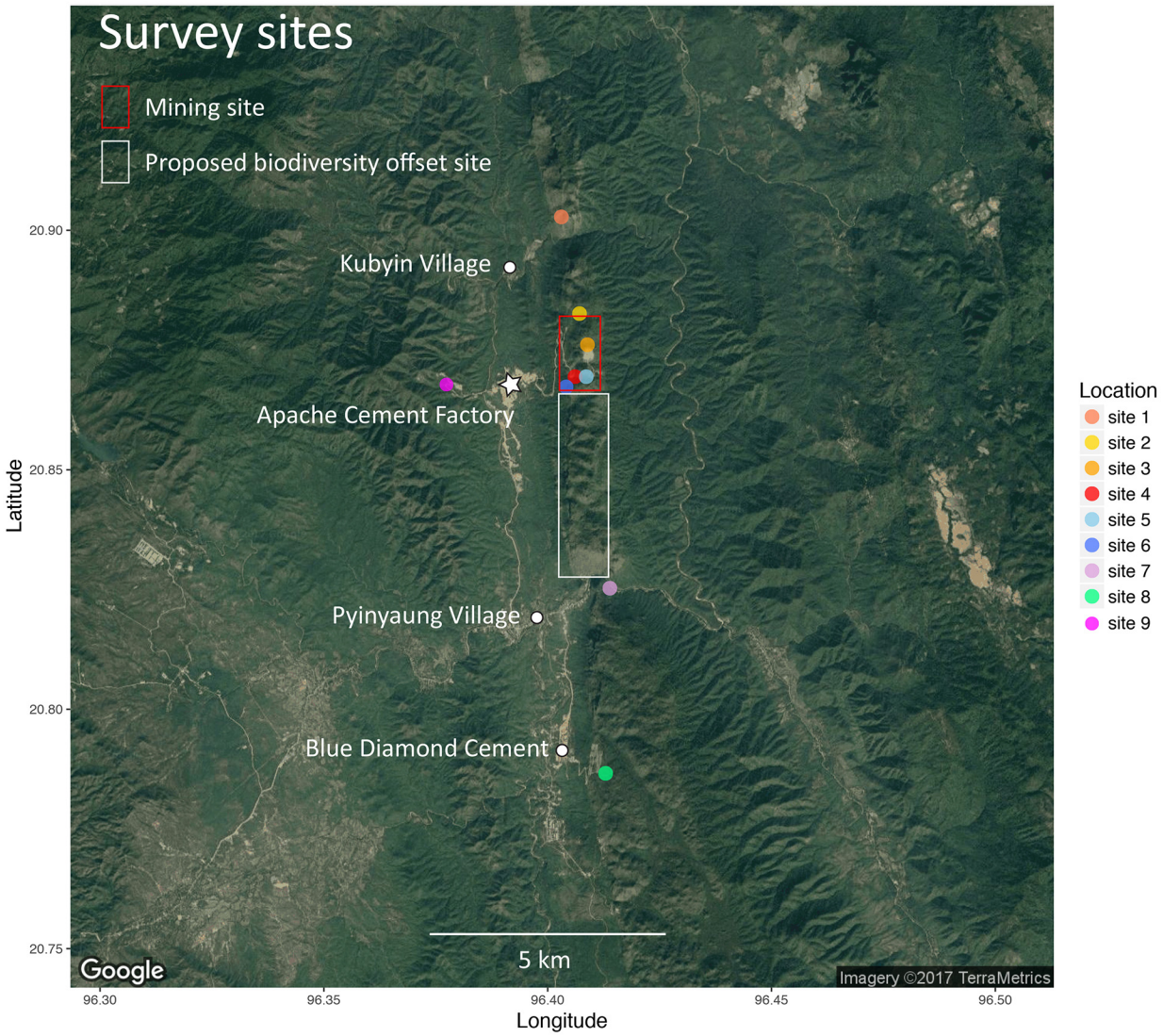

Figure 3. Location of survey sites 1–9 and proposed biodiversity offset site.

Target species

General natural history

This survey was done primarily to further assess the status and habitat requirements of the three newly discovered species of geckos: *Cyrtodactylus* sp. nov. 1, *Cyrtodactylus* sp. nov. 2, and *Hemidactylus* sp. nov. (Fig. 1). Each species was found in limestone forests along the Sai Taung Range. Threat levels of each species were assessed according to each species' occurrence and abundance throughout sites 1–9.

Cyrtodactylus sp. nov. 1

This species was found at sites 3, 5, and 6 of which the latter two sites are contiguous along the same short valley. These sites occur in disturbed, secondary, bamboo forest with varying sizes of

limestone outcroppings extending along a drainage with several smaller ravines leading into the main drainage area. The sides of each ravine are lined with limestone outcroppings with limestone boulders scattered throughout the ravine bottom. The boulders provide cliff faces that are perforated with several cracks and holes that provide ideal microhabitat structure for gekkonids (Fig. 5). These structures are utilized as retreat sites during the day in which geckos remain inactive but are used as escape sites into which geckos flee at night upon approach. Eight specimens of *Cyrtodactylus* sp. nov. 1 were seen over the course of two nights. Another specimen was found in a similar habitat at site 7. All lizards were at the base of large limestone rocks, fallen logs, or on the ground (in the case of hatchings) and would flee toward rocks when illuminated with light. It is clear that the most important component of this species' habitat are the limestone boulders.

Cyrtodactylus sp. nov. 2
A single specimen was collected at 1030 hours approximately 0.3 m above the ground on the side of a karst boulder at site 6 during the October 2016 survey. The collection site is situated at the lower end of a steeply sloping valley composed of disturbed secondary forest, scattered outcroppings of karst rocks, and shallow lateral drainages that feed into the valley floor (Fig. 5). During this survey, an adult female and a hatchling were collected on the forest floor in a narrow valley in the mudstone hills at site 9 in highly disturbed, sparsely vegetated forest bearing scattered outcroppings of small mudstone rocks. The presence of hatchings indicates that this is a viable population.

Hemidactylus sp. nov. 1
Several individuals of this species were seen throughout the Sai Taung Range at all sites. All were observed at night between 1800 and 2100 hours. Nearly all specimens were seen on karst boulders and rocks but some were also found on nearby trees, bamboo, wood plies, or on the ground. This species appears to use all substrates in its habitat. Additional specimens were collected on the forest floor among the scattered outcroppings of small rocks in the highly degraded, sparsely vegetated forest of the mudstone hills west of the cement plant. Others specimens were seen on the sides of earthen road cuts and on the large rocky face of a small, ephemeral stream.

Other species
Three species of frogs, seven species of lizards, and three species of snakes have been reported from the APC (Myint Kyaw Thura 2016). To this was added two species of amphibians and four species of lizards during the October 2016 survey and one species of frog, one species of lizard and two species of snakes were added during the current survey (Tables 2, 3; Fig. 4).

Species status and distribution
On-site observations

The genetic and morphological analyses clearly confirmed that all three gekkonid species are new to science and the manuscript reporting and naming those species has been submitted to the *Zoological Journal of the Linnean Society* (Grismer *et al.* 2017).

Cyrtodactylus sp. nov. 1

The surveys during October 2016 and March 2017 strongly suggest that this species does not range continuously throughout the Sai Taung Range but is restricted to specific habitats within that range. Specimens were found only at sites 3, 5, and 6 in block 4, and site 7 in block 5. Straight line distance between sites 3 and 7 is 5 km. These sites all share the same microhabitat structure of having extensive karst walls from 5–20 m in height extending for 20–50 m in length (Fig. 5). Most importantly, however was that these microhabitats were in areas sheltered from the sun by either dense vegetation or by being on the lower slopes or floors of east-west tending valleys that transect the Sai Taung Range. This species was not uncommon and during the March 2017 survey and five hatchings were found at site 5 indicating that the population here is still viable despite the nearby mining activities. Gene flow between the populations at different sites, however, is likely to be limited due to the intervening inappropriate habitat or in the case of site 5, the road and the Pyinyaung River. No specimens were found in the mudstone hills.

Table 2. Total number of species of amphibians and reptiles reported from three independent studies.

Taxon	Thura (2016)	Grismer et al. (2016)	This study
AMPHIBIA			
Bufonidae			
Duttaphryne melanostictus		X	
Dicroglossidae			
Limnonectes sp.		X	
Microhylidae			
Kaloula pulchra	X	X	
Microhyla berdmorei	X		
Microhyla fissipes		X	
Microhyla pulchra	X		
REPTILIA			
Lizards			
Gekkonidae			
Cyrtodactylus sp. nov. 1		X	X
Cyrtodactylus sp. nov. 2		X	
Hemidactylus brookii	X		
Hemidactylus sp. nov.	X	X	X
Gekko gecko	X	X	X
Agamidae			
Calotes versicolor	X	X	X
Calotes bachae	X		
Draco maculatus			X
Scincidae			
Eutropis macularius	X		X
Lygosoma popae		X	
Scincella reevesii		X	X
Sphenomorphus maculatus	X		X
Snakes			
Typhlopidae			
Indotyphlops braminus			X
Colubridae			
Amphiesma stolatum	X		
Dryocalamus davisonii			X
Ptyas korros	X		
Lycodon capucinus	X		X
Xenochrophis piscator	X		

Figure 4. Cumulative number of species added by each subsequent survey.

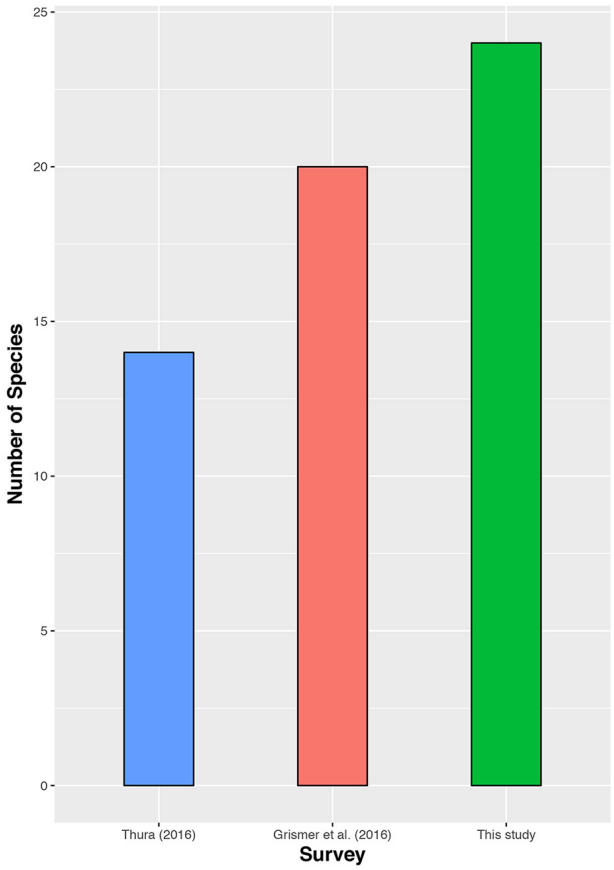

Table 3. Taxon-collection pairwise site matrix listing the species found at each survey site within the limestone mining area. site 1 = Kubyin Village; site 2 = northern site, APC; site 3 = blast site, APC; site 4 = upper valley site, APC; site 5 = lower valley site, APC; site 6 = cliff site, APC; site 7 = Pyinyaung River; site 8 = Blue Diamond; and site 9 = mudstone hills. See Figure 3 for locations.

Taxon	site 1	site 2	site 3	site 4	site 5	site 6	site 7	site 8	site 9
AMPHIBIA									
Bufonidae									
Frogs									
Duttaphryne melanostictus			X						
Dicroglossidae									
Fejevarya limnocharis									X
Limnonectes sp.			X						
Microhylidae									
Kaloula pulchra			X						
Microhyla fissipes			X						X
REPTILIA									
Lizards									
Gekkonidae									
Cyrtodactylus sp. nov. 1			X		X		X		
Cyrtodactylus sp. nov. 2						X			X
Hemidactylus sp. nov.	X	X	X	X	X	X	X	X	X
Gekko gecko	X	X	X		X	X			
Hemidactylus brookii									X
Agamidae									
Calotes versicolor	X	X	X	X	X	X		X	X
Draco maculatus								X	
Scincidae									
Eutropis macularius				X	X			X	
Lygosoma popae			X						
Scincella reevesii			X						
Sphenomorphus maculatus						X			X
Snakes									
Typhlopidae									
Indotyphlops braminus							X		
Colubridae									
Dryocalamus davisonii					X			X	
Lycodon capucinus		X			X				
Ptyas korros					X				

Cyrtodactylus sp. nov. 2

The data from this survey show that this species is not a limestone adapted species endemic to the Sai Taung Range as specimens were found in the highly degraded forest of the mudstone hills. *Cyrtodactylus* sp. nov. 2 appears to be a habitat generalist that occurs in rocky areas but is not restricted to a particular rock type as populations occur in both mudstone and limestone rocky

habitats at sites 9 and 6, respectively. The mudstone hills extend to the west at least 17 km to the eastern edge of the Aeyerwaddy Basin and extend a total of at least 55 km from north to south. It is likely that *Cyrtodactylus* sp. nov. 2 ranges throughout these hilly areas. It can be noted as well, that because of its presence at site 6 in an area composed of disturbed secondary forest with scattered outcroppings of karst rocks and not boulders (Fig. 5), it may have different habitat requirements than that of *Cyrtodactylus* sp. nov. 1 which requires areas with extensive karst walls and very large boulders. Habitat partitioning may be one way these two species reduce interspecific competition within these sheltered valleys where their distributions overlap.

Hemidactylus sp. nov. 1

This species was found at all collecting sites along an approximately 14 km straight line distance between stie 1 and site 8 in the Sai Taung Range as well as in the mudstone hills. In the Sai Taung Range, it occurred in the foothills of unsheltered sparsely vegetated talus slopes of the valley floor as well as the large cliff faces along the west facing ridges above 700 m in elevation. Nearly all specimens were seen on karst boulders or small rocks on the ground (Fig. 5) and some were found on nearby trees, bamboo, wood piles, or on the ground in bamboo leaf litter. This species utilizes all the substrates in its habitat. In the mudstone hills, *Hemidactylus* sp. nov. 1 was observed on the ground amongst small rocks (Fig. 5), on earthen banks, and on rock faces bordering a small, ephemeral stream. Based on these data, this species is considered a habitat generalist.

Figure 5. Upper left: sheltered large-boulder microhabitat of *Cyrtodactylus* sp. nov. 1 at site 5. Lower left: sheltered small-rock microhabitat of *Cyrtodactylus* sp. nov. 2 at site 6. Right: exposed degraded habitat of *Hemidactylus* sp. nov and *Cyrtodactylus* sp. nov. 2 at site 9.

Off-site observations

Two off-site surveys were conducted in Shan State along the karstic Kwaland Taung Range that parallels the Sai Taung Range 13 km to the northeast. A lowland survey (302 m in elevation) during the morning and afternoon at the Pyadalin Cave (21°07'59.6" N, 96°20'24.6" E) resulted in the rediscovery of *Cyrtodactylus chrysophylos* Bauer, 2003 but the habitat surrounding the cave which is composed of karst rocks with only a few boulders and sparse vegetative cover, is not appropriate habitat for either *Cyrtodactylus* sp. nov. 1 and as such, it is believed this species does not occur north of the Sai Taung Range. We surveyed an upland site (21°08'46.5" N, 96°25'18.0" E: 1167 m in elevation) in the foothills east of the Kwaland Taung Range, 2.5 km due west of Ywangan town during the evening of the same day. The habitat here was similar to the lowland site west of the Kwaland Taung Range with the exception that karst boulders were common and it was much higher in elevation. No *Cyrtodactylus* were found and it is believed that *Cyrtodactylus* sp. nov. 1 and *Cyrtodactylus* sp. nov. 2 do not occur at this site. However, new species of the gekkonids *Hemiphyllodactylus* and *Hemidactylus* were found. *Hemidactylus* sp. nov. of the Sai Taung Range and mudstone hills appears to be replaced by the ecologically similar new species of *Hemidactylus* in the Kwaland Taung Range. At this point, it is thusly concluded that the three new species found at the APC most likely do not occur in the limestone areas of the Kwaland Taung Range or it foothills. Additional off-site will be needed to confirm this.

Identified threats

It is determined here, that only the new species of gecko *Cyrtodactylus* sp. nov. 1 is restricted to a specific limestone habitat in the Sai Taung Range where it is likely to be endemic. The forest habitat in this range has been heavily degraded and we could find no large trees. Much of the current vegetation is brushy secondary growth and bamboo that is burned off annually when fires can last for weeks at a time during the early months of the year. Logging and bamboo collection takes a heavy toll on the forest habitat throughout the study area and all the Sai Taung Range. Heavy forest degradation in the sheltered valleys could affect the overall viability of *Cyrtodactylus* sp. nov. 1 as it requires vegetative cover above its limestone microhabitat wherein it shelters, lays eggs (evidenced by finding eggs in rock cracks), and forages for food. The primary threat to the *Cyrtodactylus* sp. nov. 1 is the nearby mining at sites 3, 5, and 6. If this reaches into the sheltered valleys where this species resides, it will irrevocably alter its habitat unihabitable. A secondary threat would be the logging and burning of the forest cover that shelters its limestone microhabitat.

At this juncture, there is no primary or secondary threats to *Cyrtodactylus* sp. nov. 2 and *Hemidactylus* sp. nov. along the Sai Taung Range as these species appear to be habitat generalists and are found outside the mining area (certain for *Hemidactylus* sp. nov. and most likely for *Cyrtodactylus* sp. nov. 2). In the mudstone area, the primary threat to these two species would be mining operations that obliterate the habitat. The cutting of the forest and its annual burning appears to pose no threat to these species as both were prevalent in areas where these activities were currently taking place at the time of collection.

Recommendations for reduction and mitigation of threats and biodiversity offset

Preventing the burning of vegetation in the sheltered valleys wherein *Cyrtodactylus* sp. nov. 1 occurs would reduce the threat of degrading the suitability of its forest cover. Also, not mining the limestone in these areas will prevent the extirpation of this species from these sites. It is recommended in this report that at least a 5 km^2 (= 500 ha; 247 acres) area containing the appropriate forested valleys bearing large limestone walls at elevations between 300–750 meters along the Sai Taung Range between sites 4 and 5 be set aside as a biodiversity offset plan for *Cyrtodactylus* sp. nov. 1 (Fig. 3). Setting aside this area would be valuable towards this species' conservation and would not interrupt current mining operations. This species was not found in any of the mining concessions to the south in block 5, but from the inspection of satellite images, there does appear to be suitable habitat along these higher elevation valleys as well that could be considered as biodiversity offset sites in the future.

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Potential *Endemic* and *Restricted Range* plant species in and around the Shwe Taung Cement (=Apache Cement) concession between Pyinyaung and Kubyin, Mandalay Province, Myanmar.

J.J. Vermeulen & K. Anker

25/08/2017

Contents

1. Major conclusions

In view of the limited available time, and of the floristic wealth of the region, we apply a three-step strategy to find plant species which would be significantly threatened by the APACHE quarry:

1. We estimate the general probability that such species occur, based on biological and environmental properties of limestone-restricted plant species in the region, and the distribution of limestone in the region.
2. We check the 216 plant species listed in the Sept. 2014 report for such species (*Report On Environmental And Social Impact Assessment For The Apache Cement Plant, Thazi Township, Mandalay Region - Appendix c.: Shwe Taung Cement Factory Project Flora Report* – Chapter 5.2.2.12: p 24-29).
3. In the field, we search for such species; we document these and, if possible, contact a specialist for further assessment.

1.1. General probability that species occur which will be threatened by the APACHE quarry

See our report: *Probability of the presence of plant species which require mitigating or offsetting measures in the APACHE concession* (May 2017).

1.2. Species on the 2014 list which may be threatened by the APACHE quarry

The list includes 216 species (see *Appendix 1*), mainly trees and shrubs. Most are widespread and will not suffer significantly from the quarrying operation. Two species may require measures to avoid net biodiversity loss:

72 *Dalbergia oliveri* (Fabaceae)
IUCN Red List: EN A1cd.
A widespread species, but declining in numbers because of logging for its valuable timber.
Possible action: see Chapter 4.5 of Vermeulen & Anker (2017b).

94 *Firmiana kerrii* (Sterculiaceae)
Not Red-listed by IUCN.
Probably a regional-endemic species (Shan Plateau and adjacent Thailand), restricted to limestone areas and apparently rare (at least in Thailand).
Possible action: It is advisable to see how the Pyinyaung limestone range population of the species would be impacted if the concession is quarried to its limit. If this would destroy a significant part of the population, enrichment planting of this tree species in the offset area is an option. We were not able to spot this species with certainty; young specimens seen probably are another species of the same genus.

1.3. Species found during the August 2017 survey which may be threatened by the APACHE quarry

We documented some 70 species (see *Appendix 3*), mainly herbaceous plants. We found a single species that may require measures to avoid net biodiversity loss:

***Impatiens* sp., probably new to science (Balsaminaceae)** (Picture: *Appendix 5*)
Range Site Category: 2 or 3 (Local-endemic or Regional-endemic).
We found the species only in two places within the concession. With its exploding fruits, it is probably a good disperser, and its preferred habitat (rock crevices in exposed places on limestone peaks) is widespread on the range, and seems not to put constraints on its distribution. Therefore, it is likely that it occurs over most of the Pyinyaung limestone range (Cat. 2), possibly including adjacent ranges (Cat. 3).
Possible action: It is advisable to establish its occurrence outside the concession area.

1.4. Vegetation quality increase towards the north

The least disturbed forest type on the carbonate (i.e. limestone and dolomite) bedrock on the range contains most of the biodiversity values. This *Moderately Disturbed Forest* (MDF) is worthy of protection. So are the gorges cutting through the range in various places, and the north-facing slopes bordering these; they harbor a biodiversity which differs from that in the MDF.

Generally, the distribution of MDF is inverted proportional to the population pressure and industrial activity in the surroundings. Towards the South, in sector E (see *Appendix 4*, also see *map 3a* of our previous report), only patches remain. In sector D, it is still present south of the APACHE concession, but the largest stretches of MDF can be found in sector C, B, and A. In these sectors, it reaches low down along the mountain flanks, to the topographic base of the carbonate rock (limestone and dolomite).

From a biological-evolutionary point of view, site-endemic and local-endemic species are most likely to be found in the northern part of the range. There, geographical isolation of populations of species, one of the underlying causes of limestone biodiversity and endemism, is most effective.

This leads to the conclusion that the northern part of the Pyinyaung limestone range is likely to be most suitable area for offsetting purposes.

More detailed investigation may bring to light that the altitudinal range is relevant: differences in species composition with increasing altitude may be found. *Impatiens* sp.n. (Balsaminac., see *Appendix 3* and *5*) may be an example of a species which is restricted to the upper zone of the range.

We found no indicators that a major gradient in species composition is present in the MDF from north to south. Some species, however, seem to have a very patchy distribution.

2. Introduction

The survey is conducted for ERM (Environmental Resource Management), Thailand office (David Nicholson), acting as consultant for Shwe Taung Development (APACHE CEMENT).

APACHE needs to assess the impact on the local biodiversity of their limestone quarry between Pyinyaung and Kubyin, Mandalay Province, Myanmar, following the conditions on biodiversity conservation in IFC PS6 (2012).

In this context, the company wishes us to explore the possibility that, on the quarry site as well as pre-selected potential offset sites, plant species occur that would trigger Criterion 2 (Endemic or Restricted Range Species; in IFC Updated GN6, 2012).

For a site, IFC Updated GN6, 2012, defines Criterion 2: the presence of Endemic (E) or Restricted Range (RR) Species on the site. The definition of E and RR species is different for various groups of organisms.

For plants:

- *'An endemic species is defined as one that has ≥ 95 percent of its global range inside the country or region of analysis'. (GN79).*
- *'For plants, restricted-range species may be listed as part of national legislation. Plants are more commonly referred to as "endemic," and the definition provided in paragraph GN79 would apply'. (GN80).*

These guidelines are not strict, and, apparently, for plants they make no distinction between (E) and (RR) species. The probable reason that the term '*Endemic*' for plants is tied to larger geographical units ('*region*' and '*country*'), is that relatively few plant species have a distribution so limited that a single quarrying operation could threaten their continued existence.

Also, the categories (E) and (RR) seem not suitable to identify plant species with a range so small that quarrying the concession to its limit would trigger one of the criteria VU, EN or CR, if they were IUCN-Red Listed.

Nevertheless, such plant species exist, and we need a categorization to identify them.

2.1. Range Size Categories

To identify potential species that would suffer a significant range reduction because of the APACHE quarry, we apply the following range size categories, adapted from Vermeulen & Whitten (1999: 14):

- **(Cat. 1)** *A* ***SITE-ENDEMIC*** species has a range of up to about 100 km. *For this survey:* ***a plant species occurring restricted to the quarry concession and immediately adjacent parts of the Pyinyaung limestone range (see map of Appendix 4), to such extent that quarrying the concession would trigger the IUCN criteria EN, or CR if it were Red Listed.***
- **(Cat. 2)** A ***LOCAL-ENDEMIC*** species has a range covering 100 to 10.000 km^2. *For this survey:* ***a plant species occurring restricted to the limestone range bordering the Shan Plateau (see map of Appendix 4, sectors A to F)***. ***Depending on distribution patterns, quarrying the concession might trigger the IUCN criterion VU if it were***

Red Listed. This also includes the IFC categories (E) and (RR), as far as these refer to 'region of analysis'.

- **(Cat. 3)** A ***REGIONAL-ENDEMIC*** species has a range covering 10.000 to 100.000 km^2. *For this survey:* ***a plant species restricted to the central part of Myanmar, East of the Irawaddy River, and including the adjacent mountain ranges of Laos, and Thailand. This also includes the IFC categories (E) and (RR) as far as they speak of 'region of analysis'. Occasional Cat. 3 species may be so rare within their range, or occur in such small numbers that eradication of a population in the quarry may trigger the IUCN criterion VU or NT if they were Red Listed.***
- **(Cat. 4)** A ***WIDESPREAD*** species has a range covering more than1000.000 km^2. *Here, the term is used for* ***species that occur beyond the range outlined under (Cat. 3, usually in large parts of India, Indochina, and/or southern China****.*
- **(Cat. 5)** An ***INTRODUCED*** species (introduced by humans) does not add to the biodiversity value of a hill, but is often indicative of environmental disturbance.

Next to these categories, we look out for plants that are IUCN Red Listed as VU, EN, or CR, as well as for CITES listed on Appendix 1.

CITES regulates trade in species; protection is no primary goal. Nevertheless, Appendix 1 includes species that have suffered so much decline because of wild-collecting for trade, that measures to prevent further decline would be appropriate if they are found in the concession.

2.2. Limitations

The taxonomic exploration of the Flora of a country needs to have reached certain levels of completeness before we can identify plant species with reasonable certainty. In Myanmar, the botanical exploration is still very incomplete: the first steps along the path towards a comprehensive description of the Flora have recently resulted in a partly critical checklist of species (see: http://botany.si.edu/myanmar).

Next to this, representative botanical exploration, even if restricted to only the hill range in which the quarry is situated, is well beyond the scope of this survey.

Therefore, we apply a strategy to find, with considerable margins of error, potential local-endemic, site-endemic, or otherwise relevant plant species.

2.3 Applied strategy

Given the very limited time available, we apply a three-pronged strategy:

1. We estimate the general likelihood that species of Cat. 1, 2, and 3 occur, based on general patterns of distribution of limestone-restricted plant species in the region, in combination with the general distribution of limestone bedrock in the area. **See our report:** ***Probability of the presence of plant species which require mitigating or offsetting measures in the APACHE concession*** (Vermeulen & Anker, 2017b).

2. We categorize the 216 species of plants (mainly trees and shrubs) listed in the report: *Report on Environmental and Social Impact Assessment For The Apache Cement Plant, Thazi Township, Mandalay Region - Appendix c.: Shwe Taung Cement Factory Project Flora Report* – Chapter 5.2.2.12: p 24-29 (Sept. 2014) (anon. 2014). **See Chapter 3 of this report**.

All widespread (Cat. 4) and introduced (Cat. 5) species listed in this report are excluded from further enquiries. Potentially interesting species are included in the field survey, under 3.

3. During a field survey, we search the concession area as well as potential offset sites for (mainly herbaceous) plant species that belong to selected plant families which, elsewhere, are known for frequent limestone endemism among their species. We document these species (photographs, Schweinfurth material for herbarium), and we check for each species found in the concession if it occurs in the offset areas as well. We also try to find and document species that have emerged from the existing list of plant species as relevant. **See Chapter 4 of this report**.

Documented species which are only found in the concession area and not elsewhere, are listed as potentially site-endemic or local-endemic species. Before listing, however, we check biological properties of the species and its habitat requirements. For example, a species with adaptations on its seeds to be dispersed by the wind, is highly unlikely to be a site endemic, even if we cannot prove its presence outside the concession.

For identification and assessment of documented species, we will immediately approach a specialist for that group of plants (if available!), and send him photographs.

3. Assessment of species listed in the 2014 species list

This is step 2 in the strategy proposed in Chapter 2.3.

Using the range size categories explained in chapter 2.1, we apportion to categories the 216 plant species (mainly trees and shrubs) listed in Anon. 2014; see Appendix 1.

Species which may be relevant (name printed bold in the list in Appendix 1) are:

70 *Dalbergia cultrata* Grah. (Fabaceae)
Range Site Category: 4 (widespread: Cambodia, China (Yunnan province), Laos, Myanmar, Thailand, Vietnam; introduced to India).
IUCN Red List: NT
'Botanical exploration in Myanmar' (accessed July 2017): widespread.
The species is 'very common in open, fire-prone areas, often shrubby and coppicing' in northern Thailand (Gardner, 2000). This suggests a very resilient species in degraded land; nevertheless, its numbers are dwindling because of over-exploitation for its good timber, and because of habitat fragmentation (IUCN Red List).
Possible action: It seems unlikely that the APACHE quarry seriously impacts the species.

71 *Dalbergia kurzii* Prain (Fabaceae)
Range Size Category: 3? (Regional-endemic?)
Found in the central and central-west part of Myanmar (Bago, Chin, Yangon, 'Botanical exploration in Myanmar', accessed July 2017. A single record from adjacent Thailand (Doi Sutep) in the Aberdeen University Herbarium, Thai Collection: http://www.abdthaitypes.com/dalbergia/.

However, its taxonomic status is not entirely resolved: by some it is regarded as a variety of the common and widespread (Myanmar, Laos, northern Thailand) *D. cana* Grah. ex Benth. (IUCN Red List: LC).
Possible action: It seems unlikely that the APACHE quarry seriously impacts the taxon.

72 *Dalbergia oliveri* Gamble (Fabaceae)
Range Site Category: 4 (Widespread: Myanmar, Thailand, Vietnam)
IUCN Red List: EN A1cd.
'Common, semi-open forests but avoiding very degraded areas' in northern Thailand (Gardner et al., 2000); central part of Myanmar ('Bago, Mandalay': 'Botanical exploration in Myanmar', accessed July 2017).
Not a limestone-restricted species; it is found scattered in dense evergreen and semi-deciduous forest up to 1,200 m. The species is over-exploited for its high-quality timber (IUCN Red List).
Possible action: see Chapter 4.5 of Vermeulen & Anker (2017b).

94 *Firmiana kerrii* (Sterculiaceae)
Range Site Category: 3 or 4 (Regional-endemic or Widespread).
'Rare; open areas on limestone' in Northern Thailand (Gardner et al., 2000); not listed in 'Botanical exploration in Myanmar' (accessed July 2017).
The single Myanmar record from the Pyinyaung limestone Range suggests that Gardner's assessment is correct. The species may be endemic to the Shan Plateau and adjacent mountain ranges in Thailand.
Possible action: It is advisable to see how the Pyinyaung limestone range population of the species would be impacted if the concession is quarried to its limit. If this would destroy a significant part of the population, enrichment planting of this tree species in the offset area is an option.

194 *Terminalia oliveri* (Combretaceae)
Range Site Category: 3? (Regional-endemic?).
Central, northwest and west Myanmar (Magway, Mandalay, Sagaing: 'Botanical exploration in Myanmar', accessed July 2017).
Probably also native at least in adjacent India, although we can only find a record in a list of indigenous drugs in India (Chopra et al, 1933).
Possible action: It seems unlikely that the APACHE quarry seriously impacts the species.

4. The field survey, August 2017
This is step 3 in the strategy proposed in Chapter 2.3.

4.1. methods
The survey concentrates on herbaceous species which are not on the 2014 species list mentioned above, and which belong to selected plant families. Elsewhere, these families include a high percentage of site-endemic or local-endemic species.

- **Acanthaceae**. Some limestone endemic species, next to widespread and even weedy species.

- **Araceae** (Arum lilies). Particularly the genus *Amorphophallus* and smaller, herbaceous species.
- **Balsaminaceae**. A family with numerous limestone endemic species.
- **Begoniaceae**. A family with numerous limestone endemic species.
- **Commelinaceae**. Some limestone endemic species, next to widespread and even weedy species.
- **Cycadaceae**. Modern taxonomy distinguishes many endemic species
- **Gesneriaceae**. Various genera with limestone endemic species.
- **Liliaceae** sensu lato. Some genera with limestone endemic species, next to widespread species.
- **Orchidaceae**. Particularly the genus *Paphiopedilum* (Slipper orchids) includes numerous endemic species.

We document potentially endemic species of these families with photographs, taken according to standards so that they are optimally suitable for identification purposes. We also take herbarium material for permanent storage, and to make possible formal description of species, later.

We also collect herbarium because we consider that this part of the range will disappear forever, and that some permanent documentation of the local Flora is therefore in order. In fact, emergency collecting should be obligatory in potentially high-biodiversity areas under threat of destruction; just as emergency excavation is obligatory if archaeological remains are found on a building site.

We need to consult scientists specializing in plant groups for identification of the most interesting species, and of species which are present in the concession area, but which we cannot find elsewhere. To encourage a quick and inspired provisional identification, we email photographs before completing the survey. Sending herbarium specimens by mail would not work: busy as many specialists are with university duties, they may eventually identify our herbarium specimens but, more likely, they add them to a pile of specimens for later study.

However, a specialist who receives an email with pictures representing a rare or new species will reply quickly when he realizes that somebody out in a remote area has collected specimens and is prepared to make these available to him for study, including, if necessary, formal description of the species. Herbarium material, after all, is still obligatory for this.

If the specialist returns a positive identification, or if he has seen the species before without being able to identify it, we can establish its status (widespread, local-endemic or site-endemic) more reliably. If the specialist has never seen the species before, we categorize it as a potential local-endemic, or as site-endemic, depending on the distribution of the habitat favored by the species, and on its biological properties.

See *Appendix 6* for a list of specialists who have contributed to this report.

Herbarium material will be stored at L (Naturalis, Leiden, the Netherlands), from where it can be requested on loan by specialists (not as a part of the survey). We will add a label to the specimens requesting to communicate new identifications etc. with us.

We will make herbarium specimens with the Schweinfurth method: during the survey, the specimens are stored in newspaper folders soaked in alcohol 70%. This will preserve the specimens until we are home again, where we dry the specimens in plant stoves, or permanently store parts in alcohol, following the wishes of specialists. No bulky equipment like plant presses or stoves are needed during the survey; Ziploc-bags, sheets of newspaper and some alcohol are sufficient.

Plants that do not flower during our visit are in most cases only recognizable down to family level, and useless for our goal. By necessity, our dataset will be limited to plants flowering during our short visit. We will miss relevant species occurring in numbers, but not flowering at the time. If not-flowering, but possibly relevant species come to our attention, we will list them for later investigation. In some cases, we take propagules (cuttings, or tubers), to be sent to a specialist for the plant group for cultivation.

We also add to our dataset the plant species observed or photographed on the same localities we visited now, or nearby these localities, during our earlier visit of the area.

4.2. Where we collected

During the survey, we visited localities in the concession as well as in potential offset areas:

DAY	LOCALITY	ALT	LAT	NOTES
1	STC-APACHE concession, S-side	700-750	20°52'17.39"N 96°24'31.02"E	Small peak in limestone crest. Slopes rocky, with somewhat degraded forest, with undergrowth of bamboo thickets
2	STC-APACHE concession, NE-flank	600-700	20°52'36.04"N 96°24'30.81"E	Steep, rocky limestone slope with rather high forest, somewhat degraded by selective logging. Varied herbaceaous flora on forest floor, between rocks
3	Just N of STC-APACHE concession, transverse depression through limestone ridge	700-750	20°52'55.69"N 96°24'27.91"E	Transverse depression through limestone ridge. N and E facing slopes on dolomite and limestone bedrock, with vegetation degraded by logging and fire, largely consisting of bamboo thickets.
4	Limestone gorge East of Kubyin village	c. 300	20°53'56.34"N 96°24'22.05"E	Gorge through limestone range. Rocky woodland above river bed.
5	W flank of limestone range near gorge c. 4.5 km N of Kubyin village		20°55'39.45"N 96°23'43.38"E	Rocky limestone slope with degraded teak woodland, immediately SW of gorge

See also the map in *Appendix 2*. Our primary task was to find potential site-endemic and local-endemic species. We worked as follows:

On day 1 and 2, we visited sites in the concession. We listed, collected, and documented as many as possible potentially interesting species in flower. We prioritized families in chapter 4.1, but in between we took every flowering undergrowth and herbaceous species catching our attention because it did not look like some ordinary roadside weed. This yielded a list of

documented –and memorized- species. We could identify some species down to family or genus level, others we could not, but in the process a partial name only becomes important if the species is marked as a potential endemic.

On day 3*,* we visited an area immediately North of the concession, with a vegetation thoroughly degraded by logging and burning, and largely consisting of bamboo thickets. On the list of species documented during day 1 and 2, we generally deleted as potentials all the species that we found again in this degraded vegetation (marked 'deg' in the table in Appendix 3), unless we found positive reasons to retain a species as a potential.

We reason that most species with an environmental amplitude large enough to effectively spread in an area so degraded, has at least some weedy properties, is less likely to be dependent on limestone environment for its survival, and therefore is less likely to be a local-endemic or site-endemic species. We carefully distinguished between the degraded land, and the occasional rock outcrop on the site with a small remnant of less degraded vegetation.

There is reason for caution here. Limestone restricted species may occasionally flourish well away from their natural habitat. For instance, *Begonia augustinei* is found along the road leading to the quarry, germinating in numbers on recently cut roadsides. It will survive there until it is competed out by fast growing roadside weeds.

At the end of day 3, I sent images of potentially endemic species to specialists.

On day 4, we visited the Kubyin Gorge, well north of the concession, and with a different type of vegetation. Hoping to find more potential endemics, we examined the damp limestone rocks just above the stream bed, and, again, ticked off the species we met on our list. We also added species.

This should have concluded our field work but, at that time, principal asked if we could examine the woodlands further north, with regard to the possibility that an offsetting area would have to be selected in that part of the range.

We were to investigate if the forest in the north generally resembles that in the concession, so that selection of an offsetting site in the north would optimally reduce net loss of biodiversity because of the quarrying.

On day 5, therefore, we went by lorry, the only vehicle capable to negotiate the dreadful, monsoon-drenched tracks north of Kubyin, to the gorge 4.5 km north of that village, in the hope to find an entrance to the forest on the limestone slopes. Again, we used our list to tick off the species we found, and documented species we had not seen before.

4.3. List of species documented in the field

See *Appendix 3*. We collected and documented some 70 species.

Marked *pale orange* are species which, intially, we marked as potentially interesting, but which, after finding them in degraded vegetation on day 3, 4, or 5, or after an appreciation by a specialist, could be excluded from our investigations.

Marked *orange* are species that are still seen as potentially interesting, in the sense that they may be affected by the APACHE quarrying enterprise, pending further investigation, or appreciation of a specialist.

Notes with species which are marked orange:

***Koyamasia calcarea* (Asteraceae)** (Picture: Appendix 5)
Range Size Category: 3 (Regional-endemic).
We found the species in the concession, flowering luxuriantly in soil-filled crevices in limestone rocks recently exposed by removal of the vegetation. We also found plants in dense limestone forest north of Kubyin.
So far, the species is known from a single locality in northern Thailand (Chiangdao Wildlife Reserve, on limestone). It is not listed in the Checklist for the Flora of Myanmar, nor in the Flora of China. It is potentially a regional-endemic, limestone restricted species, and it may be rare.
Possible action: The species probably occurs scattered over the Pyinyaung limestone range, and is therefore unlikely to be significantly impacted by the APACHE quarry.

***Impatiens* sp., probably new to science (Balsaminaceae)** (Picture: *Appendix 5*)
Range Size Category: 2 or 3 (Local-endemic or Regional-endemic).
We found the species only in two places in the concession as an annual on rocky hilltops, growing in exposed or half-shaded crevices with small soil deposits. We did not find it in severely degraded environment, although it germinates and flowers in soil deposits scattered around by the opening the new quarry to the South. As soon as ordinary roadside weeds settle, it disappears. As in all *Impatiens*, the fruit explodes at the slightest touch when mature, and seeds fly around. It must be a reasonably good disperser, and the chances that the species occurs restricted to the concession are small. Also, it is unlikely that the preferred habitat limits its distribution. More likely, it occurs over most of the Pyinyaung limestone range (Cat. 2), possibly including adjacent ranges (Cat. 3).
Possible action: It is advisable to establish its occurrence outside the concession area.

***Boesenbergia kerrii* (Zingibergaceae)** (Picture: *Appendix 5*)
Range Size Category: 3 (Regional-endemic).
Known from Myanmar and Thailand. We found the species in moderately degraded forest but also in wooded roadsides and plantations with young teak trees; apparently it is tolerant to disturbance.
The taxonomy around the species is unresolved; it may be part of a unresolved species complex which, as a whole, is widespread.
Possible action: *B. kerrii*, as a discrete taxon, is unlikely to be impacted by the APACHE quarry, because it survives and spreads easily in degraded woodland.

***Curcuma cordata* (Zingiberaceae**) (Picture: *Appendix 5*)
Range Size Category 3 or 4 (Regional-endemic or Widespread).
Known from Myanmar and adjacent Thailand. May be Range Size Category 3, but the taxon is part of an unresolved species complex.
We found the species in abundance in and around the concession, in moderately degraded forest, but also in teak plantations and degraded bamboo woodland.

Possible action: It is unlikely that the APACHE quarry seriously impacts the species.

***Curcuma myanmarensis* (Zingibergaceae)** (Picture: *Appendix 5*)
Range Size Category: 3 (Regional-endemic).
Only known from Myanmar, Mandalay Div., townships Dhazi, Pyin-Oo-Lwin and Thabeikyin. We found the species in moderately degraded forest but also in wooded roadsides and plantations with young teak trees; apparently it is tolerant to disturbance.
Possible action: Because it survives and spread easily in degraded woodland, it seems unlikely that the APACHE quarry seriously impacts the species.

Next to that, we note one species outside the concession, in Kubyin Gorge:

Canscora helferiana (Gentianaceae) (Picture: *Appendix 5*)
Range Size Category: 3 (Regional-endemic).
Known from Myanmar and Thailand, but its occurrence is highly localized, with only 3 localities known (Ubolcholaket, undated). Probably, it occurs very localized because of its habitat requirements: permanently damp places in limestone areas (Ubolcholaket: 'In crevices of limestone cliffs and on damp limestone rock'). Unfortunately, no detailed information is available on the species. We note it, because the species and the habitat in which it grows may be an element of worth in the future offset area.

Finally, we sent propagules (tubers) of potentially endemic aroid species (*Amorphophallus, Arisaema*, marked pale green in the species list) to a specialist for cultivation. Their status will be established, hopefully, within one or two years.

4.4. Offsetting projects

4.4.1. Moderately Disturbed Forest

We have seen no pristine forest in in Pyinyaung Limestone Range. Logging has left traces everywhere. Even in remote parts we find sawn-off stumps and remnants of sawn timber. The logging was, and is, done by local people, not by large companies. Trees are felled, and sawn up into planks on the spot, which are then dragged down narrow skidding tracks. There is no removal of biomass from the forest other than the sawn planks. The structure of the forest sustains minimal damage, and little soil is so churned up that it washes off. If done with future income in mind, and in combination with replacement planting, this logging comes close to being sustainable.

However, after taking the first cut of hardwood, people go in again for second-choice timber and firewood. The latter is used for household purposes, but also, in large quantities, to fire lime kilns around Pyinyaung village and further south. Also, small fires are often laid in the undergrowth to 'chase out the snakes'. As a result, little by little, the forest is depleted, and replaced by bamboo vegetation.

The least disturbed forests have a more or less closed tree canopy and only minor presence of bamboo. This is best seen during the wet season, when the foliage of the deciduous trees covers the evergreen bamboo in the undergrowth. During the dry season, the trees are leafless and the bamboo is the most conspicuous green. The forest floor (again, only in the wet season) has a varied herbaceous vegetation. This consists of species which we found in

the forest only, next to a suite of more weedy species which, judging from their occurrrence in heavily degraded bamboo vegetation, have a larger ecological amplitude. Grasses are virtually absent in these forests except for a few, often broad-leafed forest species. In the tree crowns, particularly of medium-sized Teak trees, an epiphytic flora is locally present: probably a few tens of orchid species, and ferns like *Platycerium*. Generally, epiphytic orchids do not survive in truly degraded woodland; the presence of saome 10 species on one location (sector C, *location 2017.10* of our previous report, data added to the nearby locality *Day 5* of the present survey) indicates a degree of maturity of the woodland.

This forest type contains most of the biodiversity value in the area. In spite of the selective logging, these values are still intact. For short, we call it ***Moderately Disturbed Forest*** (**MDF**); and it is worthy of protection.

4.4.2. The gorges through the limestone range

We visited Kubyin Gorge and the gorge 4.5 km north of Kubyin. Based on our list of flowering species, we found a flora of somewhat different composition on the north-facing slopes towards the gorges.

The gorges themselves have, of course, a very different vegetation. The limestone rocks at, and somewhat above flood level, are home to some small herbs typical for the environment, and, considering their habitat requirements, probably rare in the area (*Canscora helferiana*, Gentian., see species list). In the stream bed, we found two species of shrub adapted to flooding (rheophytes): *Homonoia ripar*ia (Euphorb.), and another, unidentified, which we could not spot in stream beds outside the gorge.

Both gorges and their immediate surroundings harbor biodiversity different from that in the MDF. They are also the most spectacular elements in the local landscape. They, too, are worthy of protection.

4.4.3. Land suitable for offsetting purposes

After roughly identifying the most valuable vegetation types in the area, we look at their distribution. We use the division of the Pyinyaung limestone range in sectors A to F, see *Appendix 4*.

The distribution of MDF is inverted proportional to the population pressure and industrial activity in the surroundings. Towards the South (sector E), it is remaining only on the steeper slopes, and has largely disappeared in the southern part of the sector (all observed from the west flank of the range). In sector D, it is still present south of the APACHE concession, but the largest stretches can be found in sector C, and further north in sectors B and A (Google Earth). In these sectors, it reaches down to the foot of the carbonate rock (limestone and dolomite).

With our list of flowering species in hand, we compared the MDF on the hills in the concession (sector D) with the MDF of a west-facing limestone cliff about 4 km north of Kubyin (sector C, north end). We found that the flora on the sites is essentially similar in general aspect, although species seem to have a rather patchy distribution, which can probably be explained by their habitat requirements.

4.4.4. Possibly higher rates of endemism in the north part of the limestone range

If, as explained in our previous report, spatial isolation of populations of species is instrumental to the frequent occurrence of narrow-endemic species in limestone areas, the northern part of the Pyinyaung range qualifies as the area potentially richest in endemic species. There, after some 30 km running parallel to the nearrest limestone range at a distance of some 5 km on average, the range runs out, after four interruptions posed by the gorges, which cut into the range over major fault lines.

4.4.5. Suitability of the northern part of the range as offsetting area

Concluding, we find that the northern part of the Pyinyaung limestone range is likely to be most suitable area for offsetting purposes.

There, the largest tracts of MDF can be found, reaching from the highest limestone crests to, in some places, the lower boundary of the carbonate rock outcrops. More detailed investigation may bring to light that the altitudinal range is relevant: differences in species composition with increasing altitude may be found. *Impatiens* sp.n. (Balsaminac., see species list) may be an example of a species which is restricted to the upper zone of the range.

A perfunctory comparison of two sites with MDF, one in the concession (day 1 and 2) and one c. 4 km north of Kubyin (day 5), revealed no significant differences in species composition. Thus, we found no indicators that a major gradient in species composition is present in the MDF from north to south. We did observe, however, that some species seem to have a very patchy distribution: *Stemona* sp. (Stemonac.) seems to be very rare in the concession, but abundantly present north of Kubyin.

5. References

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Appendix 1. List of Plant Species (2014)

Source: Anon. (2014). Species that may be relevant have **their name printed in bold**.

Range Size Categories are explained in Chapter 2.1.

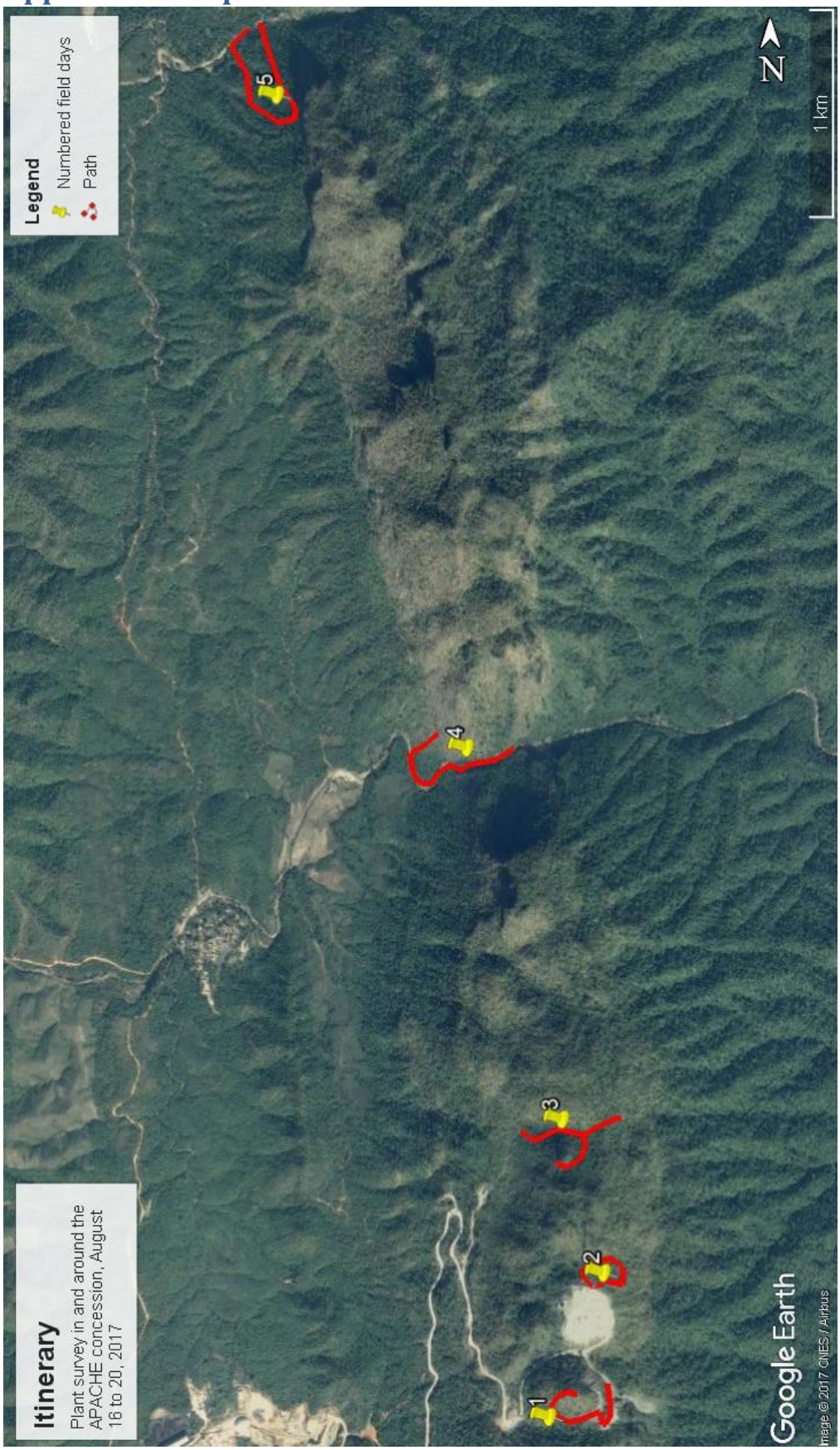
Range Size Cat.	No., Scientific Name, and (Family)	IUCN-Red List Status & other remarks
4	1 *Acacia concinna* (Willd.) DC. (Mimosac.)	
5	2 *Acacia farnesiana* (L.) Willd. (Mimosac.)	
4	3 *Acacia intsia* Willd. (Mimosac.)	
5	4 *Acmella calva* (DC.) R.K. Jansen (Asterac.)	
4	5 *Adina cordifolia* Hook. f. (Rubiac.)	
4	6 *Aegle marmelos* L. (Rutac.)	
5	7 *Ageratum conyzoides* L. (Asterac.)	
4	8 *Albizia lebbekoides* (DC.) Benth. (Mimosac.)	
4	9 *Albizia myriophylla* Benth. (Mimosac.)	
5	10 *Aloe vera* L. (Aloac.)	
5	11 *Alternanthera sessilis* (L.) R.Br. (Amaranthac.)	
5	12 *Amaranthus viridis L.* (=*gracilis* Desf., on list) (Amaranthac.)	
5	13 *Amaranthus spinosus* L. (Amaranthac.)	
4	14 *Amorphophallus paeoniifolius* (Dennst.) Nicolson (Arac.)	
4	15 *Anacolosa griffithii* Mast. (Olacac.)	
4	16 *Anogeissus acuminata* Wall. (Combretac.)	
4	17 *Anthocephalus morindaefolius* Korth. (Rubiac.)	
4	18 *Antidesma velutinum* Tul. (Euphorbiac.)	
4	19 *Ardisia humilis* Vahl (Myrsinac.)	
4	20 *Argyreia barbigera* Choisy (Convolvulac.)	
4	21 *Argyreia nervosa* (Convolvulac.)	
4	22 *Artocarpus lakoocha* (Morac.)	
4	23 *Asparagus racemosus* Willd. (Asparagac.)	
4	24 *Atalantia monopyhlla* A.DC. (Rutac.)	
4	25 *Baccaurea sapida* Muell. Arg. (Euphorbiac.)	
4	26 *Bambusa polymorpha* Munro (Poac.)	
4	27 *Bambusa tulda* Roxb. (Poac.)	
4	28 *Bauhinia acuminata* L. (Caesalpiniac.)	
4	29 *Bauhinia ornata* Kurz (Caesalpiniac.)	**(LC)**
4	30 *Bauhinia variegata* L. (Caesalpiniac.)	
4	31 *Blumea balsamifera* DC. (Asterac.)	
4	32 *Boesenbergia rotunda* (L.) Mansf. (Zingiberac.)	
4	33 *Bombax anceps* Pierre (Bombacac.)	
4	34 *Bombax ceiba* L. (Bombacac.)	
4	35 *Bombax insigne* Wall. (Bombacac.)	
4	36 *Butea monosperma* (Lam.) Kuntze (Fabac.)	
4	37 *Butea superba* Roxb. (Fabac.)	
4	38 *Caesalpinia crista* L. (Caesalpiniac.)	
4	39 *Calotropis gigantea* (L.) Dryand. ex W.T. Aiton (Asclepiadac.)	
4 or 5	41 *Canscora diffusa* (Vahl) R.Br. (Gentianac.)	
4	42 *Careya arborea* Roxb. (Lecythidac.)	
4	43 *Cassia fistula* L. (Caesalpiniac.)	
4	44 *Cephalostachyum pergracile* Munro (Poac.)	
5	45 *Chromolaena odorata* (L.) R.M. King & H Robinson (Asterac.)	
4	46 *Chukrasia velutina* Roem. (Meliac.)	**(LC)**
4	47 *Cibotium barometz* (Linn.) J. Sm. (Dicksoniac.)	
4	49 *Clausena excavata* var. *villosa* Hook. f. (Rutac.)	
4	50 *Clerodendrum indicum* (=*siphonanthus*) R.Br. (Verbenac.)	
5	51 *Colocasia esculenta* (Arac.)	
4	52 *Combretum alfredii* Hance (Combretac.)	
4	53 *Combretum pilosum* Roxb. (Combretac.)	
4	54 *Congea tomentosa* Roxb. (Verbenac.)	
4	55 *Connarus paniculatus* Roxb. (Connarac.)	

5	56 *Corchorus aestuans* L. (Tiliac.)	
4	57 *Corchorus capsularis* L. (Tiliac.)	
4	58 *Cordia myxa* L. (Boraginac.)	
4	59 *Costus speciosus* Sm. (Costac.)	
5	60 *Crassocephalum crepidioides* (Benth.) S. Moor. (Asterac.)	
4	61 *Crateva magna* (Lour.) DC. (Capparac.)	
4	62 *Cratoxylum sumatranum* (=*neriifolium*) Kurz. (Hypericac.)	
4	63 *Cratoxylum cochinchinense* (=*polyanthum*) Korth. (Hypericac.)	
4	64 *Croton oblongifolius* Roxb. (Euphorbiac.)	
4	65 *Cryptolepis buchanani* Rome. & Schult (Asclepiadac.)	
4	66 *Cyanotis barbada* D.Don. (Commelinac.)	
4	67 *Cyanthillium cinereum* (L.) H. Robinson (Asterac.)	
4	68 *Cymbidium aloifolium* (L.) Sw. (Orchidac.)	
5	69 *Cynodon dactylon* (L.) Pers. (Poac.)	
4	**70 *Dalbergia cultrata* Grah. (Fabac.)**	**(NT)**
3?	**71 *Dalbergia kurzii* Prain (Fabac.)**	**(In Myanmar only?)**
4	**72 *Dalbergia oliveri* Gamble (Fabac.)**	**(EN)**
4	73 *Dalbergia rimosa* Roxb. (Fabac.)	**(LC)**
4	74 *Dalbergia volubilis* Roxb. (Fabac.)	
5	75 *Delonix regia* (Bojer ex Hook.) Rafin. (Fabac./Caesalpiniac.)	
4	76 *Dendrocalamus longispathus* (Kurz) Kurz (Poac.)	
4	77 *Dendrocalamus membranaceus* Munro (Poac.)	**(LC)**
4	78 *Dillenia pentagyna* Roxb. (Dilleniac.)	
4	79 *Dinochloa maclellandii* Kurz (Poac.)	
4	80 *Dioscorea bulbifera* L. (Dioscoreac.)	
4	81 *Dipterocarpus tuberculatus* Roxb. (Dipterocarpac.)	**(LC)**
4	82 *Dolichandrone spathacea* (L. f.) K. Schum. (Bignoniac.)	
4	83 *Drynaria quercifolia* (Polypodiac.)	
4	84 *Duabanga grandiflora* (Lythrac.)	
4	85 *Ehretia acuminata* R.Br. (Boraginac.)	
4	86 *Entada scandens* Benth. (Mimosac.)	
4	87 *Erythrina stricta* Roxb. (Fabac.)	
5	88 *Euphorbia hypericifolia* L. (Euphorbiac.)	
4	89 *Ficus benghalensis* (Morac.)	
4	90 *Ficus hispida* L. (Morac.)	
5	91 *Ficus obtusifolia* Roxb. (Morac.)	
4	92 *Ficus racemosa* (Morac.)	
4	93 *Ficus virens* Aiton (Morac.)	
3 or 4	**94 *Firmiana kerrii* (Sterculiac.)**	**('rare on limestone in N Thailand')**
4 or 5	95 *Flacourtia jangomas* (=*cataphracta* Roxb.) (Flacourtiac.)	
4	96 *Flemingia macrophylla* (=*congesta*) Roxb. (Fabac.)	
4	97 *Gardenia coronaria* Buch-Ham. (Rubiac.)	
4	98 *Getonia* (=*Calycopteris*) *floribunda* Roxb. (Combretac.)	
4	99 *Gmelina arborea* Roxb. (Verbenac.)	
4	100 *Harrisonia perforata* Merr. (Simaroubac.)	
4	101 *Fernandoa* (=*Heterophragma*) *adenophyllum* Seem. (Bignoniac.)	
4	102 *Hiptage benghalensis* (L.) Kurz (Malpighiac.)	
4	103 *Holoptelea integrifolia* Planch. (Ulmac.)	
4	104 *Homalium tomentosum* Benth. (Flacourtiac.)	
4	105 *Homonoia riparia* (Euphorbiac.) (Rheophyte)	
4	106 *Hydrocotyle sibthorpioides* Thunb. (Apiac.)	
4	107 *Hydrolea zeylanica* (L.) Vahl (Hydrophyllac.)	**(LC)**
4	108 *Hymenodictyon orixense* (Roxb.) Mabb. (Rubiac.)	
4	109 *Imperata cylindrica* L. (Poac.)	
4	110 *Justicia procumbens* L. (Acanthac.)	
4	111 *Kaempferia* (=*Curcuma*) *candida* Wall. (Zingiberac.)	
4	112 *Lagerstroemia parviflora* Roxb. (Lythrac.)	
4	113 *Lagerstroemia speciosa* (L.) Pers. (Lythrac.)	
4	114 *Lagerstroemia tomentosa* Presl. (Lythrac.)	
4	115 *Lannea coromandelica* (Houtt.) Merrr. (Anacardiac.)	
4	116 *Lasia spinosa* (=*aculeata* Lour.) (Arac.)	**(LC)**
4	117 *Lepidagathis incurva* (=*semiherbacea* (Clarke) Nees) (Acanthac.)	
4 or 5	118 *Leptadenia reticulata* Wight & Arn. (Asclepiadac.)	

5	119 *Leucaena leucocephala* (Lam.) De Wit (Mimosac.)	
4	120 *Litsea monopetala (*Roxb.) Pers. (Laurac.)	
	121 *Livistona* sp. (Arecac.)	
4	122 *Loranthus pulverulentus* Wall. (Loranthac.)	
5	123 *Ludwigia hyssopifolia* (Onagrac.)	
4 or 5	124 *Ludwigia octovalvis* (Onagrac.)	
4	125 *Luffa aegyptiaca* Mill. (Cucurbitac.)	
5	126 *Lycopersicon esculentum* Mill. (*Solanum lycopersicon*) (Solanac.)	
4	127 *Lygodium japonicum* (Thunb.) Sw. (Lygodiac.)	
4	128 *Madhuca longifolia* (Koen.) Macbride (Sapotac.)	
4	129 *Mangifera sylvatica* Roxb. (Anacardiac.)	
4	130 *Markhamia stipulata* (Wall.) Seem.ex K.Schum. (Bignoniac.)	
4	131 *Mazus pumilus* (Burm.f.) Steenis (Scrophulariac.)	
4	132 *Melanorrhoea usitata* Wall. (Anacardiac.)	
5	133 *Melochia corchorifolia* L. (Sterculiac.)	
4	134 *Merremia hirta* (Convolvulac.)	
4	135 *Mesua ferrea* L. (Hypericac.)	
4	136 *Millettia extensa* Benth. (Fabac.)	
4	137 *Millettia peguensis* (=*ovalifolia*) Kurz (Fabac.)	**(S Myanmar & S Thailand only)**
4	138 *Mimusops elengi* L. (Sapotac.)	
4	139 *Mitragyna rotundifolia* (Roxb.) Kuntze (Rubiac.)	
4	140 *Morinda tinctoria* Roxb. (Rubiac.)	
4	141 *Mucuna pruriens* (L.)DC. (Fabac.)	
5	142 *Muntingia calabura* L. (Muntingiac.)	
4	143 *Myriopteron extensum* (Wight) K. Schum. (Asclepiadac.)	
4	144 *Nauclea orientalis* L. (Rubiac.)	
4	145 *Operculina turpethum* (L.) Silva Mansa (Convolvulac.)	
4	146 *Oroxylum indicum* (L.) Kurz. (Bignoniac.)	
4	147 *Oryza rufipogon* Griff. (Poac.)	
?	148 *Oryza sativa* L. (Poac.)	
5	149 *Oxalis corniculata* L. (Oxalidac.)	
4	150 *Oxytenanthera albociliata* Munro (Poac.)	
4	151 *Paederia scandens* Lour. (=*foetida*) (Rubiac.)	
4	152 *Pajanelia longifolia* (Willd.) K. Schum. (Bignoniac.)	
4	153 *Phyllanthus emblica* L. (Euphorbiac.)	
4	154 *Phyllanthus niruri* L. (Euphorbiac.)	
4	155 *Phyllanthus urinaria* L. (Euphorbiac.)	
5	156 *Plumeria acutifolia* Poir. (Apocynac.)	
5	157 *Plumeria obtusa* L. (Apocynac.)	
5	158 *Plumeria rubra* L. (Apocynac.)	
	159 *Polygonum* sp. (Polygonac.)	
5	160 *Potamogeton natans* L. (Potamogetonac.)	
4	161 *Pterocarpus macrocarpus* Kurz (Fabac.)	
4	162 *Quercus mespilifolia* Wall. (Fagac.)	
4	163 *Rauvolfia serpentina* (L.) Benth. (Apocynac.)	
5	164 *Samadera indica* Gaertn. (Simaroubac.)	
5	165 *Scadoxus (Haemanthus) multiflorus* (Amaryllidac.)	
4	166 *Schleichera oleosa* (Lour.) Oken (Sapindac.)	
5	167 *Scoparia dulcis* L. (Scrophulariac.)	
5	168 *Senna alata* L. (Caesalpiniac.)	
5	169 *Senna hirsuta* (L.) Irwin & Barneby (Caesalpiniac.)	
4	170 *Senna timoriensis* (DC.) Irwin & Barneby (Caesalpiniac.)	
4	171 *Senna tora* (L.) Roxb. (Caesalpiniac.)	
4	172 *Shorea obtusa* Wall. (Dipterocarpac.)	
4	173 *Shorea siamensis* (Kurz) Miq. (Dipterocarpac.)	
5	174 *Sida acuta* Burm.f. (Malvac.)	
5	175 *Solanum torvum* Swartz (Solanac.)	
5	176 *Solanum erianthum* (=*verbascifolium*) L. (Solanac.)	
5	177 *Spermacoce exilis* (=*mauritiana*) (Rubiac.)	
4	178 *Spondias pinnata* (L. f.) Kurz. (Anacardiac.)	
4	179 *Stephania venosa* (Blume) Spreng. (Menispermac.)	
4	180 *Sterculia foetida* L. (Sterculiac.)	
4	181 *Sterculia oblongata* (Sterculiac.)	

4	182 *Sterculia villosa* (=*ornata*) Wall. ex Kurz (Sterculiac.)	
4	183 *Sterculia urens* var. *thorelii* Shaw (Sterculiac.)	
4	184 *Sterculia versicolor* Wall. (Sterculiac.)	**(Bangladesh and Myanmar only)**
4	185 *Strychnos nux-blanda* A.W. Hill (Loganiac.)	
4	186 *Syzygium grande* (Wight) Walp. (Myrtac.) (coastal sp.?)	
4	187 *Tadehagi triquetrum* (L.) H. Ohashi (Fabac.)	
5	188 *Tamarindus indica* L. (Caesalpiniac.)	
4	189 *Tectona grandis* L.f. (Verbenac.)	
5	190 *Telosma cordata* (Andrews) Craib (=*minor*) (Asclepiadac.)	
4	191 *Terminalia alata* (Heyne) Roth (Combretac.)	
4	192 *Terminalia bellirica* (Gaertn.) Roxb. (Combretac.)	
4	193 *Terminalia chebula* Retz. (Combretac.)	
3?	**194 *Terminalia oliveri* Brandis (Combretac.)**	**(Endemic to Myanmar?)**
4	195 *Terminalia pyrifolia* Kurz (Combretac.)	
4	196 *Tetrameles nudiflora* R. Br. (Datiscac.)	**(LC)**
4	197 *Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb. (Acanthac.)	
4	198 *Thunbergia laurifolia* Lindl. (Acanthac.)	
4	199 *Thyrsostachys oliveri* Gamble (Poac.)	**(S-Yunnan and Myanmar only)**
4	200 *Thyrsostachys siamensis* (Kurz ex Munro) Gamble (Poac.)	
4	201 *Tinospora nudiflora* Kurz (Menispermac.)	
4	202 *Trema orientalis* (Ulmac.)	
4	203 *Tristaniopsis burmanica* (Griff.) P.G. Wilson & J.T. Waterh. (Myrtac.)	
4	204 *Typha angustifolia* Chaub. & Bory (Typhac.)	
5	205 *Urena lobata* L. (Malvac.)	
	206 *Utricularia* sp. (Lentibularac.)	
4	207 *Uvaria cordata* Schum. & Thonn. (Annonac.)	
4	208 *Vangueria* (=*Meyna*) *spinosa* Roxb. (Rubiac.)	
4	209 *Vitex pubescens* Vahl (Verbenac./Lamiac.))	
4	210 *Vitis* (=*Cissus*) *discolor* (Vitac.)	
4	211 *Wattakaka volubilis* (L. f.) Stapf. (Asclepiadac.)	
4	212 *Wendlandia tinctoria* DC. (Rubiac.)	
4	213 *Wrightia arborea* (Dennst.) Mabb. (Apocynac.)	
4	214 *Xylia xylocarpa* (Roxb.) Taub. (Mimosac.)	
4	215 *Zanthoxylum rhetsa* (=*budrunga* Wall., in list) (Rutac.)	
4	216 *Ziziphus jujuba* Lam. (Rhamnac.)	

Appendix 2. Map of localities visited



Appendix 3. List of Plant Species collected during August 2017 survey

(See separate spreadsheet)

Appendix 3. List of Plant Species collected during August 2017 survey

Range size cat.	herb	phot	Sample #	Family	Species	aug-16	aug-17	aug-18	aug-19	aug-20	Notes on species	Comments
		F	3880	?	indet.				x			
	L	F	4007	?	indet. (herb, fr with basal collar)					x	Herb, c 1 m high, slightly woody at base	
	L	F	3979	?	indet. (lvs 2-pinnate, leaflets very narrow-ovate)		x	deg		x	Erect perennial with sympodial growth, stems up to c 1 m long.	
	L	F	3965	?	indet. (lvs imparipinnate)	x		deg	x		Straggling shrub.	
	L	F	3980	?	indet. (perennial 1 m high, lvs palmatilobate)	x	x				Erect perennial with sympodial growth, c 1 m high.	
	L	F	3966	?	indet. (perennial 1 m high, lvs wide-ovate-cordate)	x	x	deg		x	Erect perennial with sympodial growth, stems up to c 1 m long..	
	L	F	4006	?	indet. (treelet with pear-shaped fruits)					x	Treelet c 5 m high, with wide-spreading, umbellate crown	
4	L	F	3986	(Fern)	Adianthum sp.	x	x	deg	x	deg		
		F	3877	Acanthaceae	indet.	x						
		F	3879	Acanthaceae	indet.				x			
4	L	F	4005	Acanthaceae	Dipteracanthus prostratus					x	Perennial herb, c 1 m high. Flowers purple	Widespread
	L	F	3988	Acanthaceae	Justicia sp.			deg			Annual.	
4	L	F	3973	Acanthaceae	Justicia procumbens	x					Annual herb.	Widespread weed.
4	L	F	3982	Acanthaceae	Asystasia gangetica		x	deg		x	Annual herb.	Widespread

4		F	3874	Acanthaceae	Strobilanthes auriculata	x						Widespread
4	L	F	3962/ 3991	Araceae	Alocasia acuminata	x		deg		x	Growing in deep and narrow fissures in limestone rock	NE India to N Vietnam (Det. W. Hetterscheid)
5	L	F	4010	Araceae	Amorphophallus paeoniaefolius					X	Stem green, mottled brown, surface rough	(Det W. Hetterscheid)
	L	F	3974	Araceae	Amorphophallus sp.	x	x	deg			Stem green, smooth (Only foliage preserved)	(tuber to W. Hetterscheid for cultivation).
	L	F	3985	Araceae	Amorphophallus sp.		x	deg	x		Stem green, smooth (Only foliage preserved)	(tuber to W. Hetterscheid for cultivation).
	L	F	3992	Araceae	Amorphophallus sp.			deg			Stem dark,grey-brown with elongated, somewhat lighter, thin rings, surface slightly velvety (Only foliage preserved)	(tuber to W. Hetterscheid for cultivation).
	L	F	3993	Araceae	Amorphophallus sp.			deg	x		Stem green with elongated pale brown spots, smooth (Only foliage preserved)	(tuber to W. Hetterscheid for cultivation).
	L	F	4004	Araceae	Amorphophallus sp.				x		Stem blackish purple with irregular white spots, surface smooth (Only foliage preserved)	(tuber to W. Hetterscheid for cultivation).
	L	F	3969	Araceae	Arisaema sp.	x					Stem green, smooth (Only foliage preserved)	(tuber to W. Hetterscheid for cultivation).
4		F	3882	Araceae	Pothos sp.				x			Genus with generally widespread species.
		F	3875	Asteraceae	indet.	x						

3	L	F	3961	Asteraceae	Koyamasia calcarea	x				deg	Annual herb, c 1 m high.	(Det. H. Robinson)
		F	3876	Asteraceae	Senecio sp.	x						
2 or 3	L	F	3959	Balsaminaceae	Impatiens sp., probably new	X		x			Annual herb	(Det. N. Tanaka)
4	L	F	3960	Begoniaceae	Begonia (Duploclinium) modestiflora	x	x				Herb with small underground tubers	Taxonomic status of this form somewhat doubtful, perhaps it is a separate variety of the species. The same form has been reported from Natma Taung NP (Det & info: C.I. Peng and Y.D. Kim)
4	L	F	3971	Begoniaceae	Begonia (Platycentrum) augustinei	x	x	x	x		Herb with fleshy rootstock and densely placed leaves.	If the identification is correct, the species has been reported from Natma Taung NP in Myanmar. Elsewhere in Yunnan (Det by C.I. Peng and Y.D. Kim; info from Fl China)
4	L	F	3994	Begoniaceae	Begonia demissa				x			Distributed in Myanmar, Laos, and Thailand (Det. C.I. Peng)
4	L	F	3981	Acanthaceae	Thunbergia fragrans		x	deg			Winding herb with thin stems. Flowers white.	Widespread
4	L	F	3976	Cucurbitaceae	Solena heterophylla		x	deg			Winding annual herb with thin stems. Flowers creamy white, central part yellow.	Widespread from Afghanistan to Vietnam to Indonesia (Det. De Wilde; infor Fl. China)
4	L	F	4003	Euphorbiaceae	Homonoia riparia				x		Rheophytic shrub	Widespread

4	L	F	3989	Euphorbiaceae (Phyllanthaceae)	Phyllanthus gracilipes		x	deg		x	Treelet, c 1 m high, with thin, upright stem and numerous radiating, horizontal branches up to c. 60 cm long.	Thailand, China, Vietnam (Det. Van Welzen, info Fl. China)
	L	F	3983	Fabaceae (Caesalpiniaceae)	Bauhinia sp. (?)		x	deg	x	x	Short-winding herb with tough stems, somewhat woody at base	
3	L	F	4001	Gentianaceae	Canscora helferiana				x			Thailand, Myanmar
	L	F	3996	Gesneriaceae	Rhynchoglossum obliquum			deg	x	x		Widespread and common (Det. D. Middleton)
	L	F	4009	Gesneriaceae	Paraboea (Trisepalum) birmanica (?)					x	Plant found cut off and half dried, with brown flowers.	Yunnan, Thailand, Myanmar. Identification uncertain because of poor quality of material (Det. Pramote Triboun, info Fl. China)
4	L	F	3997	Gesneriaceae	Primulina hamosa (?)	x		deg	x	x		Widespread
4	L	F	3978	Lamiaceae	Clerodendron paniculatum		x	deg			Shrublet.	Widespread
4	L	F	3975	Liliaceae	Chlorophytum nepalense		x	deg		x	Flowers white	Widespread (Det. & info: Averyanov)
4		F	3878	Nyctaginaceae	Boerhavia (Commicarpus) sinensis	x	x	deg		x		Widespread from India to China (Det. Van Balgooij)
4				Orchidaceae	Ascocentrum sp.					x		
4				Orchidaceae	Bulbophyllum (Racemosae) sp.					x		
4				Orchidaceae	Bulbophyllum (Sunipia) sp.					x		
				Orchidaceae	Cleisostoma sp.					x		
4				Orchidaceae	Cymbidium aloifolium					x		Widespread

				Orchidaceae	Dendrobium sp. 1					x		
				Orchidaceae	Dendrobium sp. 2					x		
				Orchidaceae	Dendrobium sp. 3					x		
				Orchidaceae	Dendrobium sp. 4					x		
				Orchidaceae	Gastrodia sp.			x				
				Orchidaceae	Micropera sp.					x		
				Orchidaceae	Oberonia sp.					x		
	L	F	3963	Orchidaceae	Peristylus sp.	x						
		F	4008	Orchidaceae	Taeniophyllum sp.					x	Leafless herb with thick, greyish green roots.	
				Orchidaceae	Trichoglottis sp.					x		
4	L	F	3968	Orobanchaceae	Aeginetia indica	x		deg		x		Widespread
4	L	F	3970	Passifloraceae	Adenia pinnatisecta	x	x	deg				Widespread (det. De Wilde)
	L	F	4000	Peperomiaceae	Peperomia sp.				x	x		
	L	F	3967	Rubiaceae	indet. (Flowers as Valantia, but 5 together)	x	x					
	L	F	3999	Scrophulariaceae	indet.				x		Small, creeping weed	Seen elsewhere as a garden weed
4		F	3881	Scrophulariaceae	Lindenbergia indica				x			Widespread
	L	F	3987	Stemonaceae	Stemona sp.	x		x		x	Perennial herb, no flowers found	(Det. De wilde)
	L	F	3995	Urticaceae	indet.	x	x	deg	x	deg		
	L	F	3964	Vitaceae	Cissus sp. (lvs simple, ovate, dentate)	x	x	deg	x		Herbaceous climber.	
3	L	F	3977	Zingiberaceae	Boesenbergia longiflora aggr., possibly B. kerrii		x	deg	x	x	Division of B. longiflora into smaller taxa contested; B. longiflora aggr. = cat. 4	B. kerrii: Myanmar & Thailand, cat. 3 (Det. A. Poulsen)

3 or 4	L	F	3972	Zingiberaceae	Curcuma cordata	x	x	deg		x		Only Myanmar, possibly in adjacent Thailand. Taxonomy unresolved (Det. & info J. Zkornickova)
3	L	F	4002	Zingiberaceae	Curcuma myanmarensis				x	x		Mandalay Div., Dhazi, Pyin-Oo-Lwin and Thabeikyin townships only (Det. & info J. Zkornickova)
4	L	F	3984/ 3998	Zingiberaceae	Globba marantina	x	x	deg	x	x		Widespread (Det. J. Zkornickova)

Appendix 4. Division of Pyinyaung Limestone Range into sectors

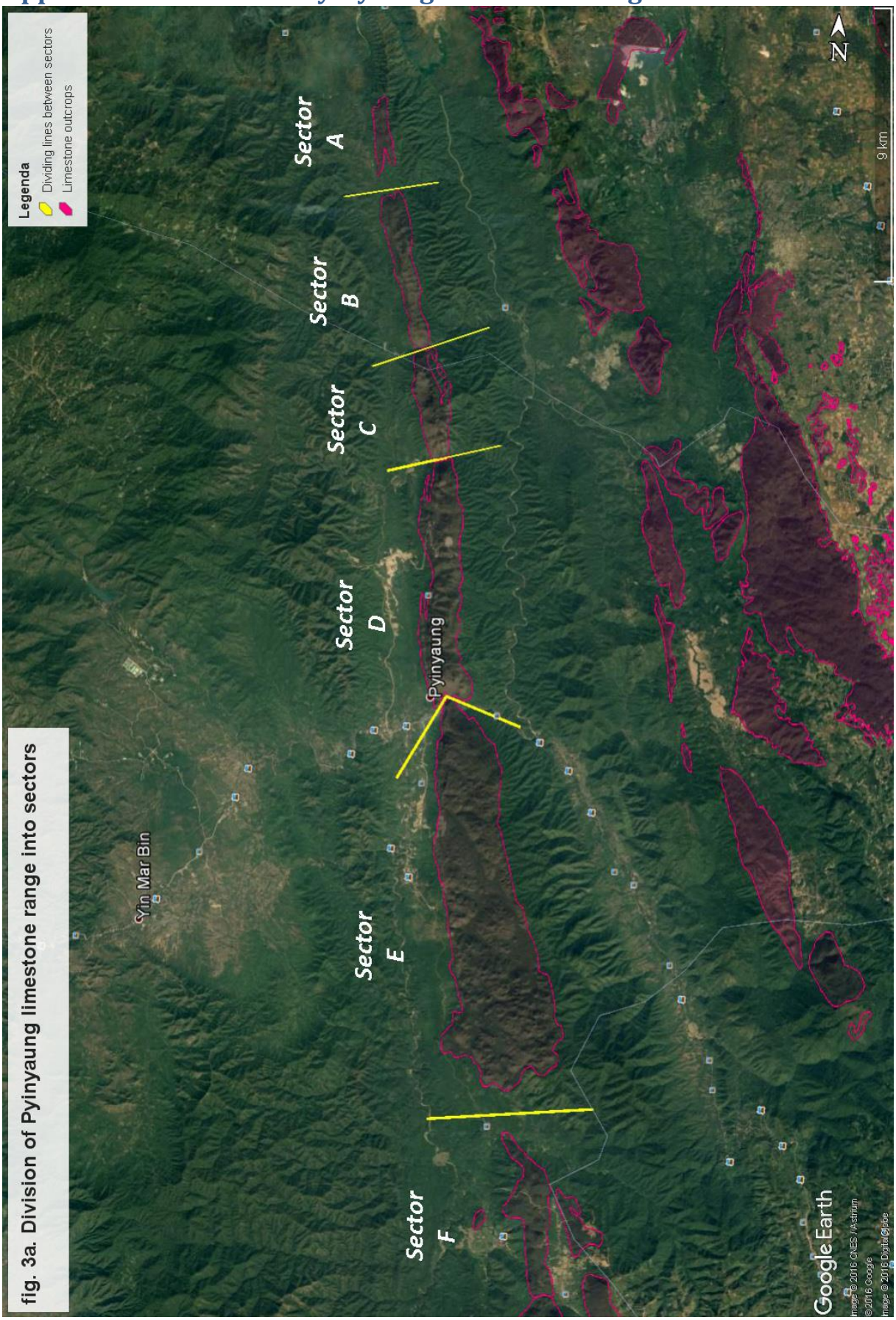


fig. 3a. Division of Pyinyaung limestone range into sectors

Appendix 5. Pictures of some plant species

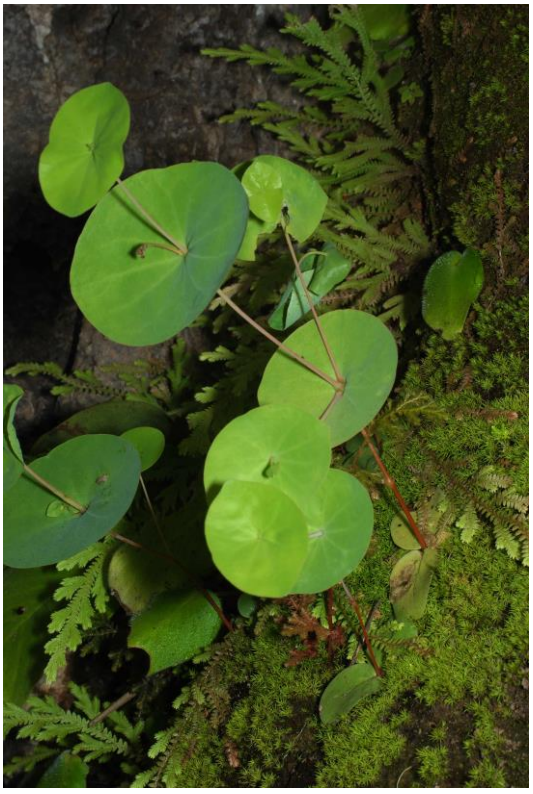
Koyamasia calcarea

Impatiens sp.n.

Boesenbergia kerrii

Curcuma cordata

Curcuma myanmarensis



Canscora helferiana

Appendix 6. List of specialists who contributed to this report

L. Averyanov, Russia

M. Van Balgooij, Netherlands

W. Hetterscheid, Netherlands

Y.D. Kim, South Korea

D. Middleton, Singapore

C.I. Peng, China

A. Poulsen, Norway

H. Robinson, USA

N. Tanaka, Japan

P. Triboun, Thailand

P. Van Welzen, Netherlands

W. & B. de Wilde, Netherlands

J. Zkornikova, Singapore

The Floristic and Vegetation Survey Report along the Transmission Line of Apache Cement Factory, Pyinyaung

January, 2018

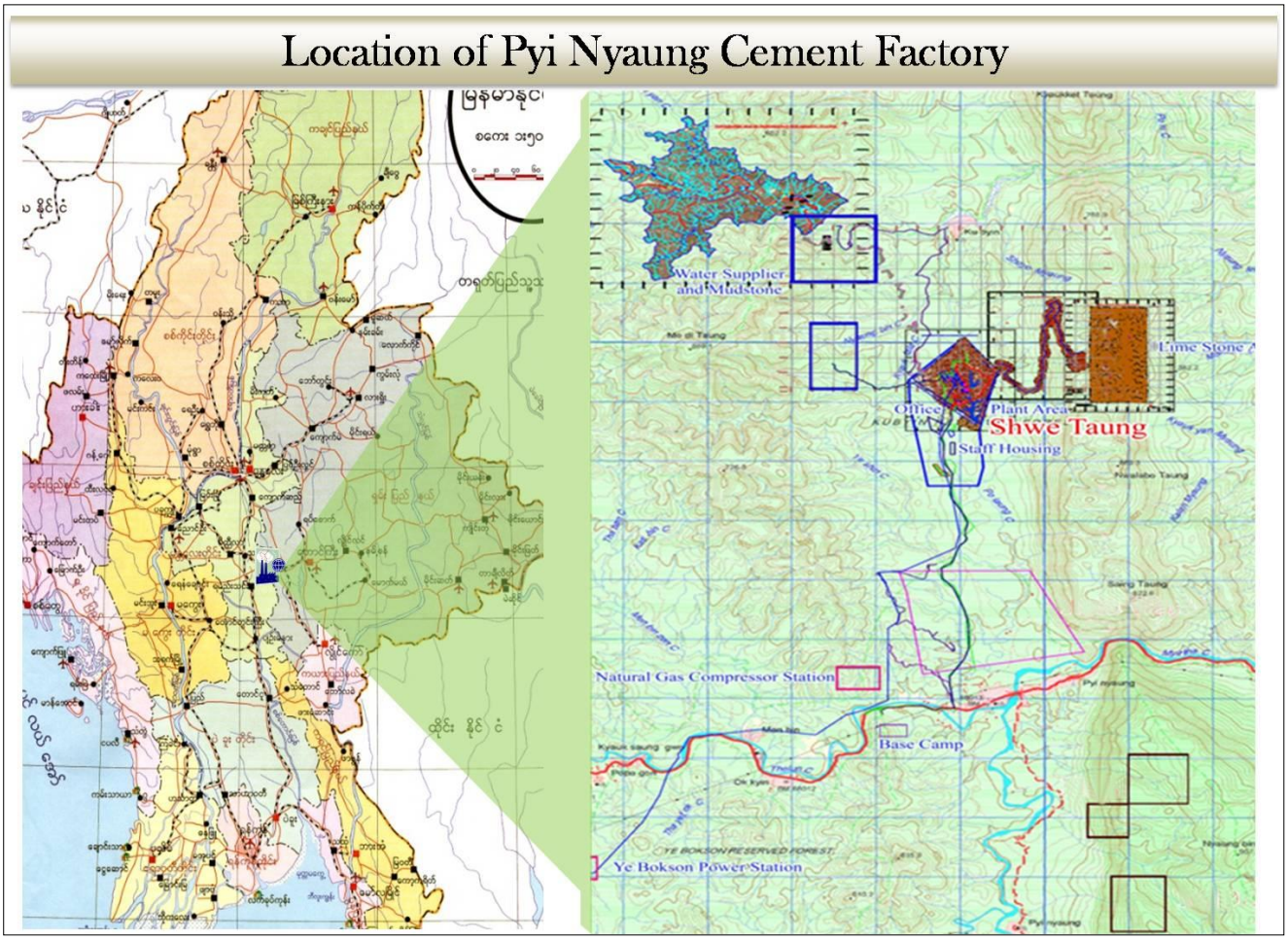
CONTENT

I. INTRODUCTION

1.1. Background History

Apache cement factory is located in the Kupyin Resrve Forest, Pyinyaung Village tract, Thasi Township, Meiktila District, Mandalay Division. The total forest area including extension is 11,800 hectare (29,158 acre). The total project area including mining area is 500.19 hectare (1,236 acre). (Map I)

Map I.

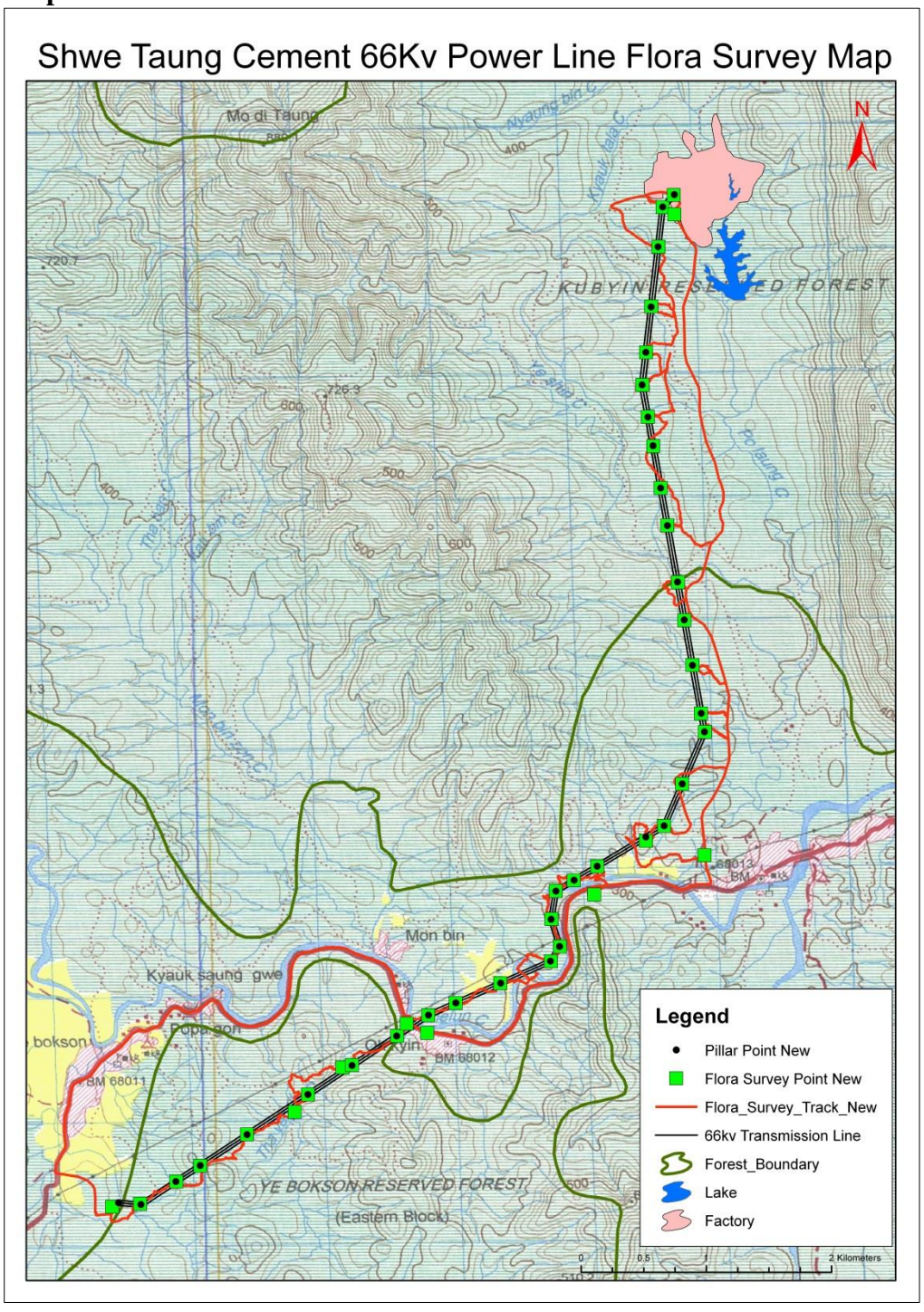


1.2. Geology

The Transmission Line is passing through the two reserved forests namely Kubyin Reserved forest and Yepaungsone Reserved forest. The geology of the two reserved forests are mostly mudstone. The mudstone – sandstone habitat favours the growing the tree species like *Tectona grandis*, *Xylia xylocarpa*, *Dipterocarpus tuberculatus*, *Pterocarpus indicus*, *Shorea siamensis*, *Bambusa polymorpha* and *Dendrocalamus* sp.

1.3. Transmission Line

Map II.



The transmission line area from Yepaungsone Station to cement plant area is 11km in length and composed of 35 pillars. The distance from one pillar to next is estimated btween 0.1km to 0.5km. The base of the pillar will be 50 square meter.

The pillar No.1 and 2 is closed to the Yepaungsone Power Station. There is no tree species in this area. Only some shrubs and herbs species are recorded.

The pillar No.3 to pillar No.7 is located in the forest area. All together five representative sample plots had been marked and data collection had been carried out. Pillar No.8 to pillar No.15 is in the cultivated area especially the banana and mango plantation data collection is also carried out. Pillar No.16 to pillar No.19 is in the forest area data collection had been carried out by sample plotting method. Pillar No.20 and 21 are in the banana plantation. Pillar No.22 and 34 are in the forest area. The forest inventory by sample plotting method had been carried out and data recorded. Pillar No.35 is in the Apache cement factory area. Since the vegetation had been cleaned up only the existing plants are recorded.

The data analysis had been carried out, forest types and vegetation along the length of the transmission line route is identified. The species of conservation significance such as IUCN Red list species, endemic species, Myanmar Protected species and invasive species are recorded and identified. Vegetation class map or land cover map of the studied area is also set up by using satellite image and ground survey findings. Some photos of IUCN Red list species and Myanmar protected species and invasive species are interpreted.

II. AIMS AND OBJECTIVES

1. To collect, identify and list the plant species along the transmission line route.
2. To record the dominant tree species and evaluate the forest types.
3. To identify and record the red list species protected species and invasive species.
4. To describe the vegetation classes of the survey area by using the satellite image and ground survey data.
5. To record the GPS reference locations of the representative areas.

III. MATERIALS AND METHODS

3.1 Participants

(1) Dr. Win Myint (Associated Professor, ex.), Ecologist

(2) U Nyo Maung (Retired Professor), Taxonomist

(3) Dr. Ei Ei Phyoe (Taxonomist)

(4) U Tun Thura (Botanist & GIS/RS)

(5) U Thin Phyoe Aung (Assistant Botanist)

3.2 Method

The floristic data and ecological data collection were conducted by the following methods in the study Area.

3.2.1 Sample Ploting

The Global Positioning System was used to navigate and mark the coordinates of the sample plots. In order to obtain essential data for predicting of tree species composition in the mangrove forest, 20x20 meter quadrants were set up and tree species in the plot were collected and population of each species were also counted. The species identification was carried out by using key to families of flowering plants and appropriate literature and confirmed by matching with herbarium specimens of Department of Botany, University of Yangon.

3.2.2 Random Transecting

To get representative checklists of the plant species, collection was also carried out by random transect lines within the direct impact zone and indirect impact zone of the project site.

3.2.3.Maping

Location maps are set by the method based on the Google map, landsat 8 satellite image (LC08-L1TP-133046-20171223-20180103) and UTM map mark the GPS position of vegetation survey.

3.3 Materials

Materials used for recording are strings for sample plotting and transecting, digital camera for recording, GPS, maps, heavy duty plastic bags, newspapers, alcohol, spray jug (for fixing specimens), 10x lens, permanent marker, field note books, field press, drying press and dryers.

3.4 Data Analysis

After field survey, data entry was carried out in excel work sheet. Analysis of population per hectare percentage was conducted using excel work 2007.

3.4.1 Population of individual species (Per hectare)

The population of species will show not only the composition of species but also the richness of the species in the study area. According to R.He'dl, M Sva'tek, M. Dancak, Rodzay A.W., M. Salleh A.B., Kamariah A.S.(2009), population of individual species (per hectare) is determined by following formula.

Total Individual species

$$\text{Population of Individual Species} = \frac{\text{Total Plots Area } (m^2)}{} \times 10000 m^2 (1ha)$$

3.4.2 Relative Density of Tree specis

The density of a species refers to the numerical representation of its individual and the availability of space in a unit area. The density index shows not only the richness of the texa but also the relative distribution of the individuals. According to Curtis (1959), the density index is determined by the following formula.

$$\text{Relative Density of Tree species} = \frac{\text{No. of Individual species}}{\text{Total no. of all individual Species}} \times 100$$

3.4.3 Relative frequency of Tree species

The relative frequency of a species refers to the percentage occurrence of its individuals and shows the frequency of different species growing in the study area. The species which fall in high frequency class can be considered as the most common species in the study area. According to Curtis (1959), the relative frequency is determined by the following formula.

$$\text{Relative frequency of Tree species} = \frac{\text{No. of sample plot occurs}}{\text{Total no. of all species occur}} \times 100$$

3.4.4 Species distribution by frequency class

According to Raunkiaer's Law of frequency (1934), each species was grouped into one of five frequency class (FC); Frequency range (1-20%) represents rare species, (20 - 40%) represents seldom species, (40 - 60%) represents often species, (60 - 80%) represents mostly species, and (80 - 100%) represents constantly present species. This frequency class will also clarify the homogeneity or heterogeneity of the floristic distribution in the study area.

3.4.5 Tree species in DBH class interval

Tree species in DBH class interval is calculated by

$$\text{Population of DBH class interval} = \frac{\text{No. of species}}{\text{Total no. of all species}} \times 100$$

Low DBH class interval shows the degraded and secondary forest height DBH class interval shows the primary forest.

3.4.6 Tree species in Height class interval

Tree species in Height class interval is calculated by

$$\text{Population of Height class interval} = \frac{\text{No. of species}}{\text{Total no. of all species}} \times 100$$

Low height class interval shows the degraded and secondary forest and high height class interval shows the primary forest.

IV. OBSERVATION

4.1. Deciduous Forest

Deciduous Forest

4.1.1. Floristic composition

The total number of tree species collected in 29 representative sample plots in this area is 60 species belonging to 53 genera. The dominant tree species in this area are *Xylia xylocarpa* (Roxb.)Taub. (Pyin-ka-doe) followed by *Tectona grandis* L. f. (Kyun) *Dipterocarpus tuberculatus* Roxb., (In), and *Mitragyna rotundifolia* (Roxb.) Kuntze. (Bin-ga).

4.1.2. Tree Species Population

No.	Scientific Name	Total no. of individual/ha	Total no. of population/ha(%)
1	*Adina cordifolia* Hook. f.	4.31	0.60
2	*Aegle marmelos* L.	1.72	0.24
3	*Albizia lebbekoides* (DC.) Benth.	1.72	0.24
4	*Anogeissus acuminata* Wall.	2.59	0.36
5	*Antidesma velutinum*Tul.	3.45	0.48
6	*Bauhinia malabarica* Roxb.	4.31	0.60
7	*Bombax insigne* Wall.	2.59	0.36
8	*Bridelia retusa* (L.) A. Juss.	3.45	0.48
9	*Careya arborea* Roxb.	2.59	0.36
10	*Cassia fistula* L.	7.76	1.08
11	*Cedrela serrata* Royle	3.45	0.48
12	*Chukrasia velutina* Roem.	1.72	0.24
13	*Colona floribunda*	1.72	0.24
14	*Cratoxylum neriifolium* Kurz.	7.76	1.08
15	*Cratoxylum polyanthum*Korth.	18.10	2.53
16	*Croton oblongifolius* Roxb.	7.76	1.08
17	*Dalbergia cultrata* Grah.	1.72	0.24
18	*Dalbergia oliveri* Gamble	3.45	0.48
19	*Dalbergia rimosa* Roxb.	3.45	0.48
20	*Dalbergia volubilis* Roxb.	2.59	0.36
21	*Derris* sp.	7.76	1.08
22	*Dillenia pentagyna* Roxb.	13.79	1.93
23	*Dipterocarpus tuberculatus* Roxb.	52.59	7.34
24	*Erythrina stricta* Roxb.	0.86	0.12

25	*Ficus religiosa* L.	1.72	0.24
26	*Flacourtia cataphracta* Roxb.	3.45	0.48
27	*Getonia floribunda* Roxb.	1.72	0.24
28	*Gmelina elliptica* Sm.	0.86	0.12
29	*Grewia hirsuta* Vahl	6.90	0.96
30	*Grewia laevigata* Vahl	23.28	3.25
31	*Harrisonia perforata* Merr.	43.10	6.02
32	*Holarrhena pubescens* Wall. ex G. Don	0.86	0.12
33	*Hymenodictyon orixense* (Roxb.) Mabb.	0.86	0.12
34	*Lagerstroemia tomentosa* Presl.	9.48	1.32
35	*Lannea coromandelica* (Houtt.) Merrr.	6.90	0.96
36	*Leucaena leucocephala* (Lam.) De.Wit	4.31	0.60
37	*Mangifera indica* L.	1.72	0.24
38	*Melanorrhoea usitata* Wall.	1.72	0.24
39	*Microcos paniculata* L.	4.31	0.60
40	*Millettia ovalifolia* Kurz	1.72	0.24
41	*Mitragyna rotundifolia* (Roxb.) Kuntze	49.14	6.86
42	*Morinda tinctoria* Roxb.	10.34	1.44
43	*Oroxylum indicum* (L.) Kurz.	11.21	1.56
44	*Phyllanthus emblica* L.	5.17	0.72
45	*Prema pyramidata* Wall.	0.86	0.12
46	*Pterocarpus indicus*Willd.	24.14	3.37
47	*Pterospermum semisagittatum* Buch.-Ham.	8.62	1.20
48	*Ricinus communis* L.	3.45	0.48
49	*Schleichera oleosa* (Lour.) Oken	5.17	0.72
50	*Shorea obtusa* Wall.	4.31	0.60
51	*Shorea siamensis* (Kurz) Miq.	6.90	0.96
52	*Strychnos nux-blanda* A.W.Hill	23.28	3.25
53	*Tamarindus indica* L.	3.45	0.48
54	*Tectona grandis* L. f.	111.21	15.52
55	*Tectona hamiltoniana* Wall.	14.66	2.05
56	*Vitex peduncularis* Wall.	4.31	0.60
57	*Vitex pubescens* Vahl	2.59	0.36
58	*Wendlandia tinctoria* DC.	7.76	1.08
59	*Xylia xylocarpa* (Roxb.)Taub.	133.62	18.65
60	*Ziziphus glabra* Roxb.	12.07	1.68
	Total	**716.38**	**100.00**

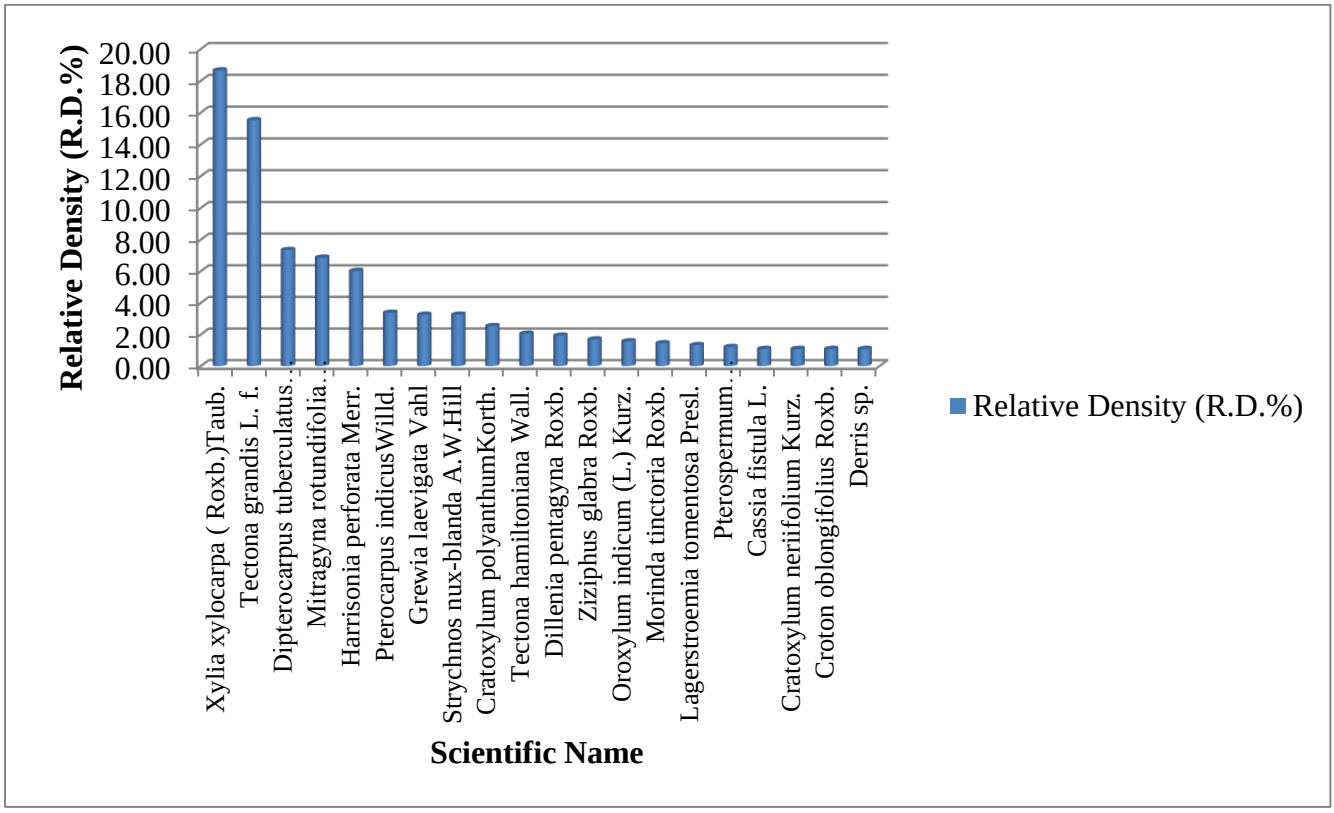
4.1.3. Relative density

Among the sample plots species density per hectare varied and the highest density was observed *Xylia xylocarpa* (Roxb.)Taub., *Tectona grandis* L. f., *Tetrameles nudiflora* R.Br.

followed by *Dipterocarpus tuberculatus* Roxb., *Mitragyna rotundifolia* (Roxb.) Kuntze and *Harrisonia perforata* Merr.. This shows that these six species are abundant in this area.

No.	Scientific Name	Density (D)	Relative Density (R.D.%)
1	*Xylia xylocarpa* (Roxb.)Taub.	5.34	18.65
2	*Tectona grandis* L. f.	4.45	15.52
3	*Dipterocarpus tuberculatus* Roxb.	2.10	7.34
4	*Mitragyna rotundifolia* (Roxb.) Kuntze	1.97	6.86
5	*Harrisonia perforata* Merr.	1.72	6.02
6	*Pterocarpus indicus*Willd.	0.97	3.37
7	*Grewia laevigata* Vahl	0.93	3.25
8	*Strychnos nux-blanda* A.W.Hill	0.93	3.25
9	*Cratoxylum polyanthum*Korth.	0.72	2.53
10	*Tectona hamiltoniana* Wall.	0.59	2.05
11	*Dillenia pentagyna* Roxb.	0.55	1.93
12	*Ziziphus glabra* Roxb.	0.48	1.68
13	*Oroxylum indicum* (L.) Kurz.	0.45	1.56
14	*Morinda tinctoria* Roxb.	0.41	1.44
15	*Lagerstroemia tomentosa* Presl.	0.38	1.32
16	*Pterospermum semisagittatum* Buch.-Ham.	0.34	1.20
17	*Cassia fistula* L.	0.31	1.08
18	*Cratoxylum neriifolium* Kurz.	0.31	1.08
19	*Croton oblongifolius* Roxb.	0.31	1.08
20	*Derris* sp.	0.31	1.08
21	*Wendlandia tinctoria* DC.	0.31	1.08
22	*Grewia hirsuta* Vahl	0.28	0.96
23	*Lannea coromandelica* (Houtt.) Merrr.	0.28	0.96
24	*Shorea siamensis* (Kurz) Miq.	0.28	0.96
25	*Phyllanthus emblica* L.	0.21	0.72
26	*Schleichera oleosa* (Lour.) Oken	0.21	0.72
27	*Adina cordifolia* Hook. f.	0.17	0.60
28	*Bauhinia malabarica* Roxb.	0.17	0.60
29	*Leucaena leucocephala* (Lam.) De.Wit	0.17	0.60
30	*Microcos paniculata* L.	0.17	0.60
31	*Shorea obtusa* Wall.	0.17	0.60
32	*Vitex peduncularis* Wall.	0.17	0.60
33	*Antidesma velutinum*Tul.	0.14	0.48
34	*Bridelia retusa* (L.) A. Juss.	0.14	0.48
35	*Cedrela serrata* Royle	0.14	0.48
36	*Dalbergia oliveri* Gamble	0.14	0.48
37	*Dalbergia rimosa* Roxb.	0.14	0.48
38	*Flacourtia cataphracta* Roxb.	0.14	0.48

39	*Ricinus communis* L.	0.14	0.48
40	*Tamarindus indica* L.	0.14	0.48
41	*Anogeissus acuminata* Wall.	0.10	0.36
42	*Bombax insigne* Wall.	0.10	0.36
43	*Careya arborea* Roxb.	0.10	0.36
44	*Dalbergia volubilis* Roxb.	0.10	0.36
45	*Vitex pubescens* Vahl	0.10	0.36
46	*Aegle marmelos* L.	0.07	0.24
47	*Albizia lebbekoides* (DC.) Benth.	0.07	0.24
48	*Chukrasia velutina* Roem.	0.07	0.24
49	*Colona floribunda*	0.07	0.24
50	*Dalbergia cultrata* Grah.	0.07	0.24
51	*Ficus religiosa* L.	0.07	0.24
52	*Getonia floribunda* Roxb.	0.07	0.24
53	*Mangifera indica* L.	0.07	0.24
54	*Melanorrhoea usitata* Wall.	0.07	0.24
55	*Millettia ovalifolia* Kurz	0.07	0.24
56	*Erythrina stricta* Roxb.	0.03	0.12
57	*Gmelina elliptica* Sm.	0.03	0.12
58	*Holarrhena pubescens* Wall. ex G. Don	0.03	0.12
59	*Hymenodictyon orixense* (Roxb.) Mabb.	0.03	0.12
60	*Prema pyramidata* Wall.	0.03	0.12

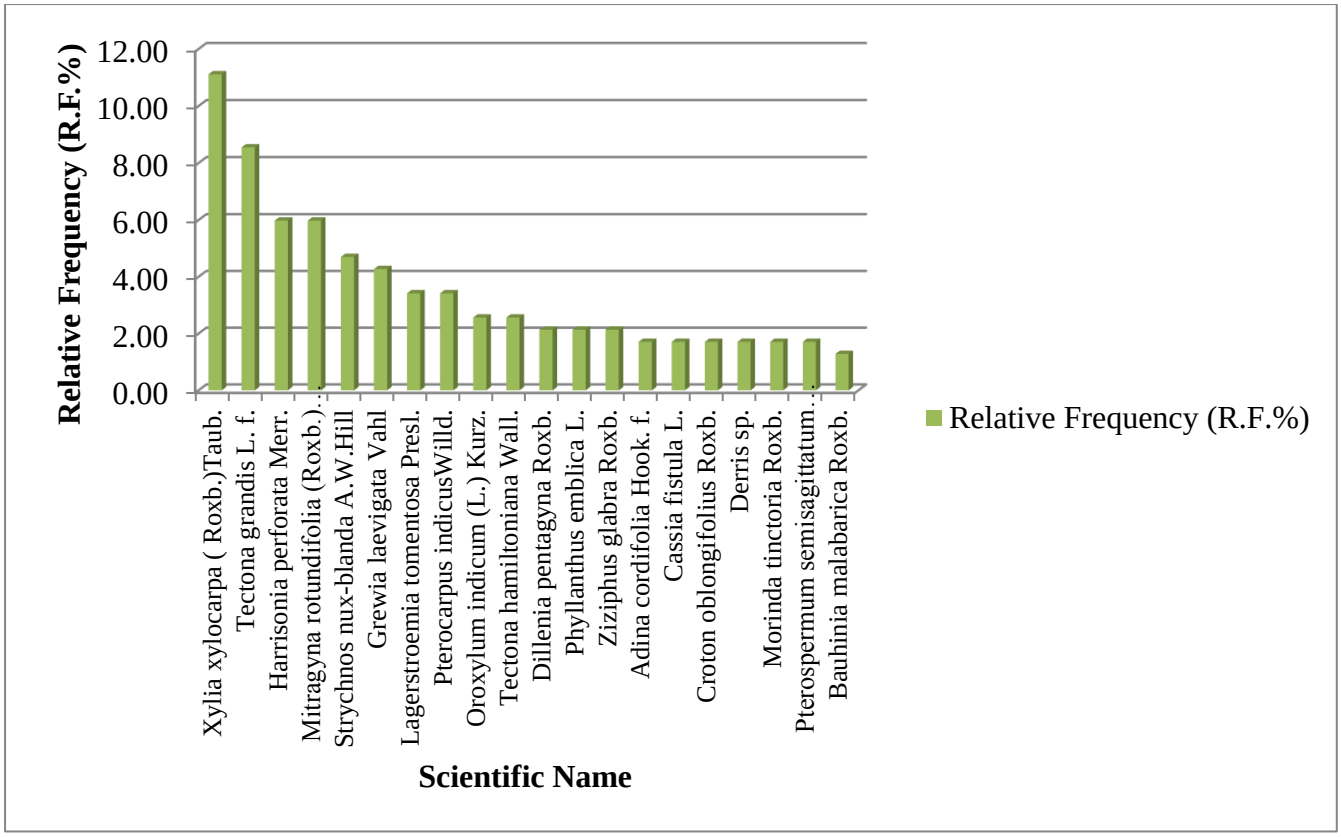


4.1.4. Relative frequency of Tree species

Relative frequency is the frequency of one species compared to the total frequency of all the species. According to the results**,** *Xylia xylocarpa* (Roxb.)Taub.is high relative frequency value (11%), follow by *Tectona grandis* L. f.(9) and *Harrisonia perforata* Merr. and *Mitragyna rotundifolia* (Roxb.) Kuntze are equally (6%). Therefore these species occur everywhere in the study area. The lower frequency of some species is *Mangifera indica* L. (Lamk.) Rich, *Ricinus communis* L., *Albizia lebbekoides* (DC.) Benth. and other species are equally (0.4%) demarcated as rare species in the area.

No.	Scientific Name	Frequency (F)	Relative Frequency (R.F.%)
1	*Xylia xylocarpa* (Roxb.)Taub.	0.90	11.11
2	*Tectona grandis* L. f.	0.69	8.55
3	*Harrisonia perforata* Merr.	0.48	5.98
4	*Mitragyna rotundifolia* (Roxb.) Kuntze	0.48	5.98
5	*Strychnos nux-blanda* A.W.Hill	0.38	4.70
6	*Grewia laevigata* Vahl	0.34	4.27
7	*Lagerstroemia tomentosa* Presl.	0.28	3.42
8	*Pterocarpus indicus*Willd.	0.28	3.42
9	*Oroxylum indicum* (L.) Kurz.	0.21	2.56
10	*Tectona hamiltoniana* Wall.	0.21	2.56
11	*Dillenia pentagyna* Roxb.	0.17	2.14
12	*Phyllanthus emblica* L.	0.17	2.14
13	*Ziziphus glabra* Roxb.	0.17	2.14
14	*Adina cordifolia* Hook. f.	0.14	1.71
15	*Cassia fistula* L.	0.14	1.71
16	*Croton oblongifolius* Roxb.	0.14	1.71
17	*Derris* sp.	0.14	1.71
18	*Morinda tinctoria* Roxb.	0.14	1.71
19	*Pterospermum semisagittatum* Buch.-Ham.	0.14	1.71
20	*Bauhinia malabarica* Roxb.	0.10	1.28
21	*Cratoxylum neriifolium* Kurz.	0.10	1.28
22	*Cratoxylum polyanthum*Korth.	0.10	1.28
23	*Dalbergia oliveri* Gamble	0.10	1.28
24	*Schleichera oleosa* (Lour.) Oken	0.10	1.28
25	*Tamarindus indica* L.	0.10	1.28
26	*Vitex peduncularis* Wall.	0.10	1.28
27	*Bombax insigne* Wall.	0.07	0.85
28	*Bridelia retusa* (L.) A. Juss.	0.07	0.85
29	*Careya arborea* Roxb.	0.07	0.85
30	*Cedrela serrata* Royle	0.07	0.85
31	*Chukrasia velutina* Roem.	0.07	0.85
32	*Colona floribunda*	0.07	0.85
33	*Dalbergia cultrata* Grah.	0.07	0.85

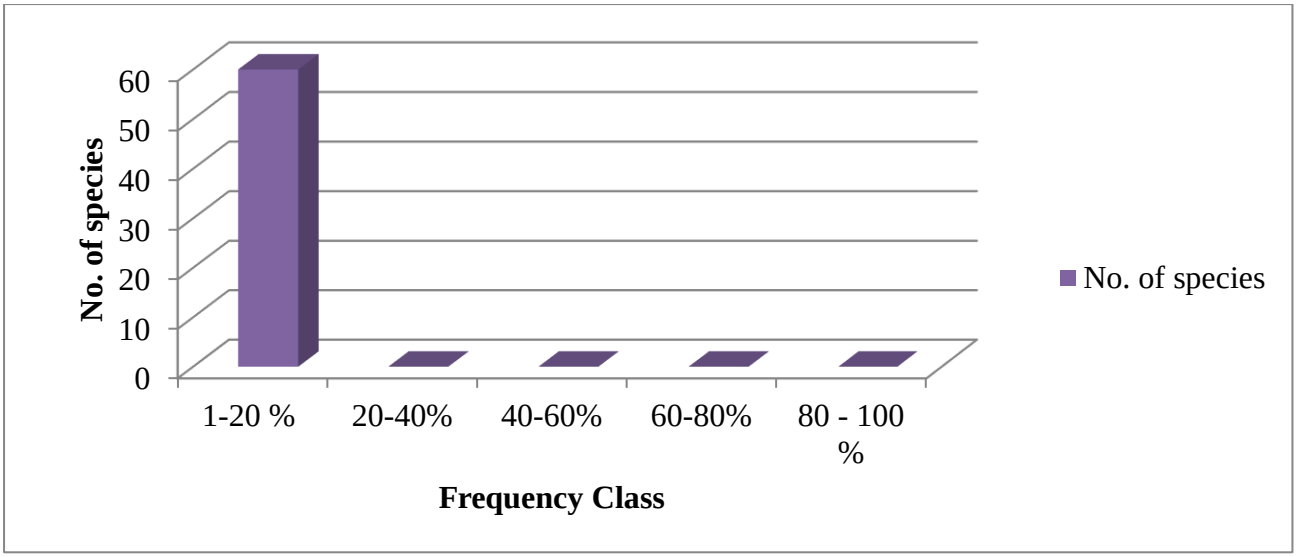
34	*Dipterocarpus tuberculatus* Roxb.	0.07	0.85
35	*Flacourtia cataphracta* Roxb.	0.07	0.85
36	*Grewia hirsuta* Vahl	0.07	0.85
37	*Leucaena leucocephala* (Lam.) De.Wit	0.07	0.85
38	*Microcos paniculata* L.	0.07	0.85
39	*Millettia ovalifolia* Kurz	0.07	0.85
40	*Shorea obtusa* Wall.	0.07	0.85
41	*Shorea siamensis* (Kurz) Miq.	0.07	0.85
42	*Vitex pubescens* Vahl	0.07	0.85
43	*Wendlandia tinctoria* DC.	0.07	0.85
44	*Aegle marmelos* L.	0.03	0.43
45	*Albizia lebbekoides* (DC.) Benth.	0.03	0.43
46	*Anogeissus acuminata* Wall.	0.03	0.43
47	*Antidesma velutinum*Tul.	0.03	0.43
48	*Dalbergia rimosa* Roxb.	0.03	0.43
49	*Dalbergia volubilis* Roxb.	0.03	0.43
50	*Erythrina stricta* Roxb.	0.03	0.43
51	*Ficus religiosa* L.	0.03	0.43
52	*Getonia floribunda* Roxb.	0.03	0.43
53	*Gmelina elliptica* Sm.	0.03	0.43
54	*Holarrhena pubescens* Wall. ex G. Don	0.03	0.43
55	*Hymenodictyon orixense* (Roxb.) Mabb.	0.03	0.43
56	*Lannea coromandelica* (Houtt.) Merrr.	0.03	0.43
57	*Mangifera indica* L.	0.03	0.43
58	*Melanorrhoea usitata* Wall.	0.03	0.43
59	*Prema pyramidata* Wall.	0.03	0.43
60	*Ricinus communis* L.	0.03	0.43



4.1.5. Species distribution by frequency class

In order to clarify the homogeneity and heterogeneity of the floristic distribution in the area, the species distribution by frequency class was examined. According to the outcome of the frequency classes zero species is in high frequency class and 60 species are in low frequency class. This shows that this area is floristically low degree of homogeneity.

Frequency class	No. of species
1-20 %	60
20-40%	0
40-60%	0
60-80%	0
80 - 100 %	0



4.1.6. Tree species in DBH class interval

The distribution of DBH interval class reveals the dominant of small stem individuals in the area 98% of the tree species are less than 40cm DBH. Large stem individuals with DBH more than 60cm and above are of 2 %. Majority of the trees are less than 40cm in diameter, which indicates that the forests secondary types.

DBH Class	No. of species	Total number of individual	% of total population
<40cm	812	700.00	97.71
41-60cm	9	7.76	1.08
61-80cm	8	6.90	0.96
81-100cm	0	0.00	0.00
>101cm	2	1.72	0.24
Total	**831**	**716.38**	**100.00**

4.1.7. Tree species in Height class interval

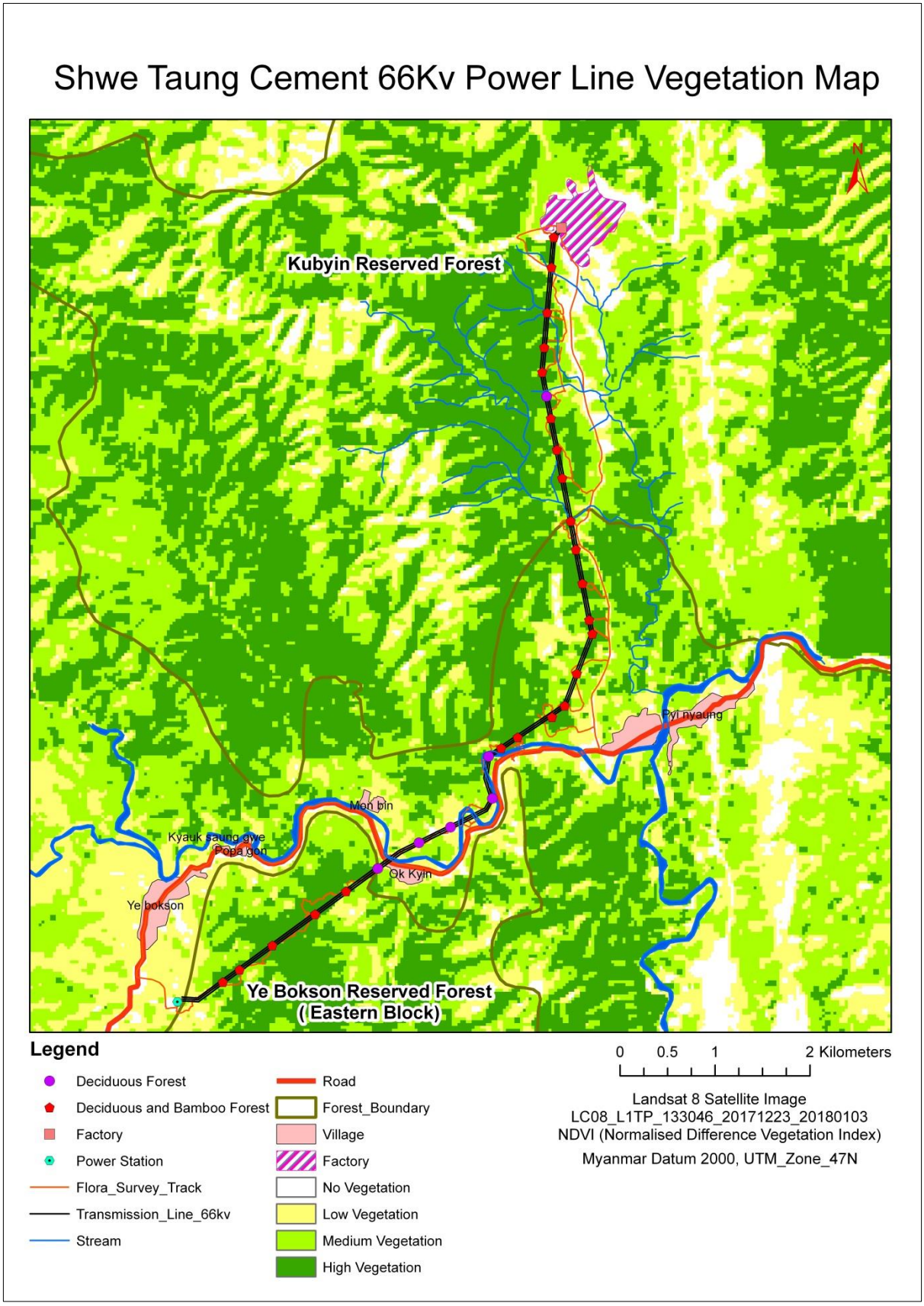
The distribution of Height shows that 715 individuals are less than 10 meter, comprising 100% of the total population and 2 individuals are 15meter and above, comprising the 0%. Since most canopy height classes are less than 10m, the forests in the area could be classified as secondary forests.

Height Class	No. of species	Total number of individual	% of total population
<10m	829	714.66	99.76
11-15m	0	0.00	0.00
16-20m	0	0.00	0.00
21-25m	0	0.00	0.00
>26m	2	1.72	0.24
Total	**831**	**716.38**	**100.00**

4.1.8. Vegetation type in the study area

No.	Sample Quadrant	Vegetation type	Longitude	Latitude	Altitude (m)	Dominant species
1	TLQ I	Deciduous and Bamboo Forest	96.353572	20.796157	367	*Xylia xylocarpa (Roxb.)Taub.,Tectona grandis L. f.,Dendrocalamus membranaceus Munro,Dipterocarpus tuberculatus Roxb.,Mitragyna rotundifolia (Roxb.) Kuntze,Thyrsostachys oliveri Gamble,Harrisonia perforata Merr.,Pterocarpus indicusWilld.,Bambusa polymorpha Munro , Grewia laevigata Vahl, Strychnos nux-blanda A.W.Hill, Cratoxylum polyanthumKorth., Tectona hamiltoniana Wall., Dillenia pentagyna Roxb., Ziziphus glabra Roxb.,Oroxylum indicum (L.) Kurz.,Morinda tinctoria Roxb., Morinda tinctoria Roxb.,Lagerstroemia tomentosa Presl., Pterospermum semisagittatum Buch.-Ham.,Cephalostachyum pergracile Munro*
2	TLQ II		96.355297	20.797291	391	
3	TLQ III		96.358655	20.799545	357	
4	TLQ IV		96.363047	20.802422	359	
5	TLQ V		96.366216	20.804535	340	
6	TLQ VI	Deciduous Forest	96.369471	20.806642	325	
7	TLQ VII		96.373686	20.809006	325	
8	TLQ VIII		96.376903	20.810425	311	
9	TLQ IX		96.381196	20.813073	307	
10	TLQ X		96.380900	20.817072	305	
11	TLQ XI	Deciduous and Bamboo Forest	96.382194	20.817834	329	
12	TLQ XII		96.383884	20.818839	321	
13	TLQ XIII		96.387393	20.820677	318	
14	TLQ XIV		96.388706	20.821746	329	
15	TLQ XV		96.389999	20.824781	316	
16	TLQ XVI		96.391650	20.828520	338	
17	TLQ XVII		96.391356	20.829849	345	
18	TLQ XVIII		96.390750	20.833333	333	
19	TLQ XIX		96.390164	20.836563	347	
20	TLQ XX		96.389701	20.839293	338	
21	TLQ XXI		96.388940	20.843381	346	
22	TLQ XXII		96.388459	20.846078	359	
23	TLQ XXIII		96.387923	20.849093	371	
24	TLQ XXIV	Deciduous Forest	96.387531	20.851189	372	
25	TLQ XXV	Deciduous and Bamboo Forest	96.387146	20.853499	370	
26	TLQ XXVI		96.387402	20.855845	365	
27	TLQ XXVII		96.387777	20.859151	353	
28	TLQ XXVIII		96.388299	20.863441	367	
29	TLQ XXIX		96.388599	20.866293	360	

Map III.


Shwe Taung Cement 66Kv Power Line Vegetation Map
N
Kubyin Reserved Forest
Pyi nyaung
Mon bin
Kyauk saung gwe
Popa gon
Ok Kyin
Ye bokson
Ye Bokson Reserved Forest
(Eastern Block)
Legend
Deciduous Forest
Deciduous and Bamboo Forest
Factory
Power Station
Flora_Survey_Track
Transmission_Line_66kv
Stream
Road
Forest_Boundary
Village
Factory
No Vegetation
Low Vegetation
Medium Vegetation
High Vegetation
0 0.5 1 2 Kilometers
Landsat 8 Satellite Image
LC08_L1TP_133046_20171223_20180103
NDVI (Normalised Difference Vegetation Index)
Myanmar Datum 2000, UTM_Zone_47N

4.2. Bamboo Forest

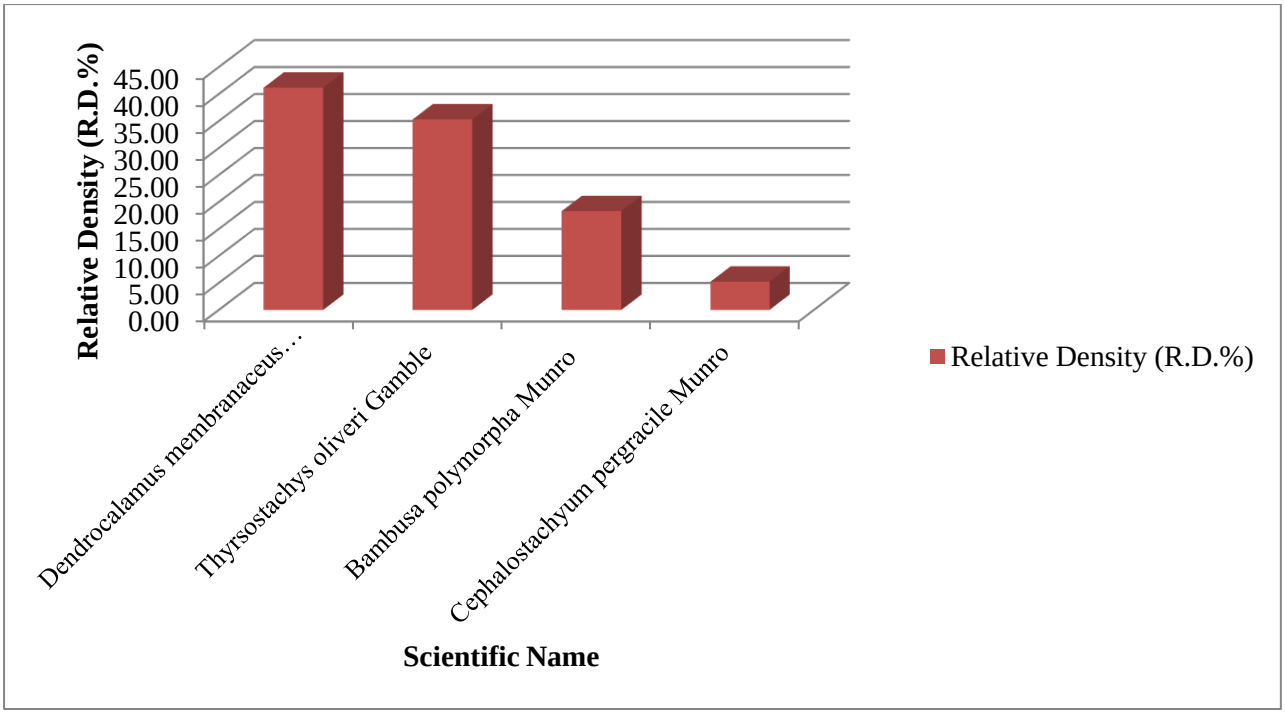

Bamboo Forest

4.2.1. Bamboo Species Population

No.	Scientific Name	Total no. of individual/ha	Total no. of population/ha(%)
1	*Bambusa polymorpha* Munro	30.43	18.30
2	*Cephalostachyum pergracile* Munro	8.70	5.23
3	*Dendrocalamus membranaceus* Munro	68.48	41.18
4	*Thyrsostachys oliveri* Gamble	58.70	35.29
	Total	**166.30**	**100.00**

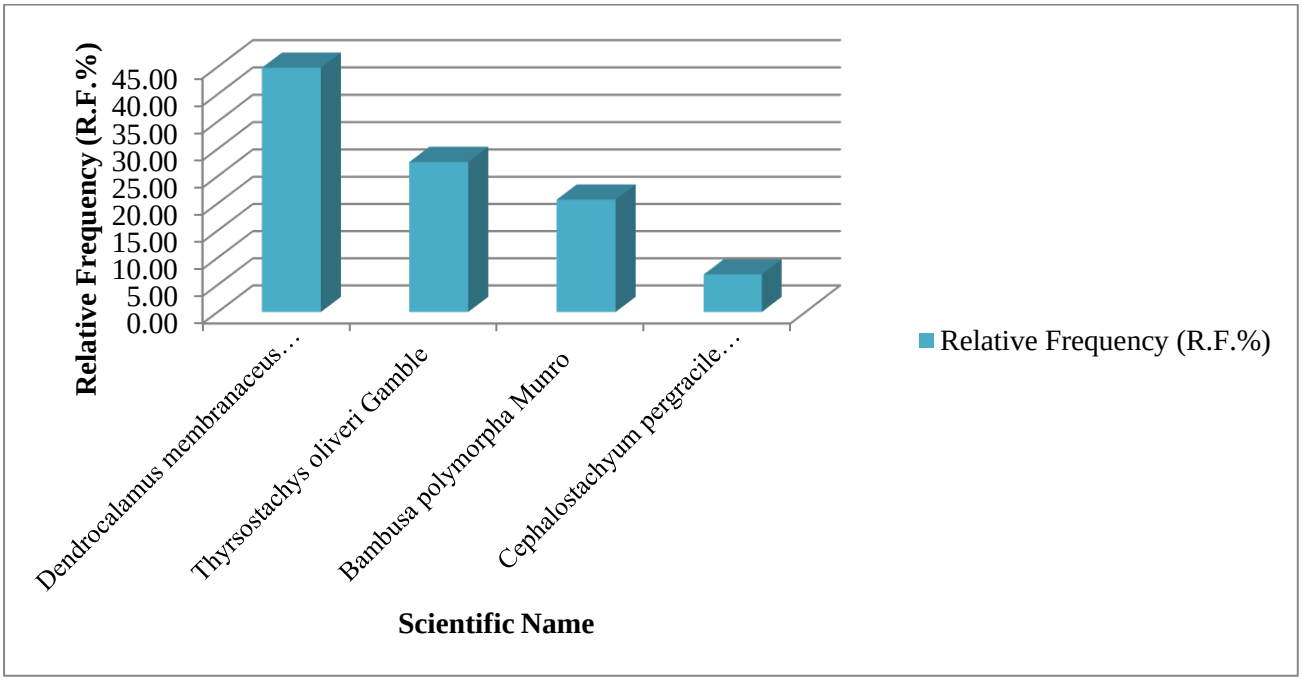
4.2.2. Relative density

No.	Scientific Name	Density (D)	Relative Density (R.D.%)
1	*Dendrocalamus membranaceus* Munro	2.74	41.18
2	*Thyrsostachys oliveri* Gamble	2.35	35.29
3	*Bambusa polymorpha* Munro	1.22	18.30
4	*Cephalostachyum pergracile* Munro	0.35	5.23



4.2.3. Species distribution

No.	Scientific Name	Frequency (F)	Relative Frequency (R.F.%)
1	*Dendrocalamus membranaceus* Munro	0.57	44.83
2	*Thyrsostachys oliveri* Gamble	0.35	27.59
3	*Bambusa polymorpha* Munro	0.26	20.69
4	*Cephalostachyum pergracile* Munro	0.09	6.90



4.3. Invasive Species List of Transmission Line Area

Portulaca oleracea L.

Ageratum conyzoides L.

Chromolaena odorata (L.) R.M. King & H Robinson

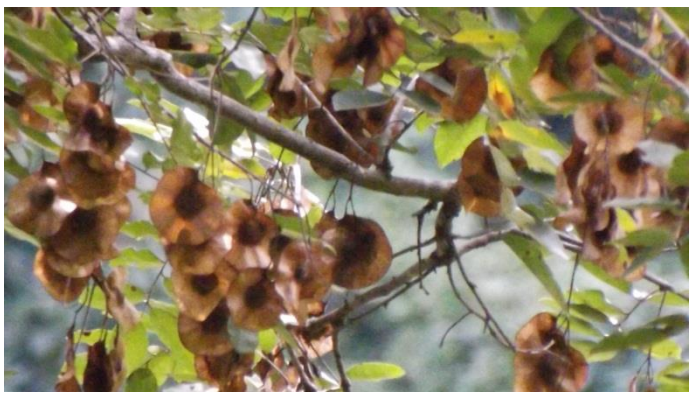
Bidens pilosa

Leucaena leucocephala (Lam.) De.Wit

Ricinus communis L.

No	Scientific Names	Familiy	Common Names	Origin
1	*Ageratum conyzoides* L.	Asteraceae	Khwe-thay-pan	Tropical America
2	*Adenanthera pavonina* L.	Mimosaceae	Ywe-gyi	India, Malaysia
3	*Amaranthus spinosus* L.	Amaranthaceae	Hnin-nu-new-su-bauk	Tropical America
4	*Bidens pilosa*	Asteraceae	Hmwe-sok	Tropical America
5	*Caesalpinia decapetala* (Roth.)Alston	Caesalpinaceae	Suk-yan-bo /Kyant-sa-su-pin	Tropical Asia
6	*Chromolaena odorata* (L.) R.M. King & H Robinson	Asteraceae	Bi-zet	Central America, South America
7	*Ficus religiosa* L.	Moraceae	Baw-di-nyaung	India/Native
8	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	Taw-pin-sein	Tropical America
9	*Imperata cylindrica*	Poaceae	Thet-ke	Old world
10	*Leucaena leucocephala* (Lam.) De.Wit	Mimosaceae	Baw-za-gaing	Hawaii
11	*Mimosa pudica* L.	Mimosaceae	Hti-ka-yone	South America, Mexico, Amazon,Tropical America
12	*Oroxylum indicum* (L.) Kurz.	Bignoniaceae	Kyaung-sha	India
13	*Paederia foetida* L.	Rubiaceae	Pe-bok-nwee	Asia
14	*Portulaca oleracea* L.	Portulacaceae	Myay-byit	Possibly Central America
15	*Ricinus communis* L.	Euphorbiaceae	Kyet-su India	India
16	*Ziziphus jujuba* Lam.	Rhamnaceae	Zi	China

4.4. Myanmar Protected Species List of Transmission Line Area



*Pterocarpus indicus*Willd.

Bombax insigne Wall.

No.	Scientific Name	Common Name	Family Name
1	*Bombax insigne* Wall.	De-du	Bombacaceae
2	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae
3	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae
4	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae

4.5. IUCN red list species of Transmission Line Area

Dalbergia oliveri

Dalbergia cultrata

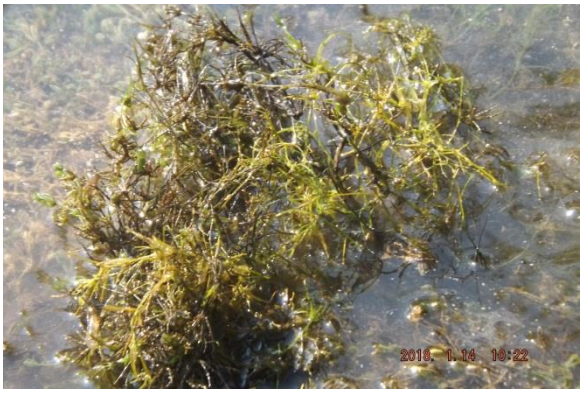
Shorea siamensis

Dipterocarpus tuberculatus

Lygodium microphyllum

Dalbergia rimosa Roxb.

Hydrolea zeylanica (L.) Vahl



Najas minor

No.	Scientific Name	Common Name	Family Name	IUCN Criteira
1	*Aeschynomene indica* L.	Not known	Fabaceae	LC ver 3.1
2	*Alternanthera sessilis* (L.) R.Br.	Pa-zun-sa-yaing	Amaranthaceae	LC ver 3.1
3	*Carica papaya* L.	Thin-baw	Caricaceae	DD ver 3.1
4	*Colocasia esculenta*	Pein-yaing	Araceae	LC ver 3.1
5	*Commelina diffusa*	Wet-kyut	Commelinaceae	LC ver 3.1
6	*Cyclosorus interruptus*	Swamp Fern	Thelypteridaceae	LC ver 3.1
7	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	NT ver 3.1
8	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae	EN A1 cd ver 2.3
9	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	LC ver 3.1
10	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	LC ver 3.1
11	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae	NT ver 3.1
12	*Holarrhena pubescens* Wall. ex G. Don	Let-htok-gyi	Apocynaceae	LC ver 3.1
13	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	LC ver 3.1
14	*Hydrolea zeylanica* (L.) Vahl	Not known	Hydrophyllaceae	LC ver 3.1
15	*Ipomoea aquatica* Forssk.	Ka-zun	Convolvulaceae	LC ver 3.1
16	*Limnophila chinensis* (Osbeck) Merr.	Ye-tha-yet-kin	Scrophulariaceae	LC ver 3.1
17	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	LC ver 3.1
18	*Lygodium microphyllum*	Climbing Fern	Schizaeaceae	LC ver 3.1
19	*Mangifera indica* L.	Taw-tha-yet	Anacardiaceae	DD ver 2.3
20	*Marsilea crenata*	Hmo-na-to	Marsileaceae	LC ver 3.1
21	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae	LC ver 3.1
22	*Najas minor*	Brittleleaf	Najadaceae	LC ver 3.1
23	*Potamogeton natans* L.	Floating-leaf Pondweed	Potamogetonaceae	LC ver 3.1
24	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	VU ver 2.3
25	*Saccharum spontaneum* L.	Kaing	Poaceae	LC ver 3.1
26	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	NT ver 3.1
27	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	LR/lc ver 2.3
28	*Tamarindus indica* L.	Ma-gyi	Caesalpiniaceae	LC ver 3.1
29	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae	LC ver 3.1
DD=Data Deficient, EN=Endangered, LC=Least Concern, LR/lc=Lower Risk/least concern, NT=Near Threatened, VU=Vulnerable				

4.6. Red List Species in Quadrant according to their coordination

OBJECTID	Elevation(m)	Name	IUCN red list Species	Comment	T _Name	Description	POINT_X / Long	POINT_Y / Lat
1	356	cultivated land		2018-01-12 7:31:57AM	T1	Old point 1262	96.349	20.794
2	359	cultivated land		2018-01-12 7:47:36AM	T2	Old point 1263	96.351	20.795
3	367	TLQ I	*Pterocarpus indicus*Willd.,*Tamarindus indica* L., *Dendrocalamus membranaceus* Munro	2018-01-12 8:05:35AM	T3	Old point 1264	96.354	20.796
4	391	TLQ II	*Dendrocalamus membranaceus* Munro	2018-01-12 8:29:10AM	T4	Old point 1266	96.355	20.797
5	357	TLQ III	*Dendrocalamus membranaceus* Munro	2018-01-12 9:04:23AM	T5	Old point 1267	96.359	20.8
6	359	TLQ IV	*Dendrocalamus membranaceus* Munro	2018-01-12 9:45:04AM	T6	Old point 1271	96.363	20.802
7	340	TLQ V	*Mangifera indica* L., *Dalbergia rimosa* Roxb.	2018-01-12 10:47:31AM	T7	Old point 1272	96.366	20.805
8	325	TLQ VI	*Dalbergia oliveri* Gamble	2018-01-12 11:14:17AM	T8	Old point 1257	96.369	20.807
9	314	Banana & Mangoes cultivation		2018-01-12 1:55:35PM	T9	Old point 1255	96.372	20.808
10	325	TL Q VII		2018-01-12 2:03:48PM	T10	Old point 1253	96.374	20.809
11	311	TLQ VIII	*Tamarindus indica* L.	2018-01-12 2:23:38PM	T11	Old point 1252	96.377	20.81
12	315	Banana & Mangoes cultivation		2018-01-12 3:03:05PM	T12	Old point 1250	96.381	20.812
13	307	TLQ IX		2018-01-12 3:12:17PM	T13	Old point 1249	96.381	20.813
14	311	Banana & Mangoes cultivation		2018-01-12 3:25:13PM	T14	Old point 1246	96.381	20.815
15	305	TLQ X	*Tamarindus indica* L.	2018-01-12 3:42:36PM	T15	Old point 1244	96.381	20.817
16	329	TLQ XI	*Dendrocalamus membranaceus* Munro	2018-01-12 4:04:55PM	T16	Old point 1242	96.382	20.818
17	321	TLQ XII	*Dendrocalamus membranaceus* Munro	2018-01-12 4:40:59PM	T17	Old point 1240	96.384	20.819
18	318	TLQ XIII	*Dendrocalamus membranaceus* Munro	2018-01-13 8:11:46AM	T18	Old point 1237	96.387	20.821
19	329	TLQ XIV	*Dendrocalamus membranaceus* Munro	2018-01-13 8:35:58AM	T19	Old point 1235	96.389	20.822

20	316	TLQ XV		2018-01-13 8:57:55AM	T20	Old point 1234	96.39	20.825
21	338	TLQ XVI	*Pterocarpus indicus*Willd., *Dendrocalamus membranaceus* Munro	2018-01-13 9:25:34AM	T21	Old point 1233	96.392	20.829
22	345	TLQ XVII	*Dendrocalamus membranaceus* Munro	2018-01-13 9:44:47AM	T22	Old point 1232	96.391	20.83
23	333	TLQ XVIII		2018-01-13 10:11:07AM	T23	Old point 1230	96.391	20.833
24	347	TLQ XIX	*Pterocarpus indicus*Willd.,	2018-01-14 12:04:06PM	T24	Old point 1228	96.39	20.837
25	338	TLQ XX	*Dalbergia oliveri* Gamble, *Dendrocalamus membranaceus* Munro	2018-01-14 7:42:47AM	T25	Old point 1227	96.39	20.839
26	346	TLQ XXI	*Pterocarpus indicus*Willd., *Dendrocalamus membranaceus* Munro	2018-01-14 8:15:13AM	T26	Old point 1222	96.389	20.843
27	359	TLQ XXII	*Holarrhena pubescens* Wall. ex G. Don, *Dendrocalamus membranaceus* Munro	2018-01-14 8:39:55AM	T27	Old point 1224	96.388	20.846
28	371	TLQ XXIII	*Pterocarpus indicus*Willd.,	2018-01-14 8:57:28AM	T28	Old point 1225	96.388	20.849
29	372	TLQ XXIV		2018-01-14 9:17:13AM	T29	Old point 1218	96.388	20.851
30	370	TLQ XXV		2018-01-14 9:41:59AM	T30	Old point 1217	96.387	20.853
31	365	TLQ XXVI	*Dalbergia cultrata* Grah.	2018-01-14 10:00:48AM	T31	Old point 1213	96.387	20.856
32	353	TLQ XXVII		2018-01-14 10:40:52AM	T32	Old point 1209	96.388	20.859
33	367	TLQ XXVIII	*Dalbergia oliveri* Gamble	2018-01-14 11:04:53AM	T33	Old point 1205 / 1206	96.388	20.863
34	360	TLQ XXIX	*Pterocarpus indicus*Willd., *Dalbergia cultrata* Grah. *Shorea obtusa* Wall., *Shorea siamensis* (Kurz) Miq., *Dipterocarpus tuberculatus* Roxb.	2018-01-14 11:27:55AM	T34	Old point 1204	96.389	20.866
35	366	Apache site		2018-01-14 11:43:10AM	T35	Old point 1202	96.389	20.867
TLQ =Transmission Line Quadrant								

4.7. Checklist of Transmission Line Area

No.	Scientific Name	Common Name	Family Name	Habits
1	*Acacia concinna* (Willd.) DC.	Taw-kin-mon-chin	Mimosaceae	Cl/Cr
2	*Acacia intsia* Willd.	Su-pok-gyi	Mimosaceae	CL
3	*Acacia pennata* (L.) Willd.	Su-yit	Mimosaceae	Cl/Cr
4	*Achyranthes aspera* L.	Kyet-mauk-su-pyan	Amaranthaceae	S
5	*Acmella calva* (DC.) R.K. Jansen	Pe-lay-nyin	Asteraceae	H
6	*Adenanthera pavonina* L.	Ywe-gyi	Mimosaceae	T
7	*Adina cordifolia* Hook. f.	Hnaw	Rubiaceae	T
8	*Aegle marmelos* L.	Ok-shit	Rutaceae	T
9	*Aeschynomene indica* L.	Not known	Fabaceae	S
10	*Ageratum conyzoides* L.	Khwe-thay-pan	Asteraceae	H
11	*Albizia lebbekoides* (DC.) Benth.	Taung-ma-gyi	Mimosaceae	T
12	*Alternanthera sessilis* (L.) R.Br.	Pa-zun-sa-yaing	Amaranthaceae	H
13	*Amaranthus spinosus* L.	Hnin-nu-new-su-bauk	Amaranthaceae	H
14	*Ampelocissus barbata* Planch.	Not known	Vitaceae	CL
15	*Anacolosa griffithii* Mast.	Taw-tha-na-kha	Olacaceae	ST
16	*Anogeissus acuminata* Wall.	Yon	Combretaceae	T
17	*Anthocephalus morindaefolius* Korth.	Ma-u-let-tan-shae	Rubiaceae	T
18	*Antidesma velutinum*Tul.	Kin-pa-lin	Euphorbiaceae	ST
19	*Aporusa dioica* (Roxb.) Mull.Arg.	Thit-khauk	Euphorbiaceae	T
20	*Argyreia roxburghii* Choisy	Ka-zun	Convolvulaceae	CL
21	*Bambusa polymorpha* Munro	Kya-thaung-wa	Poaceae	B
22	*Barleria strigosa* Willd.	Not known	Acanthaceae	H
23	*Bauhinia malabarica* Roxb.	Pha-lan/Chin-byit	Caesalpiniaceae	T
24	*Bidens pilosa*	Hmwe-sok	Asteraceae	H
25	*Bliospermum axillare* Blume	Hnat-cho	Euphorbiaceae	H
26	*Blume balsamifera* DC..	Phon-ma-thein	Asteraceae	S
27	*Bombax ceiba* L.	Let-pan	Bombacaceae	T
28	*Bombax insigne* Wall.	De-du	Bombacaceae	T
29	*Borassus flabellifer* L.	Htan	Arecaceae	T
30	*Bridelia retusa* (L.) A. Juss.	Seik chi	Euphorbiaceae	ST
31	*Buddleja asiatica* Lour	Pon-ma-gi	Buddlejaceae	S
32	*Butea superba* Roxb.	Pauk-nwee	Fabaceae	Cl/Cr
33	*Caesalpinia crista* L.	Ka-lein	Caesalpiniaceae	Cl/Cr
34	*Caesalpinia decapetala (Roth.)Alston*	Suk-yan-bo /Kyant-sa-su-pin	Caesalpiniaceae	Cl/Cr
35	*Caesalpinia mimosoides* Lam.	Not known	Caesalpiniaceae	CL
36	*Calotropis gigantea* (L.) Dryand. ex W.T. Aiton	Ma-yoe	Apocynaceae	S
37	*Calycopteris floribunda* Lam.	Gyut-nwe	Combretaceae	Cl/Cr
38	*Canscora diffusa* (Vahl) R.Br.	Kyauk-pan	Gentianaceae	H
39	*Cardiopteris quinqueloba* (Hassk.) Hassk.	Gan-gaw-nwee	Cardiopteridaceae	CL
40	*Careya arborea* Roxb.	Ban-bwe	Lecythidaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
41	*Carica papaya* L.	Thin-baw	Caricaceae	ST
42	*Cassia fistula* L.	Ngu	Caesalpiniaceae	T
43	*Cayratia trifolia* (L.) Domin	Taw-sa-byit	Vitaceae	CL
44	*Cedrela serrata* Royle	Taung-ta-ma	Meliaceae	T
45	*Celosia argentea* L.	Taw-kyet-mauk	Amaranthaceae	S
46	*Cephalostachyum pergracile* Munro	Tin-wa	Poaceae	B
47	*Chromolaena odorata* (L.) R.M. King & H Robinson	Bi-zet	Asteraceae	S
48	*Chukrasia velutina* Roem.	Yin-ma	Meliaceae	T
49	*Cicer arietinum* L.	Ka-la-pe	Fabaceae	H
50	*Clausena excavata* Burm. f.	Seik-nan	Rutaceae	S
51	*Clematic fasiculiflora* L.	Khwa-nyo	Ranunculaceae	CL
52	*Cnestis palala* Merr.	Khwee-dauk	Connaraceae	ST
53	*Colocasia esculenta*	Pein-yaing	Araceae	H
54	*Colona floribunda*	Phet-waing	Tiliaceae	T
55	*Commelina diffusa*	Wet-kyut	Commelinaceae	H
56	*Congea tomentosa* Roxb.	Tha-ma-ga-nwee	Verbenaceae	Cl/Cr
57	*Corchorus aestuans* L.	Byauk-o	Tiliaceae	S
58	*Corchorus capsularis* L.	Gon-shaw-yine	Tiliaceae	S
59	*Costus specious* Sm.	Pha-lan-taung-hmwe	Costaceae	H
60	*Crassocephalum crepidioides* (Benth.) S. Moor.	Pan-zauk-htoe	Asteraceae	H
61	*Cratoxylum neriifolium* Kurz.	Be-bya	Hypericaceae	ST
62	*Cratoxylum polyanthum*Korth.	Be-bya	Hypericaceae	ST
63	*Crotalaria mucronata* L.	Taw-peik-san	Fabaceae	S
64	*Croton joufra* Roxb.	Tha-yin-kado	Euphorbiaceae	S
65	*Croton oblongifolius* Roxb.	Tha-yin-gyi	Euphorbiaceae	ST
66	*Cucumis maderaspatanus*	Not known	Cucurbitaceae	CL
67	*Curcuma aurantiaca*	Ma-la	Zingiberaceae	H
68	*Cyclosorus interruptus*	Swamp Fern	Thelypteridaceae	F
69	*Cynodon dactylon* (L.) Pers.	Myay-sa	Poaceae	G
70	*Dactyloctenium aegyptium*	Myet-lay-khwa	Poaceae	G
71	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	T
72	*Dalbergia oliveri* Gamble	Ta-ma-lan	Fabaceae	T
73	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	ST
74	*Dalbergia volubilis* Roxb.	Daung-ta-laung	Fabaceae	ST
75	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	B
76	*Derris* sp.	Not known	Fabaceae	ST
77	*Desmodium heterocarpon*	Myay-pe-htwe	Fabaceae	S
78	*Desmodium longipes*	Not known	Fabaceae	S
79	*Desmodium triangulare* (Retz.) Merr.	Not known	Fabaceae	S
80	*Desmodium triflorum* (L.) DC.	Not known	Fabaceae	H
81	*Dillenia parviflora* Griff	Kyet-zin-byun	Dilleniaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
82	*Dillenia pentagyna* Roxb.	Zin-byun	Dilleniaceae	T
83	*Dioscorea bulbifera* L.	Khat-cho	Dioscoreaceae	Cl/Cr
84	*Dipterocarpus tuberculatus* Roxb.	In	Dipterocarpaceae	T
85	*Ehretia acuminata* R.Br	Taung-poe-lu-lin	Boraginaceae	T
86	*Elephantopus scaber* L.	Not known	Asteraceae	H
87	*Erythrina stricta* Roxb.	Taung-ka-thit	Fabaceae	T
88	*Euphorbia hypericifolia* L.	Kywe-kyaung-hmin-se	Euphorbiaceae	H
89	*Evolvulus nummularius* L.	Kyauk-kwe	Convolvulaceae	H
90	*Ficus hispida* L.	Kha-aung	Moraceae	ST
91	*Ficus religiosa* L.	Baw-di-nyaung	Moraceae	T
92	*Flacourtia cataphracta* Roxb.	Na-ywe	Flacourtiaceae	T
93	*Flemingia congesta* Roxb.	Kye-hmi	Fabaceae	S
94	*Flemingia macrophylla* (Willd.) Merr.	Pha-lan-phyu	Fabaceae	S
95	*Gardenia coronaria* Buch-Ham.	Yin-khat-gyi	Rubiaceae	T
96	*Garuga pinnata* Roxb.	Chin-yok	Burseraceae	T
97	*Getonia floribunda* Roxb.	Kywet-nwee	Combretaceae	Cl/Cr
98	*Gmelina elliptica* Sm.	Nwee-sat	Verbenaceae	ST
99	*Grewia hirsuta* Vahl	Ta-yaw	Tiliaceae	ST
100	*Grewia laevigata* Vahl	Kyet-ta-yaw	Tiliaceae	ST
101	*Harrisonia perforata* Merr.	Su-gyin	Simaroubaceae	S
102	*Heliotropium indicum* L.	Sin-hna-maung-gyi	Boraginaceae	H
103	*Heterophragma adenophyllum* Seem.	Phet-than	Bignoniaceae	ST
104	*Hibiscus macrophyllus*	Taung-phet-wun	Malvaceae	T
105	*Holarrhena pubescens* Wall. ex G. Don	Let-htok-gyi	Apocynaceae	ST
106	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	S
107	*Hydrolea zeylanica* (L.) Vahl	Not known	Hydrophyllaceae	H
108	*Hymenodictyon orixense* (Roxb.) Mabb.	Khu-san	Rubiaceae	T
109	*Hyptis rhomboidea* Mart	Not known	Lamiaceae	H
110	*Hyptis suaveolens* (L.) Poit.	Taw-pin-sein	Lamiaceae	S
111	*Imperata cylindrica*	Thet-ke	Poaceae	G
112	*Ipomoea aquatica* Forssk.	Ka-zun	Convolvulaceae	CL
113	*Ipomoea quamoclit* L.	Myet-lay-ni	Convolvulaceae	Cl/Cr
114	*Justica tranquebariensis* L. f.	Not known	Acanthaceae	S
115	*Lagerstroemia macrocarpa* Kurz	Pyin-ma-ywet-gyi	Lythraceae	T
116	*Lagerstroemia speciosa* (L.)Pers.	Pyin-ma-ywet-thay	Lythraceae	T
117	*Lagerstroemia tomentosa* Presl.	Lae-sa	Lythraceae	T
118	*Lannea coromandelica* (Houtt.) Merrr.	Na-be	Anacardiaceae	T
119	*Leea hirta* Banks	Naga-mauk-phyu	Leeaceae	S
120	*Leea macrophylla* Roxb.	Kya-phet-gyi	Leeaceae	S
121	*Leea rubra* Blume.	Naga-mauk-ni	Leeaceae	S
122	*Lepidagathis hyalina* Nees.	Not known	Acanthaceae	S

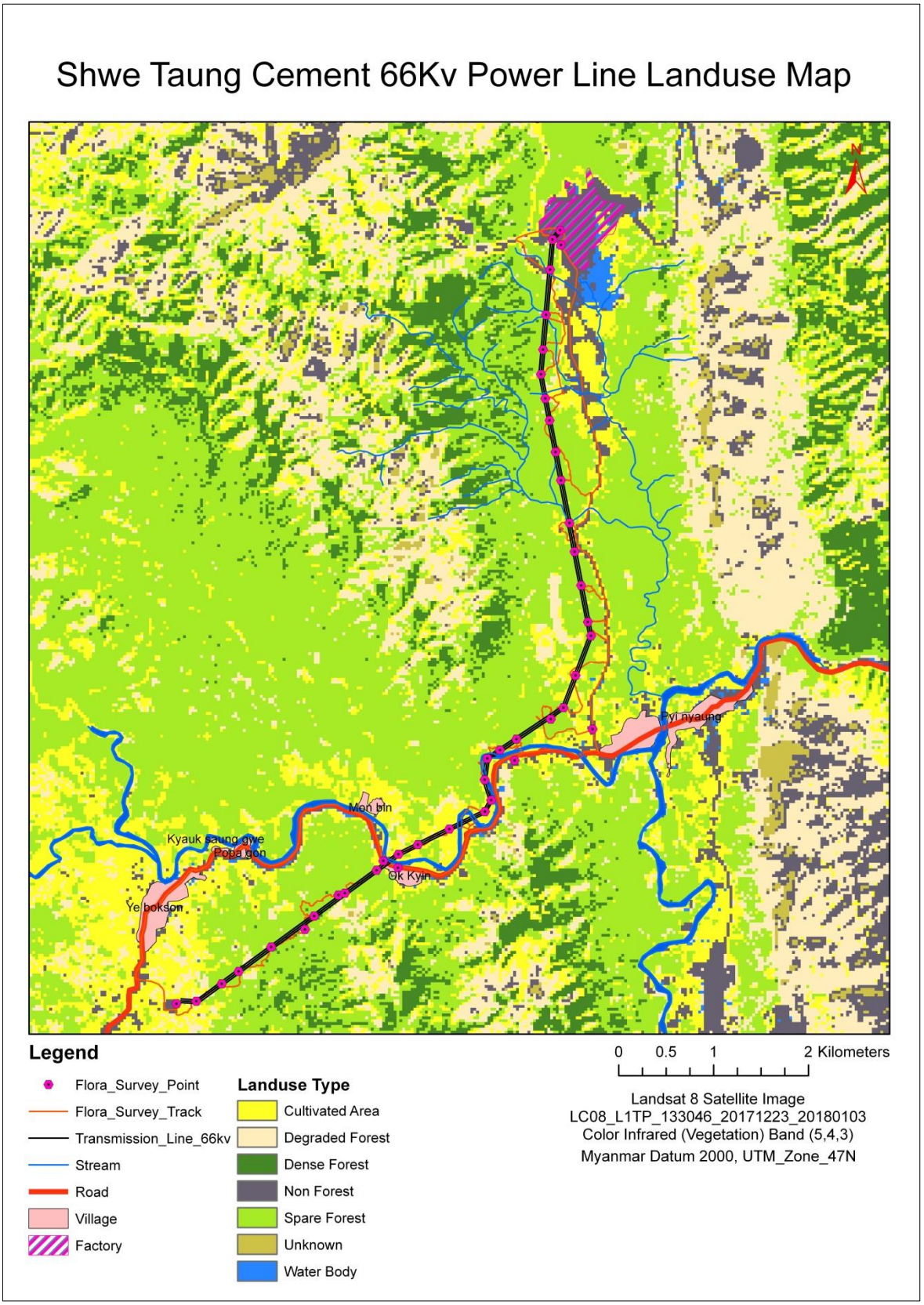
No.	Scientific Name	Common Name	Family Name	Habits
123	*Leptadenia reticulata* Wight & Arn.	Gon-kha	Asclepiadaceae	Cl/Cr
124	*Leucaena leucocephala* (Lam.) De.Wit	Baw-za-gaing	Mimosaceae	ST
125	*Leucas aspera* (Willd.) Link.	Pin-gu-hteik-paik	Laminaceae	H
126	*Limnophila chinensis* (Osbeck) Merr.	Ye-tha-yet-kin	Scrophulariaceae	AqH
127	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	H
128	*Luffa aegyptiaca* Mill.	Tha-but-kha	Cucurbitaceae	Cl/Cr
129	*Lycopersicon esculentum* Mill.	Kha-yan-gyin	Solanaceae	Cl/Cr
130	*Lygodium microphyllum*	Climbing Fern	Schizaeaceae	F
131	*Mallotus macrostachyus*	Not known	Euphorbiaceae	ST
132	*Mallotus philippinesis* (Lam.) Muell. Arg.	Taw-thi-din	Euphorbiaceae	T
133	*Mangifera indica* L.	Taw-tha-yet	Anacardiaceae	T
134	*Marsilea crenata*	Hmo-na-to	Marsileaceae	AqH
135	*Melanorrhoea usitata* Wall.	Sit-se	Anacardiaceae	T
136	*Merremia vitifolia* (Burm.f.) Hallier. f.	Kyet-hinga-lae-new	Convolvulaceae	Cl/Cr
137	*Microcos paniculata* L.	Mya-ya	Meliaceae	ST
138	*Millettia extensa* Benth.	Win-u	Fabaceae	Cl/Cr
139	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae	T
140	*Mimosa pudica* L.	Hti-ka-yone	Mimosaceae	H
141	*Mitragyna rotundifolia* (Roxb.) Kuntze	Bin-ga	Rubiaceae	T
142	*Morinda tinctoria* Roxb.	Ni-ba-sae	Rubiaceae	S
143	*Mucuna pruriens* (L.)DC.	Khwe-lae-ya	Fabaceae	Cl/Cr
144	*Mussaenda calycina* Wall. ex Kurz	Pwint-tu-ywet-tu	Rubiaceae	S
145	*Najas minor*	Brittleleaf	Najadaceae	AqH
146	*Ocimum sanctum* L.	Pin-sein	Lamiaceae	S
147	*Operculina turpethum* (L.) Silva Mansa	Kyar-hin-new	Convolvulaceae	Cl/Cr
148	*Oroxylum indicum* (L.) Kurz.	Kyaung-sha	Bignoniaceae	ST
149	*Paederia foetida* L.	Pe-bok-nwee	Rubiaceae	CL
150	*Peperomia pellucida* (L.) H.B.K.	Thit-ye-kyi	Piperaceae	H
151	*Persicaria capitata*	Not known	Polygonaceae	H
152	*Phyllanthus emblica* L.	Zi-phyu	Euphorbiaceae	ST
153	*Phyllanthus urinaria* L.	Myay-zi-phyu	Euphorbiaceae	H
154	*Physalis minima* L.	Bauk-thi	Solanaceae	H
155	*Polygonum chinense* L.	Maha-ga-kyan-sit	Polygonaceae	S
156	*Portulaca oleracea* L.	Myay-byit	Portulacaceae	H
157	*Potamogeton natans* L.	Floating-leaf Pondweed	Potamogetonaceae	Aq
158	*Prema pyramidata* Wall.	Kyun-na-lin	Verbenaceae	ST
159	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	T
160	*Pterospermum semisagittatum* Buch.-Ham.	Na-gye	Sterculiaceae	T
161	*Rauvolfia serpentina* (L.) Benth.	Bon-ma-ya-sa	Apocynaceae	H
162	*Richardia scabra*	Not known	Rubiaceae	H
163	*Ricinus communis* L.	Kyet-su	Euphorbiaceae	ST

No.	Scientific Name	Common Name	Family Name	Habits
164	*Saccharum spontaneum* L.	Kaing	Poaceae	G
165	*Schleichera oleosa* (Lour.) Oken	Gyo	Sapindaceae	T
166	*Scoparia dulcis* L.	Dana-thu-kha	Scrophulariaceae	H
167	*Selaginella willdenowii*	Peacock Fern	Selaginellaceae	F
168	*Senna hirsuta* (L.) Irwin & Barneby	Ka-thaw-hmwe-htu	Caesalpiniaceae	S
169	*Senna timoriensis* (DC.) Irwin & Barneby	Taw-ma-zeli	Caesalpiniaceae	T
170	*Senna tora* (L.*)* Roxb	Dan-gwe	Caesalpiniaceae	S
171	*Setaria lutescens* Hubb.	Yon-sa-myet	Poaceae	G
172	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	T
173	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	T
174	*Sida acuta* Burm f.	Ta-byet-si	Malvaceae	S
175	*Sida rhombifolia* L.	Ta-byet-si	Malvaceae	S
176	*Smilax aspericaulis* Wall ex A. D.C.	Sein-na-baw-thay	Smilaceae	CL
177	*Smilax macrophylla* Roxb.	Sein-na-baw-gyi	Smilaceae	CL
178	*Solanum torvum* Swartz	Kha-yan-ka-zawt	Solanaceae	S
179	*Spirogyra* sp.	Algae	Zygnemataceae	A
180	*Spondias pinnata* (L. f.) Kurz.	Taw-gwe	Anacardiaceae	T
181	*Stachytarpheta indica* (L.) Vahl.	A-seik-ta-ya	Verbenaceae	S
182	*Stephania venosa* (Blume) Spreng.	Taung-kya	Menispermaceae	Cl/Cr
183	*Sterculia ornata* Wall. ex Kurz	Done-shaw	Sterculiaceae	T
184	*Strobilanthes rufescens* T. Anders.	Not known	Acanthaceae	S
185	*Strychnos nux-blanda* A.W.Hill	Kha-baung	Loganiaceae	ST
186	*Synedrella nodiflora* (L.) Gaertn.	Biz-et-pho	Asteraceae	H
187	*Tadehagi triquetrum* (L.)H. Ohashi	Lauk-thay	Fabaceae	S
188	*Tamarindus indica* L.	Ma-gyi	Caesalpiniaceae	T
189	*Tectona grandis* L. f.	Kyun	Verbenaceae	T
190	*Tectona hamiltoniana* Wall.	Da-hat	Verbenaceae	T
191	*Terminalia bellirica* (Gaertn) Roxb.	Thit-seik	Combretaceae	T
192	*Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb.	Kyi-hnok-thi-phyu	Acanthaceae	Cl/Cr
193	*Thunbergia laurifolia* Lindl.	Kyi-hnok-thi-khayan	Acanthaceae	Cl/Cr
194	*Thyrsostachys oliveri* Gamble	Tha-net-wa	Poaceae	B
195	*Tinospora nudiflora* Kurz	Sin-don-ma-nwee	Menispermaceae	Cl/Cr
196	*Trema orientalis* (L.) Blume	Khwe-sha	Ulmaceae	ST
197	*Triumfetta bartramia* L.	Ket-si-ne-thay	Tiliaceae	S
198	*Urena lobata* L.	Ket-si-ne-gyi	Malvaceae	S
199	*Utricularia* sp.	Bladderwort	Lentibularaceae	Aq
200	*Uvaria cordata* Schum. & Thonn.	Tha-but-gyi	Annonaceae	ST
201	*Vangueria spinosa* Roxb.	Magyi-bauk	Rubiaceae	ST
202	*Ventilago maderaspatana* Benth.	Tha-yaw-nyo	Rhamnaceae	CL
203	*Vitex peduncularis* Wall.	Phet-le-zin	Verbenaceae	T
204	*Vitex pubescens* Vahl	Kyet-yoe	Verbenaceae	T

No.	Scientific Name	Common Name	Family Name	Habits
205	*Vitex vestita* Wall.	Htauk-sha	Verbenaceae	ST
206	*Vitis discolour*	Ta-bin-taing-mya-nan-phyu	Vitaceae	Cl/Cr
207	*Wendlandia tinctoria* DC.	Thit-ni/Hta-min-chauk	Rubiaceae	ST
208	*Xylia xylocarpa* (Roxb.)Taub.	Pyin-ka-doe	Mimosaceae	T
209	*Zingiber officinale*	Meik-tha-lin	Zingiberaceae	H
210	*Ziziphus glabra* Roxb.	Taw-zi-nwee/Paung-bet	Rhamnaceae	Cl/Cr
211	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae	ST

A=Algae, Aq=Aquatic, AqH=Aquatic Herb, B=Bamboo, CL=Climber, Cl/Cr=Climber/Creeper, F=Fern, G=Grass, H=Herbs, S=Shrubs, ST=Small Tree, T=Tree

Map IV.


Shwe Taung Cement 66Kv Power Line Landuse Map
N
Pyi nyaung
Mon bin
Kyauk saung gwe
Popa gon
Gk Kyin
Ye bokson
Legend
Flora_Survey_Point
Flora_Survey_Track
Transmission_Line_66kv
Stream
Road
Village
Factory
Landuse Type
Cultivated Area
Degraded Forest
Dense Forest
Non Forest
Spare Forest
Unknown
Water Body
0 0.5 1 2 Kilometers
Landsat 8 Satellite Image
LC08_L1TP_133046_20171223_20180103
Color Infrared (Vegetation) Band (5,4,3)
Myanmar Datum 2000, UTM_Zone_47N

V. POTENTIAL IMPACT ON FLORA AND VEGETATION

The transmission line route passes through the two reserved forests; Kupyin Reserved forest and Yepaungsone Reserved forest. Thus forest fragmentation will be inevitable. The conservation of the fragmented blocks should be implemented since these fragmented blocks are vulnerable according to conservation status Index (CSI) proposed by WWF Terrestrial Ecoregions of the Indo-Pacific.

VI. DISCUSSION AND CONCLUSION

The forest fragmentation will leads to the loss of forest ecosystem and ecosystem services. The forest ecosystem services are numerous and complex but these services are vital to the people dwelling in the forests or closed to the forest.

The forests on the mudstone habitat are unique since they favour the growing of Myanmar Priceless timber or Royal Teak. *Tectona grandis,* Iron wood, *Xylia xylocarpa,* and Myanmar endemic species *Dipterocarpus tuberculatus* and other currently threatened dipterocarpus species.

6.1. Recommendation and Mitigation Measure

1. To establish the exact plan and fund for reforestation and conservation of fragmented blocks.
2. To implement a plan to remove the endangered tree species in living form to the other protected area in the forest.
3. To establish a community forest for local people to restore the loss of forest ecosystem services.

6.2 Immediate Compensatory Measure

The investors of the cement factory who utilized the resources of the region have responsibility in term of Corporate Social Responsibility (CSR). Accordingly, the investor has responsible to raise a fund to aid the environmental and social development of the project impacted region. The following prioritized action should be implemented in accordance with the environmental management plan.

Prioritized Action I

Create and implement a new protected area in Kupyin Reserved Forest and Yepaungsone Reserved Forest. Approximately 0.5% of the annual proceeds from the sale of cement will raise the conservation fund. This fund will be managed by the representative of the company, local forestory department and local government representative.

Prioritized Action II

Create and implement to establish a community forest for the local people who had been lost the forest ecosystem service.

Prioritized Action III

Create and implement the socio-economic development of the local people. Approximately 0.5% of annual proceeds from cement sale will raise the socio-economic development fund. This fund should be managed by the representative of the company, local government officials, and local people representative.

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www.usgs.gov, To compute an NDVI image using ArcGIS Image Analysis


20°48'32", 96°22'25", 269.0m, 358°
Jan 12, 2018 2:08:25 PM


20°48'46", 96°22'52", 248.0m, 341°
Jan 12, 2018 3:16:22 PM

Annex D2

Critical Habitat Screening Assessment

1 CRITICAL HABITAT SCREENING ASSESSMENT

1.1 DISCRETE MANAGEMENT UNIT

Based on IFC PS 6 Guidance Note 6, the Project is required to "determine a sensible ecological or political boundary that defines the area of habitat to be considered for the Critical Habitat assessment". Termed as a Discrete Management Unit (DMU), this is an area with a 'definable boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas'. DMUs may hence be defined using ecological boundaries such as rivers and mountain ridges/valleys where wildlife is determined to be unable to cross, management boundaries such as a Protected Area, or an artificial barriers to movement such as roads and urban areas.

Cement Plant

The DMU identified at the cement plant includes three main components:

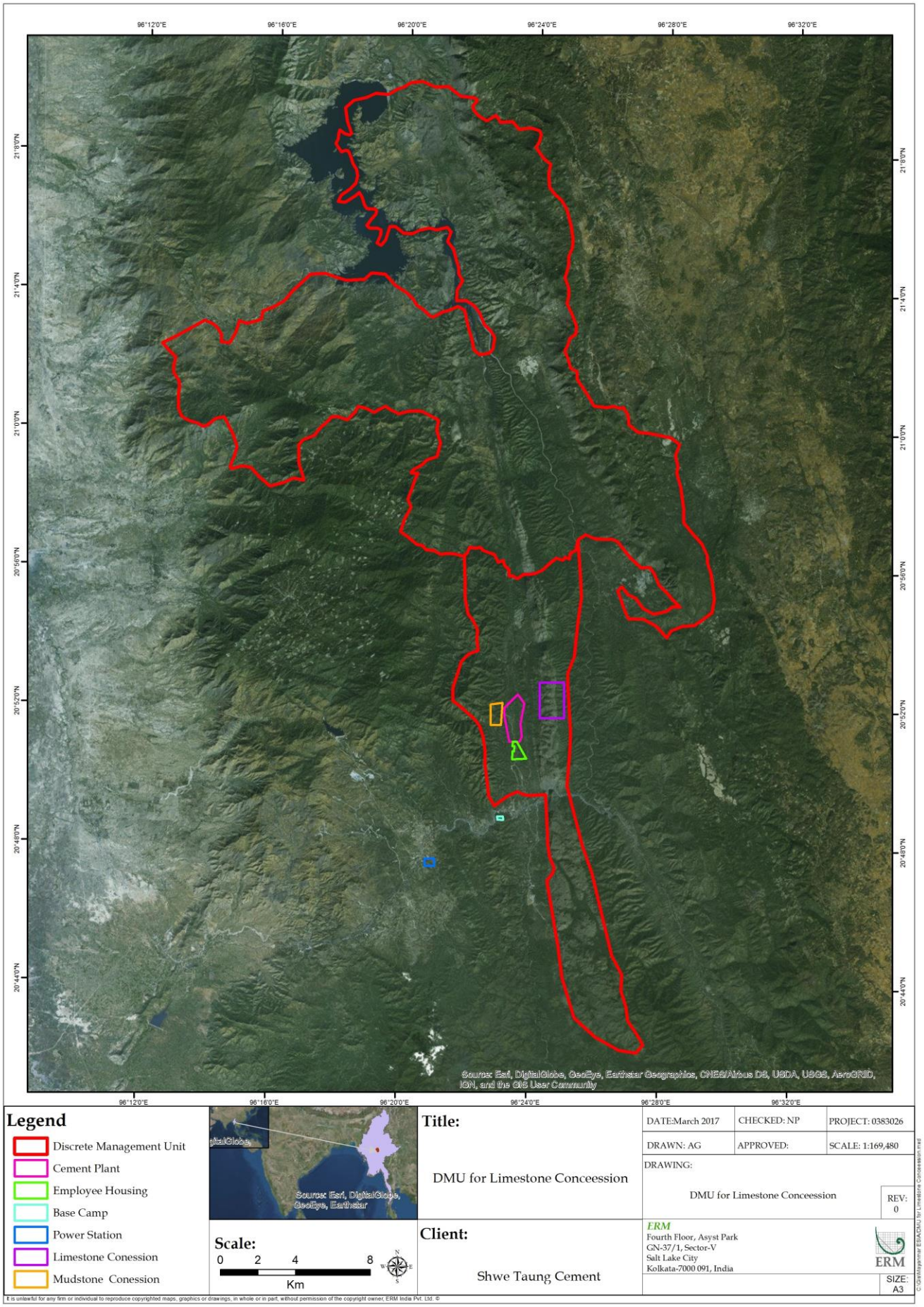
- The limestone outcrop spanning north of the limestone quarry to south of Pyi Nyaung town;
- Contiguous vegetation within and around the Project area, up to the ridge to the west of the Project; and
- Panlaung-Pyadalin Cave wildlife sanctuary, 6 km north of the cement plant.

Although the limestone outcrop is bisected by a road at Pyi Nyaung, the two sections maintain a common geological and geomorphological history. As a result, they are likely to share the same local-endemics and ecosystem types. The sections are essentially part of the same limestone cluster within the Shan plateau. The limestone outcrop in its entirety was thus used to define the DMU.

Based on a review of satellite imagery, it was observed that vegetation within and around the Project area was contiguous with Panlaung-Pyadalin Cave wildlife sanctuary. This indicates a possibility that there is movement of wildlife between Panlaung-Pyadalin and the Project area, hence warranting the inclusion of the Protected area into the project DMU.

The DMU for the cement plant occupies a total area of 45,000 hectares. The DMU for the cement plant is presented in *Figure 1.1*. As the base camp and power stations will be established within built up areas and do not share a contiguous forest with the main project components, they are not included in the DMU delineation.

Figure 1.1 Discrete Management Unit (DMU), Cement Plant



Coal Mine

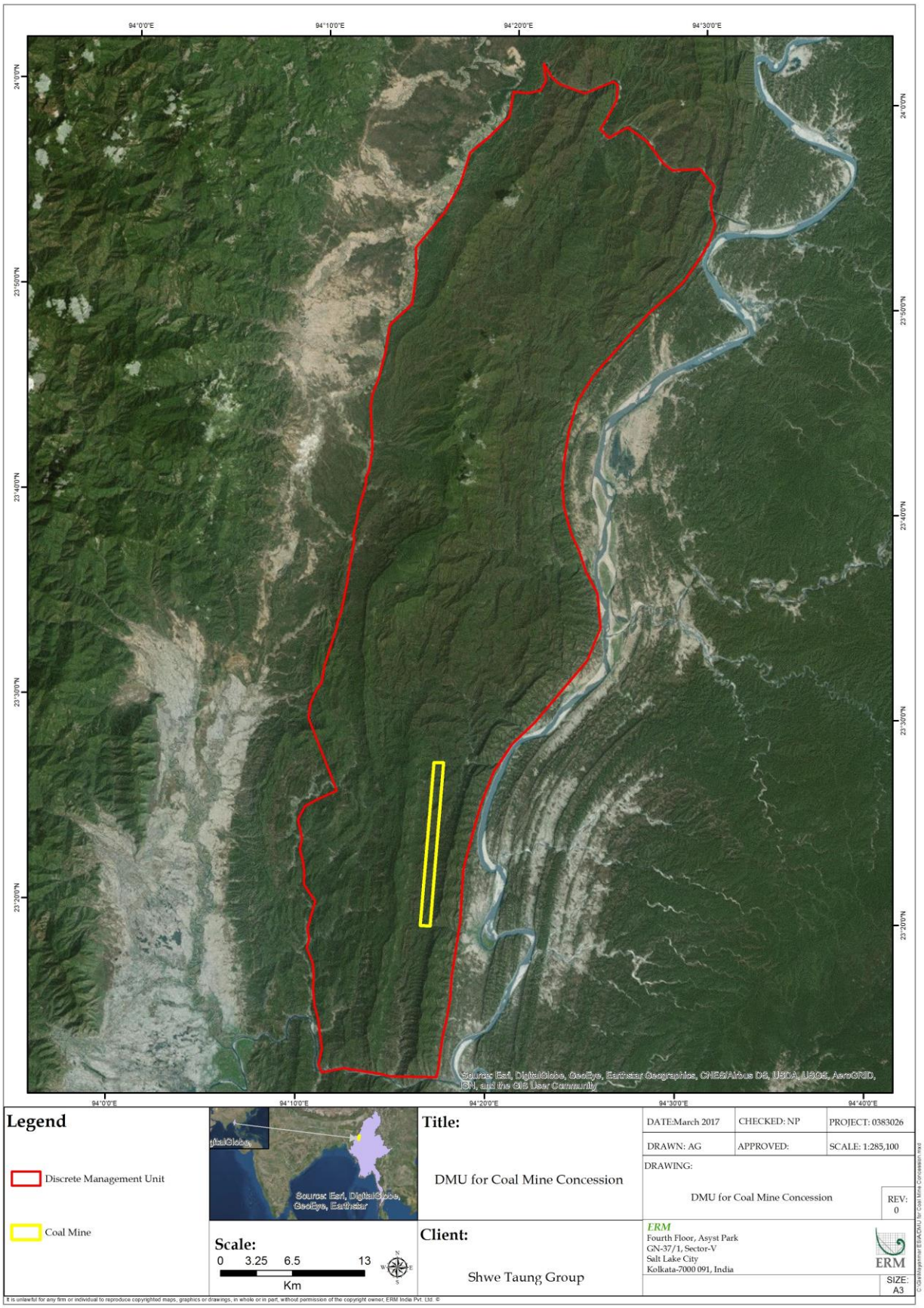
The DMU identified at the coal mine is bounded by:

- A river channel to the north;
- River valley and human-modified landscapes to the west;
- A river channel to the south; and
- The Chindwin River and human-modified landscapes to the east.

There are varying levels of logging and road construction within the DMU leading to forest loss and habitat fragmentation. However, based on a review of satellite imagery and field observations, these are not at a scale to form significant barriers to movement within the DMU. Vegetation within the DMU was thus considered to be fairly contiguous and more significant barriers to movement were considered such as river valleys, channels and tracts of urban landscapes to inform the boundaries of the DMU.

The DMU for the coal mine occupies a total area of 160,000 hectares. The DMU for the coal mine is presented in *Figure 1.2*.

Figure 1.2 Discrete Management Unit (DMU), Coal Mine



1.2 *CRITERION FOR CRITICAL HABITAT*

Critical Habitat criteria as defined in PS6 Guidance Note 6 (GN6) Paragraphs GN69 – GN97 (*IFC 2012b*), and shown in *Table 1*. This table provides detail of the qualifying requirements for Criteria 1-3 while details of the likely qualifying interests are given for Criterion 4 and 5 which will be defined based on research and expert opinion (as will those for Criteria 1-3 where data is lacking). The criteria listed have been used to complete this assessment.

Table 1 Critical Habitat Criteria

Criteria	Tier 1[1]	Tier 2[1]
Criterion 1: Critically Endangered (CR) / Endangered (EN) species:	a) Habitat required to sustain ≥ 10 % of the global population of a CR or EN species /sub /species and where there known regular occurrences of the species and where habitat could be considered a discrete management unit for the species. b) Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.	c) Habitat that supports the regular occurrence of a single individual of a CR species and/or habitat containing regionally- important concentrations of Red-listed EN species where that habitat could be considered as a discrete management unit for the species/subspecies. d) Habitat of significant importance to CR/EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species. e) As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.
Criterion 2: Habitat of significant importance to endemic and/or restricted-range species;	a) Habitat known to sustain ≥ 95 % of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species.	b) Habitat known to sustain ≥ 1 % but < 95 % of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment.
Criterion 3: Habitat supporting globally significant concentrations of migratory species and/or congregatory species;	(a) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 % of the global population of a migratory or congregatory species at any point of the species' lifecycle where that habitat could be considered a discrete management unit for that species.	(b) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 % but < 95 % of the global population of a migratory or congregatory species at any point of the species' lifecycle and where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment. (c) For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for Identifying Wetlands of International Importance. (d) For species with large but clumped distributions, a provisional threshold is set at ≥ 5 % of the global population for both terrestrial and marine species. (e) Source sites that contribute ≥ 1 % of the global population of recruits.
Criterion 4: Highly threatened and/or unique ecosystems;	Criterion 4 has no tiered system although recent publication (Keith et al, 2013) may introduce this. This criterion must include one of the following a) the ecosystem is at risk of significantly decreasing in area or quality;	

Criteria	Tier 1[1]	Tier 2[1]
and/or	b) has a small spatial extent; and /or c) contains unique assemblages of species including assemblages or concentrations of biome-restricted species. Highly threatened or unique ecosystems are defined by a combination of factors which may include long-term trend, rarity, ecological condition, and threat.	
Criterion 5: Areas associated with key evolutionary processes	The criterion is defined by: a) the physical features of a landscape that might be associated with particular evolutionary processes; and/or b) subpopulations of species that are phylogenetically or morphogenetically distinct and may be of special conservation concern given their distinct evolutionary history. The latter includes evolutionarily significant units and evolutionarily distinct and globally endangered species.	

Note: [1] No Tier system is in place for Criterion 4 and Criterion 5.

Restricted range species for terrestrial vertebrates, species which have an extent of occurrence of 50,000km.

1.3 *CRITICAL HABITAT TRIGGERS (CRITERION 1-3)*

The five criteria are 'triggers' in that if an area of habitat meets any one of the criteria then it is considered to be Critical Habitat, irrespective of any other criterion (*TBC, 2012*). Hence Critical Habitat can be determined through a single criterion or where a habitat area holds biodiversity meeting all five criteria. This approach is generally more cautious but is used more widely in conservation (*McDonald-Madden et al, 2009*). Critical Habitat criteria therefore have two distinctive characteristics. First, components of biodiversity are essentially assigned to only two levels of conservation significance, those that trigger Critical Habitat and those that do not (Tier considerations being secondary to this primary Critical Habitat determination). Second, each criterion is applied separately, not in combination, meaning that the scores are not cumulative (*TBC, 2012*).

1.4 *CRITICAL HABITAT CANDIDATE SPECIES*

For Criterion 1-3 this exercise has used species identified as threatened species. Threatened species were evaluated as threatened based on IUCN status (CR or EN), restricted range and habitat requirements.

Further desktop assessment and consultation did not identify any additional data sources for threatened species that may be considered CH candidates within both Project sites.

Table 2 outlines the CH triggers for Criterion 1-3 within the Kalimantan and Papua Project sites.

Table 2 Critical Habitat Candidate Species (Criterion 1-3) within the Project Sites

SN	Species	Common Name	IUCN Listing/Endemism
Cement Plant Site			
1	*Manis pentadactyla*	Chinese Pangolin	CR
2	*Dalbergia oliveri*	Burma Rosewood	EN

SN	Species	Common Name	IUCN Listing/Endemism
3	*Trachypithecus phayrei* spp. *shanicus*	Shan State Langur	EN
4	*Diplommatina* sp. 3, new sp.	-	Local endemic
5	*Diplommatina* sp. 4, new sp.	-	Local endemic
6	*Diplommatina* sp. 5, aff. *Crispate*	-	Local endemic
7	*Anauchen* new sp.	-	Local endemic
Coal Mine Site			
1	*Manis pentadactyla*	Chinese Pangolin	CR
2	*Trachypithecus phayrei*	Phayre's Langur	EN
3	*Hoolock hoolock*	Hoolock Gibbon	EN
4	*Cuon alpinus*	Dhole	EN
5	*Dalbergia oliveri*	Burma Rosewood	EN
6	*Dipterocarpus baudii*	-	CR
7	*Dipterocarpus costatus*	-	EN
8	*Gastrochilus calceolaris*	-	CR

ON HOLD: The findings from karst reptile and flora surveys are currently pending. The CH assessments for these groups will be placed on hold until more information is available.

It is likely that endemic fauna and flora will be identified along the limestone range. Given that Critical Habitat has been triggered for the limestone area, the risk status of the associated Project area at the STC Limestone Concession will not likely change. Site endemic species associated with the quarry concession may pose a risk if identified however.

1.5 *POTENTIAL CRITICAL HABITAT SPECIES (CRITERION 1-3)*

The CH Screening Assessment identified three (3) species and eight (8) species that are potential CH species for Criterion 1-3 for the cement plant and coal mine sites respectively. *Table 3* below provides further information on these species and assessment outcomes.

Table 3 Summary of Potential Critical Habitat Species

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
Cement Plant Site									
1	*Dalbergia oliveri*	Burma Rosewood	EN				Flora Survey (2017); Flora Survey (2015)	Species occurs within a restricted distribution in Myanmar, Thailand and Vietnam. It is found scattered in dense evergreen and semi-deciduous forest up to 1,200 m. It suffers from overexploitation.	The total size of project components of the cement plant is 618 hectares which is likely to occupy less than 1% of the global range of *Dalbergia oliveri*. Although there were 30 individuals of *Dalbergia oliveri* recorded from the project area, this is unlikely to be a globally significant number of individuals. The concession does not exceed 500 m in elevation, whereas the species can be found up to 1,200 m. As such, it is unlikely that habitats within the concession will support 10% or more of the global population of *Dalbergia oliveri* and is also unlikely to contain nationally-important concentrations of the species. Therefore, the habitat does not qualify as Critical Habitat under Criterion 1.
2	*Manis pentadactyla*	Chinese Pangolin	CR				Interview Confirmed Presence within and adjacent to the concession	The species suffers from high levels of poaching for meat and scales. It is likely extirpated from parts of its current range. In Myanmar, the species is plausibly widespread in the northern region. However there are few records and its exact distribution is not known. There are predicted continuing declines of ≤ 90% over the next 21 years or three generations.	Pangolin sightings in and around the cement plant project area were all recorded from a year ago. Field observations noted that the forests around the project area were heavily degraded and there was limited remaining use for wildlife. Given the huge reduction in wildlife, hunting activities have declined. It is noted that habitats at the cement factory are connected with the Panlaung-Pyadalin Wildlife Sanctuary to the north; the wildlife sanctuary may serve as a refuge for

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
								The species is found in a wide range of habitats, including primary and secondary tropical forests, limestone forests, bamboo forests, broad-leaf and coniferous forests, grasslands and agricultural fields. In Myanmar, this species is listed as a completely protected animal under the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law.	pangolins and any sightings at the project could be due to individuals originating from there. Critical Habitat is likely triggered for the species under Criterion 1, Tier 2 in relation to the regular occurrence of a CR listed species within the DMU.
3	*Trachypithecus phayrei* ssp. *shanicus*	Shan State Langur	EN	X			Interview Confirmed Presence adjacent to concession	The eastern subspecies of the endangered Phayre's langur, known only from a few protected areas in Myanmar.	The global population size is estimated to number fewer than 2,500 mature individuals and is experiencing continuing decline that can be attributed to the same threats as its broader species complex is facing. Interviews indicate that the species is possible inside the cement plant project areas but they are more likely to be found on adjacent mountains. A group of 5-7 individuals had been sighted previously. The habitats in the project area are connected to Panlaung-Pyadalin Wildlife Sanctuary which is believed to support populations of the Shan State langur. Considering the (i) restricted distribution of the subspecies to southwestern China and northern and eastern Myanmar and (ii) low global population number, the DMU habitat could be of significant importance to the long term survivability of the Shan State langur.

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
									Hence, the habitat qualifies as Critical Habitat under Criterion 1, Tier 2.
4	*Diplommatina* sp. 3, new sp.	-	-		X		North, within and south of the limestone concession	Likely to be a local-endemic species to the limestone range and potentially new to science	Preliminary findings suggest that it could occupy a restricted range on the limestone outcrop such that the habitat may sustain ≥1% < 95% of the global population of this species. Therefore, the habitat qualifies as Critical Habitat under Criterion 2.
5	*Diplommatina* sp. 4, new sp.	-	-		X		North of the limestone concession	Likely to be a local-endemic species to the limestone range and potentially new to science	Preliminary findings suggest that it could occupy a restricted range on the limestone outcrop such that the habitat may sustain ≥1% < 95% of the global population of this species. Therefore, the habitat qualifies as Critical Habitat under Criterion 2.
6	*Diplommatina* sp. 5, aff. *Crispate*	-	-		X		North, within and south of the limestone concession	Likely to be a local-endemic species to the limestone range	Preliminary findings suggest that it could occupy a restricted range on the limestone outcrop such that the habitat may sustain ≥1% < 95% of the global population of this species. Therefore, the habitat qualifies as Critical Habitat under Criterion 2.
7	*Anauchen* new sp.	-	Potential EN/CR	X	X		Within and south of the limestone concession	Likely to be a local-endemic species to the limestone range and potentially new to science. The species is currently only identified within the Concession however	Preliminary findings suggest that it could occupy a restricted range on the limestone outcrop such that the habitat may sustain ≥1% < 95% of the global population of this species.

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
								additional sampling will occur in adjacent areas to determine its distribution during the wet season surveys.	Expert evaluation has also indicated that quarrying the project limestone concession, leading to a loss of habitat for this species, could trigger EN or CR status for it. Given its restricted range, the habitat qualifies as of significant importance to a potential CR/EN species whose distribution is still not clearly understood. The loss of this habitat could impact the long-term survivability of this species. Therefore, the habitat qualifies as Critical Habitat under Criterion 2.
Coal Mine Site									
1	*Manis pentadactyla*	Chinese Pangolin	CR	X			Interview Confirmed Presence within and adjacent to the concession	The species suffers from high levels of poaching for meat and scales. It is likely extirpated from parts of its current range. In Myanmar, the species is plausibly widespread in the northern region. However there are few records and its exact distribution is not known. There are predicted continuing declines of ≤ 90% over the next 21 years or three generations. The species is found in a wide range of habitats, including primary and secondary tropical forests, limestone forests, bamboo forests, broad-leaf and coniferous forests, grasslands and agricultural fields.	Interviews with villages and workers from neighbouring coal mine sites have confirmed the presence of the Chinese Pangolin in habitats within and around the coal mine concession. As with other areas within its range, the Chinese Pangolin faces high hunting pressure in the project locality. There were 3 sightings of pangolins in 2 weeks prior to the interviews, suggesting that there are still regular occurrences of the species within the concession although the populations have been declining. Field observations have also identified areas of good quality forest throughout the concession and there are few proper trails granting easy access into these areas. Given the habitat plasticity of the pangolin, it is likely that there are small populations of

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
								In Myanmar, this species is listed as a completely protected animal under the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law.	pangolins persisting within and around the concession in these forest areas. Therefore, habitats within the concession support the regular occurrence of an IUCN Red-listed CR species. Habitats at the concession can be considered part of a larger DMU as indicated in *Figure 6.29* of the ESIA Report. Therefore, habitats in the concession are considered Critical Habitat, Tier 2 with the Chinese Pangolin as a trigger.
2	*Trachypithecus phayrei*	Phayre's Langur	EN	X			Sighted (2015 Survey) Interview Confirmed Presence adjacent to concession	Species is listed as EN as it is believed to have undergone a decline of more than 50% over the last 3 generations due to a combination of habitat loss and hunting. One generation length is estimated at 12 years. According to IUCN, there is little information available concerning the species' status in Myanmar. The species prefers primary and secondary evergreen and semi-evergreen forest, mixed moist deciduous forest. It can also be found in bamboo-dominated areas and some human-cultivated landscapes. It is a predominantly arboreal, diurnal and folivorous species. In several parts of its range, this species suffers from habitat disturbance, fragmentation and hunting.	Presence of this species was confirmed in all interviews and surveys in 2015 had a sighting. Individuals face hunting pressure and all interviewed persons had commented that langurs have undergone a substantial decline in the region. There were unconfirmed claims of regular sightings of langur groups around the concession. Phayre's langurs have an estimated home range of 10 to 100 ha with little overlap amongst groups. Given the coal mine concession itself is 1,450 ha and the DMU is 160,000 ha. Field observations have noted the presence of good quality forests in several parts within and around the concession. This combined with the size of the concession and DMU suggest that habitats have the capacity to support more groups of langurs than reported. According to the IUCN Red List, the status of Phayre's langurs in Myanmar is currently unknown however there is a general

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
									population decline within its range due to habitat conversion, fragmentation and hunting. The species' population distribution in Myanmar is not well understood and is fairly wide-ranging. , The DMU identified for the coal mine is unlikely to constitute a significant habitat for the Phayre's langur in Myanmar. Habitats thus qualify is not triggered as Critical Habitat under Criterion 1 Tier 2.
3	*Hoolock hoolock*	Hoolock Gibbon	EN	X			Interview; Acoustic record Confirmed Presence adjacent to concession	Main threats to this species are hunting and habitat loss. It is believed that the species has declined by at least 50% over the past 40 years. In Myanmar, the dominant threats are shifting cultivation, hunting and logging. The largest and most viable populations are believed to be found west of the Chindwin River. However, there is a lack of information regarding the population sizes and distribution of Hoolock Gibbons in these forests. The species is a forest dweller and feeds on fruits and leaves. Home ranges range from 8-63 ha but large home ranges of 200-400 ha were reported from populations in India.	Gibbons were heard calling adjacent to the concession. However, due to large home range sizes reported from other populations (8 - 63 ha, and 200 - 400 ha), it is likely that the gibbons found in the Paluzawa area would utilise habitats within the concession. The Hoolock Gibbon has been declining within its range due to habitat fragmentation and hunting. According to the IUCN Red List, the largest and most viable populations of the gibbon could be found west of the Chindwin river, where the project is located. There are remaining good quality patches of forest within the DMU defined around the coal concession that support the belief that more gibbons are likely to dwell within the area. The DMU could hence contain habitats of significant importance to Hoolock gibbons and a loss could potentially impact the long term survival of the species. Habitats thus qualify as Critical Habitat under Criterion 1 Tier 2.

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
4	*Cuon alpinus*	Dhole	EN	X			Interview; Canine tooth Confirmed Presence within concession	Dholes have disappeared from most of their historical range, and populations are still declining due to depletion of prey base, habitat loss, persecution, disease and potential interspecific competition. Based on IUCN RedList, there is an estimated 4,500 - 10,500 individuals remaining of which only 949 - 2,215 are mature. The current distribution of Dholes in Myanmar is uncertain; they have been recorded from several protected areas in Myanmar and could potentially occur throughout these regions. Myanmar has been classified as having medium numbers of Dholes (750-1,500). Dholes have been recorded from several protected areas including Mahamyaing Wildlife Sanctuary east of the Project. The Dhole is a habitat generalist and can occur in a wide variety of vegetation types including degraded forms of tropical dry and moist deciduous forests. Home range studies have estimated 23-199 km^2 and 60-80 km^2 in India and Thailand respectively.	The presence of the Dhole was confirmed in habitats within the concession. As dholes are typically found in a pack, the presence of one individual may signal the presence of a larger group of individuals. With the coal concession spanning 1,450 ha (14.5 km2), it is likely to overlap with the home range of a pack of Dholes in the locality. The distribution of Dholes in Myanmar is still poorly known, with records from the northern, western and central parts of the country. There are records from Maharmyaing Wildlife Sanctuary but the habitats there are not contiguous with the coal mine DMU due to separation by the Chindwin River. This suggests the population of dholes around the project area is distinct from the wildlife sanctuaries. With a poorly understood distribution, and continuing declines, the potential presence of a population of dholes within the DMU is of interest. The habitat within the DMU is unlikely to be of importance for the conservation of the species. Therefore, the habitat does not qualifyas Critical Habitat under Criterion 1, Tier 2.
5	*Dalbergia oliveri*	Burma Rosewood	EN				Flora Survey (2017); Flora Survey	Sepcies occurs within a restricted distribution in Myanmar, Thailand and Vietnam. It is found scattered	The coal mine concession spans 1,450 ha which is likely to occupy less than 1% of the global range of *Dalbergia oliveri*. The

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
							(2015)	in dense evergreen and semi-deciduous forest up to 1,200 m. It suffers from overexploitation.	concession does not exceed 500 m in elevation, whereas the species can be found up to 1,200 m. As such, it is unlikely that habitats within the concession will support 10% or more of the global population of *Dalbergia oliveri* and is also unlikely to contain nationally-important concentrations of the species. Therefore, the habitat does not qualify as Critical Habitat under Criterion 1.
6	*Dipterocarpus baudii*	-	CR				Flora Survey (2015)	This species is found scattered in the greatly reduced lowland evergreen forests of South East Asia. Main threat is habitat destruction. It is rather rare and scattered in low-lying, well-drained or semi-swampy forests or on low hills. It can be found at elevations up to 800 m.	The coal mine concession spans 1,450 ha which is likely to occupy less than 1% of the global range of *Dipterocarpus baudii* which occurs over Cambodia, Indonesia (Sumatra), Malaysia, Myanmar, Thailand and Vietnam. The concession does not exceed 500 m in elevation, whereas the species can be found up to 800 m. The concession also supports deciduous forest vegetation and does not contain semi-swampy forests. As such, it is unlikely that habitats within the concession will support 10% or more of the global population of *Dipterocarpus baudii* and is also unlikely to contain nationally-important concentrations of the species. However, Critical Habitat is likely triggered for the species under Criterion 1, Tier 2 in relation to the regular occurrence of a CR listed species within the DMU.
7	*Dipterocarpus costatus*	-	EN				Flora Survey (2015)	This species is found scattered in lowland, hill and upper dipterocarp forest. There are	The coal mine concession spans 1,450 ha which is likely to occupy less than 1% of the global range of *Dipterocarpus costatus* which

SN	Species	Common Name	IUCN Listing	Criteria 1	Criteria 2	Criteria 3	Observation Type and Locations	Species Information	Criterion Rationale
								populations found within reserves.	occurs over most of Southeast Asia and Bangladesh. The dominant vegetation types of the coal mine comprises deciduous forests, therefore *Dipterocarpus costatus* is unlikely to form the dominant group in project habitats. As such, it is unlikely that habitats within the concession will support 10% or more of the global population of *Dipterocarpus costatus* and is also unlikely to contain nationally-important concentrations of the species. Therefore, the habitat does not qualify as Critical Habitat under Criterion 1.
8	*Gastrochilus calceolaris*	-	CR				Flora Survey (2015)	Rare species that is only found in Benguet Province, Luzon. The species account on IUCN Red List is potentially confusing, as it lists its range to include the Himalayas, Indochina, Malaysia and Taiwan but indicates that the population is localised in the Philippines. Only found at high altitudes.	It is highly likely that this is a misidentification. However, assuming the species was correctly identified, it is found only at high altitudes. This thus excludes the project from containing high enough numbers of individuals to meet the population threshold of 10% to qualify it as a Critical Habitat. Therefore, the habitat does not qualify as Critical Habitat under Criterion 1.

ON HOLD: The findings from karst reptile and flora surveys are currently pending. The CH assessments for these groups will be placed on hold until more information is available following the completion of additional surveys.

1.6 CRITERION 4) HIGHLY THREATENED AND/OR UNIQUE ECOSYSTEMS

Highly threatened and unique ecosystems as defined by the IFC are those that are a) under significant threat; b) small in size; and/or c) have unique species assemblages. An assessment of the presence of habitats within the concessions at the Cement Plant and Coal Mine which meet these criteria and relevant discussions are provided below.

1.6.1 Ecosystems at Risk of Significantly Decreasing In Area or Quality

Myanmar's accessible forests are decreasing rapidly in extent and quality. Forest cover has reduced by approximately 58% in 1990 to 45% in 2015 (1). Further studies have shown that areas subjected to extremely high rates of deforestation occur in the mangroves in the Ayeyarwady Delta and the dry deciduous forests in the northern edge of the Central Dry Zone. The largest remaining areas of intact forests can be found in northern Sagaing region, Kachin State and Taninthayi Region. However, the Sagaing region also possesses high rates of forest conversion to plantations and mining (2). Based on Global Forest Watch Data, Myanmar has lost an estimated 2,030,101 ha of tree cover in the years of 2001-2014.

Cement Plant – Karst Ecosystem

As outlined in *Section 6.3.2 – Karst/Limestone Ecosystems* of the ESIA Report, karsts in Southeast Asia face a number of threats and lack adequate levels of protection. Poorly planned quarrying operations may destroy whole karst landforms, wiping out site-endemics and greatly reducing the populations of regional-endemics. There is also a lack of representation of karst ecosystems in Protected Area networks in Southeast Asia, with the percentage of protected karst areas ranging from 0 – 45% of total karst areas depending on the country. An assessment of protected karst areas in Southeast Asia reported that only 1 % of karst areas in Myanmar is protected (within Shwe u Daung and Shwesettaw Game Reserves, and Pindaya Cave) (5).

While there is no reported data on the decrease of karst ecosystems in Southeast Asia and Myanmar in particular, the under-representation of karsts in Protected Areas and the country's burgeoning economic growth suggests that resource extraction will continue to threaten this ecosystem. In the context of the DMU, an estimated quarter of the limestone range is within the project concession and will be removed entirely from quarrying. However, the same limestone range exists further south and other geologically and geomorphologically related outcrops are distributed across the Shan Plateau.

(1) Myanmar National Biodiversity Strategy and Action Plan (2015)

(2) Myanmar National Biodiversity Strategy and Action Plan (2015)

(5) Day M & Urich P (2000) An Assessment of Protected Karst Landscapes in Southeast Asia. Cave and Karst Science. Volume 27, No.2

Whilst karst ecosystems are not well represented in the protected area system, there is insufficient data available to suggest that they are currently highly threatened in Myanmar. Therefore, it is not likely that karst ecosystems in Myanmar qualify as Critical Habitat under Criterion 4.

Coal Mine

Evidence collected from the field studies suggest that habitats in the DMU are not decreasing rapidly in area; however the quality of habitats is at risk from logging, conversion and fragmentation. Field observations note that there is still remaining good quality forest adjacent to the concession. The forest habitats therefore are not currently threatened in area; however they are currently impacted by threats in relation to habitat quality. Illegal logging in Myanmar is currently a major threat to forest ecosystems. In relation to the DMU, whilst this threat is present, it is not determined to be a significant threat to the persistence of the forest ecosystem in terms of area. A visual assessment of satellite imagery for the DMU indicates that stands of mature forests exist within the DMU and that logging has occurred only where access has enabled this threat to occurin the landscape. Therefore, the forest ecosystem within the DMU is unlikely to qualify as Critical Habitat under Criterion 4.

1.6.2 Ecosystems with a Small Spatial Extent

The limestone ecosystems within the DMU were considered in the context of the Shan plateau – an extensive karst occurring over an area of 500 km by 300 km. The limestone outcrops within the Shan Plateau are assumed to be geologically and geomorphologically related. As limestone outcrops can differ significantly from each other in terms of habitat, a review of the findings of the karst survey was also conducted. This was to understand if the karst ecosystem present on the limestone within the concession was replicated elsewhere across the range.

No site endemics were recorded from the limestone within the project concession and preliminary findings indicate that local-endemic species are likely to occur across the limestone range and its extensions further south. This suggests that the limestone ecosystem within the DMU does not occur within a small spatial extent, and hence is unlikely to trigger Critical Habitat under this Criterion.

Coal Mine

The ecosystem found within the DMU is likely to be an extension of the deciduous forest ecosystem within the coal mine concession. In the context of the DMU (160,000 hectares), the coal mine concession occupies less than 1% of the total area. The forest ecosystem is representative of a larger forest complex that extends into Northern Myanmar and into North Eastern India.

The ecosystem does not have a small spatial extent and hence is unlikely that Critical Habitat could be triggered under this Criterion.

1.6.3 Ecosystems Containing Unique Assemblages of Species Including Assemblages or Concentrations of Biome-Restricted Species

Cement Plant

The forests around the project were also observed to be highly degraded. These suggest that the forest ecosystem around the project area has a low capacity for an assemblage of species that can be deemed unique. Therefore, forest ecosystems at the project do not qualify as Critical Habitat under Criterion 5.
Surveys of the limestone range indicate an absence of site-endemics in the project concession but a presence of local-endemics across the range. Limestone areas are typically known for containing limestone-restricted species and display high levels of endemism. The limestone range in the DMU thus qualifies as Critical Habitat under Criterion 5.

Coal Mine

Given the general inaccessibility to parts of good forest in the site, it is likely that there may be more sensitive and elusive species within the DMU. The Project site is within a Tiger Conservation Landscape, and although this species was not determined to be present during surveys conducted for this Project, suitable prey species exists within the landscape. Insufficient evidence currently exists to evaluate the coal mine site as containing a unique assemblage of species or biome restricted species. Whilst a number of different species were identified, the species mix is not unique as it is representative of the fauna that are normally associated with this habitat type in SE Asia. The number of species detected though is generally higher than equivalent habitat types sampled in adjacent countries. Therefore, the ecosystems within the DMU are not evaluated as Critical Habitat under this Criterion.

1.7 CRITERION 5) KEY EVOLUTIONARY PROCESSES

Criterion 5 recognises the attributes of a region that that can influence evolutionary processes and give rise to regional configuration of species and ecological properties. Examples can include isolated areas where populations are phylogenetically distinct, areas of high endemism, environment gradients or ecotones and biological corridors.

While no site endemic species were recorded within the limestone concession, several local-endemic species were found throughout the limestone range, including within the project concession. Most of the unidentified species (constituting a third of all recorded species) are also potentially new to science. Two limestone restricted flora species were

recorded. It is likely that there are more local-endemic and limestone restricted species within the range as the surveyors could only access sites that were severely degraded. While results are preliminary and no quantitative findings have been reported, the initial findings reflect the richness limestone-restricted species within the range. This is testament to the evolutionary significance of limestone ecosystems; hence the limestone range within the DMU qualifies as Critical Habitat under Criterion 5.

Criterion 5 assessment will be updated upon review of Final Karst Survey Report

Annex D3

Ecosystem Services Assessment

1.1 ECOSYSTEM SERVICES ASSESSMENT

1.1.1 Defining Ecosystem Services

Ecosystem services are defined as the benefits that people, including businesses, derive from ecosystems (IFC 2012). These services are substantial and varied, underpinning basic human health and survival needs as well as supporting economics activities, the fulfillment of people's potential, and enjoyment of life.

In order to provide a uniform basis to assess the status of all major global habitat across all of the word's bioregions, the United Nation's Millennium Ecosystem Assessment (UN 2005) combine diverse Ecosystem Services typologies into a consistent classification scheme.

There are four categories of ecosystem services defined in Millennium Ecosystem Assessment as outlined in IFC Performance Standard 6:

- **Provisioning Services**; these services that can be extracted from ecosystem to support human needs. This term is more or less synonymous with the term " **Ecosystem Goods**" that was used in some prior classification schemes, including such tangible assets as fresh water, food, fiber, timber and medicinal plants,

- **Regulating Services**; the benefit obtained from an ecosystem's control of the natural environment, including of the regulation of surface water purification, carbon storage, and sequestration, climate regulation, protection from natural hazard, air quality, erosion and pests,

- **Cultural Services**; non-material benefits including diverse aspect of aesthetic, spiritual, recreational, and others cultural value,

- **Supporting services**; the natural process essential to the maintenance of the integrity, resilience, and functioning of ecosystem, thereby supporting the delivery of all other benefits. They include soil formation, nutrient cycling, and primary production.

1.1.2 IFC Performance Standard Requirements

The International Finance Corporation's (IFC) performance standards require projects to assess and preserve the benefits from ecosystem services. The IFC also requires that the environmental and social risks and impacts identification process considers a project's dependence on ecosystem services. A fundamental component is to apply the mitigation hierarchy to determine measures to limit impacts on ecosystem services.

ERM has utilized the World Resources Institute (WRI) Guidelines: *Weaving Ecosystem Service into Impact Assessment* to guide the approach used to assess ecosystem services in relation to the project.

The Ecosystem Services Review was undertaken following a five-stage approach (WRI 2014):

- ***Screening assessment*** to Identify Ecosystem Services that may occur within the study area;
- ***Data Collection and prioritization*** for 'screened in' Ecosystem Services;
- ***Scoping***; to refine the list of ecosystem services based on those identify in the study area and potentially impacted by the project;
- ***Prioritization*** to identify Ecosystem services importance to beneficiaries; and
- ***Impact Assessment*** to identify the impacts to ecosystem services and their human beneficiaries as a result of the project

1.1.3 Ecosystem Services Screening Assessment

An ecosystem services screening assessment was undertaken to determine the likely ecosystem service values that could be potentially important to affected communities. This assessment was done using existing sources of data, including information gleaned during the initial scoping visit. This visit was held in October 2016 and consisted of initial management interviews with STC representatives at the cement plant on 14 November 2016 site visit.

The scoping exercise was undertaken in order to refine the list of Ecosystem Services that:

- **Potential Beneficiaries**: Known and potential beneficiaries for a service were identified and where possible identifying people at the local, national, and / or global level.
- **Sources of Impact**: Potential sources of impact were considered based on the project description (See *Section 2* of the ESIA Report);
- **Project Dependence:** IFC PS-6 requires that the Ecosystem Services assessment take into consideration any services that the Project may rely upon during construction, operation and/or decommissioning. Therefore all services for which there is a potential project dependency were scoped into the prioritisation stage.

The goal of the scoping exercise was to identify a list of Ecosystem Services to be assessed during through the surveys.

The results of the scoping assessment are contained in *Table 1*

Table 1 Ecosystem service screening assessment

Ecosystem Service Type	Description, Examples	Current Known Ecosystem Services	Screened in?
Provisioning Services			
Food: wild-caught fish and shellfish & aquaculture	Fish caught for subsistence or commercial sale; Fish, shellfish, and/or plants that are bred and reared in ponds, enclosures, and other forms of fresh- or salt-water confinement for harvesting	Evidence suggests that there is limited fishing at both Project areas. Fishing undertaken is limited to areas outside of the Project area but within the AoI. The project is unlikely to have a significant impact on this service.	No
Food: wild meat	Animals hunted for primarily for food (recreational hunting covered under cultural services)	Evidence suggests that there is currently hunting by local people for wild meat within the Project Area and AoI.	Yes
Food: cultivated crops	Annual and permanent crops grown for subsistence use and commercial sale	Evidence suggests that cultivated crops occur within the Project Area and AoI. There is potential for impacts to cultivated crops from air emissions.	Yes
Food: herbs and plants	Herbs and plants collected for food by local people	Evidence suggests that herbs and plants are collected by local people. The project may restrict or reduce the availability of this service.	Yes
Livestock farming	Sedentary and nomadic livestock farming	Evidence suggests that local people undertake livestock farming within the Project Area and AoI. The project may restrict this practice.	Yes
Biomass fuel	Wood, dung and plant matter collected for charcoal, fuel	Evidence suggests that there is limited collection of wood, dung and plant matter for the production of charcoal and fuel	No
Timber and wood products	Wood collected for local use or for sale as timber, wood pulp and paper	Evidence suggests that wood is harvested from within the Project Area and AoI for use by local people. The project may restrict this activity.	Yes
Non- Timber Forest Products (NTFP)	Non-timber products collected from the forest. For example, cane, palm, straw, cotton, hemp, twine and rope, natural rubber	Evidence suggests that NTFP is harvested from within the Project Area and AoI for use by local people. The project may restrict this activity.	Yes
Regulating services			
Freshwater	Freshwater for bathing, drinking, irrigation, laundry, household and industrial use	Evidence suggests that freshwater is used by local people from within the Project Area and AoI. The project may restrict or impact this activity.	Yes
Biochemical, natural medicines, pharmaceuticals	Natural medicines, biocides, food additives, pharmaceuticals and other biological material for commercial or domestic use. For example, pelts, carved or decorative animal products, live animal trade	Evidence suggests that there is little use of natural medicines biocides, food additives, pharmaceuticals and other biological material for commercial or domestic use.	No
	Genes and genetic information used for animal breeding, plant improvement, and biotechnology	Evidence suggests that there is no current use of genes and genetic information used for animal breeding, plant improvement, and biotechnology.	No

Ecosystem Service Type	Description, Examples	Current Known Ecosystem Services	Screened in?
Ecosystem functions	The influence ecosystems have on air quality by extracting chemicals from the atmosphere (i.e., serving as a "sink") or emitting chemicals to the atmosphere (i.e., serving as a "source")	Evidence suggests that the Project area of AoI has no major influence on air quality in the vicinity.	No
	Carbon sequestration (impacts on global climate change) regulation of temperature, shade air quality by vegetated areas	Evidence suggests that the Project area of AoI has no major influence on Carbon sequestration in the vicinity.	No
	Influence ecosystems have on the timing and magnitude of water runoff, flooding, and aquifer recharge	Evidence suggests that the Project area of AoI has no major influence on water runoff, flooding, and aquifer recharge in the vicinity.	No
	Role played by vegetation and bacteria in the filtration and decomposition of organic wastes and pollutants and the assimilation and detoxification of compounds.	Evidence suggests that the Project area of AoI has no major influence on filtration and decomposition of organic wastes and pollutants in the vicinity.	No
	Role of natural habitats (e.g. wetlands, beaches, reefs) in protecting crops, buildings, recreation areas from waves, wind and flooding from coastal storms.	Evidence suggests that the Project area of AoI has no major influence on protecting crops, buildings, recreation areas from waves, wind and flooding from coastal storms in the vicinity.	No
	Regulation of fire frequency and intensity (e.g. dense forest can provide firebreaks)	Evidence suggests that the Project area of AoI has no major influence on regulation of fire frequency and intensity in the vicinity.	No
	Predators from forests, grassland areas, etc. may control pests attacking crops or livestock	Evidence suggests that the Project area of AoI has no major influence on Predators from forests, grassland areas, etc. may control pests attacking crops or livestock in the vicinity.	No
	Influence ecosystems have on the incidence and abundance of human pathogens	Evidence suggests that the Project area of AoI has no major influence on incidence and abundance of human pathogens in the vicinity.	No
	Role of vegetation in regulating erosion on slopes and riparian areas	Evidence suggests that the Project area of AoI for the coal mine site has regulating erosion on slopes and riparian areas in the vicinity.	Yes
	Birds, insects and some small mammals pollinate certain flora species, including some agricultural crops	Evidence suggests that the Project area of AoI has no major influence on birds, insects and some small mammals pollinate certain flora species, including some agricultural crops in the vicinity.	No
Cultural Services			
Spiritual, religious or cultural value	Natural spaces or species with spiritual, cultural or religious importance	Evidence suggests that the Project area of AoI is considered as important natural spaces or species with spiritual, cultural or religious importance.	No
	Cultural value placed on traditional practices such as hunting, fishing, crafts and use of natural resources.	Evidence suggests that the Project area of AoI is not considered important areas for cultural value on traditional practices.	No
	Use of natural spaces and resources for tourism and recreation (e.g. swimming, boating, hunting, bird-watching, fishing)	Evidence suggests that the Project area of AoI is not considered important natural spaces and resources for tourism and recreation.	No
	Cultural value placed on the aesthetic value provided by landscapes, natural landmarks	Evidence suggests that the Project area of AoI is not considered as important aesthetic value provided by landscapes, natural landmarks.	No

Ecosystem Service Type	Description, Examples	Current Known Ecosystem Services	Screened in?
	Information derived from ecosystems used for intellectual development, culture, art, design, and innovation.	Evidence suggests that the Project area of AoI is not considered important for information derived from ecosystems used for intellectual development, culture, art, design, and innovation.	No
Supporting Services			
Non-use value of biodiversity (e.g. existence, bequest value)	Species and areas valued globally as of high conservation value	Evidence suggests that the Project area of AoI may contain species that are considered as being a high conservation value.	Yes
	Formation of biological material by plants through photosynthesis and nutrient assimilation.	Evidence suggests that the Project area of AoI is not considered important regarding biological material by plants through photosynthesis and nutrient assimilation.	No
	Flow of nutrients (e.g., nitrogen, sulfur, phosphorus, carbon) through ecosystems.	Evidence suggests that the Project area of AoI is not considered important for the flow of nutrients.	No
	Flow of water through ecosystems in its solid, liquid, or gaseous forms.	Evidence suggests that the Project area of AoI is not considered important for the flow of water through ecosystems.	No
	Natural soil-forming processes throughout vegetated areas.	Evidence suggests that the Project area of AoI is not considered important for natural soil forming processes.	No
	Natural spaces that maintain species populations and protect the capacity of ecological communities to recover from disturbances.	Evidence suggests that the Project area of AoI is not consider important to maintain species populations and the capacity to assist ecological communities recover from disturbances.	No

1.1.4 Ecosystem service Data Collection and Prioritization

Standard approaches to collect ecosystem service data through community consultation and market survey was conducted during the supplementary social baseline surveys undertaken for the ESHIA Addendum assessment to comply with IFC PS during April 2015. The methods used and results identified are outlined below.

Biodiversity surveys in the project area and area of influence were conducted from March 2015 until August 2015. A summary of the methodology and results are outlined below.

1.1.4.1 Community Surveys

ERM visited the two project sites in January 2017 to consult with the Project stakeholders explaining the concept of the project and administering questionnaires to individuals and groups. The stakeholder engagement included specific discussions regarding ecosystem services.

ERM undertook the following consultation as part of ESIA:

- Consultation with 100 households living in close proximity to the cement plant and coal mine from selected communities (5 villages); and
- Consultation meetings with government authorities, NGOs, PAPs and other interested people.

Household survey questionnaires were used to gather data from the communities around the cement plant and coal mine to solicit their opinions on both the positive and negative aspects of the Project development to inform the ESIA. The data is relevant to understanding current socio-economic conditions in the Area of Influence of the Project, historical impacts associated with the construction of the cement plant and coal mine as well as potential issues associated with the on-going operation of the Project.

The topics addressed in the household surveys included:

- basic household information (Individual);
- socio-economic surveys with village leaders;
- group discussions focussed on the livelihoods women and farmers; and
- socio-economic system survey as a quantitative assessment of the level of reliance on natural resources by affected communities and the linkage between the subsistence economy and the livelihoods of affected communities.

Prior to conducting household surveys, an introductory meeting was convened in the host community to introduce the purpose of the consultation.

1.1.4.2 *Data Collection*

Data was collected through community meetings, household surveys and face to face discussions with stakeholders. Community meetings were arranged by STC in collaboration with the Township General Administration Department Authorities and Village leaders. These meetings provided an opportunity to update stakeholders on the Project as well as gather feedback.

A total of 100 useable household surveys, five (5) Socio-Economic surveys to Village leaders, and 15 group discussions for socio-economic systems were completed across all five (5) villages with particular focus on the livelihoods of women and farmers. The details the surveys conducted are in *Table 2**Table*** .

Table 2 ***The details of the surveys conducted in project area.***

Date	Village	Village Tract	Township	Region	No. of HH Consulted by Village Tract
Limestone Concession					
17-1-17	Kyubin & Pyinaung	Pyinaung	Tharsi	Mandalay	Meeting with Village leaders and 2 Socio-economic Surveys
18-1-17	Kyubin	Pyinaung	Tharsi	Mandalay	25 HH Survey
19-1-17	Pyinaung	Pyinaung	Tharsi	Mandalay	25 HH Survey
20-1-17	Kyubin & Pyinaung	Pyinaung	Tharsi	Mandalay	2 Townhall Meetings, 6 Groups Discussion
Coal Mine Concession					
22-1-17	Pluzawa	Ywarthar	Kalaywa	Sagaing	Townhall Meeting, 11HH Surveys, Socio-economic survey and 3 Group Discussion
23-1-17	Nanmawke	Ma Sein	Kalaywa	Sagaing	Townhall Meeting, 19HH Surveys, Socio-economic survey
24-1-17	ChaungSone	Ma Sein	Kalaywa	Sagaing	Townhall Meeting, 20HH Surveys and Socio-economic survey
25-1-17	Nanmawke & Chaungsone	Ma Sein	Kalaywa	Sagaing	6 Groups Discussion
Total Surveys	**100 HH Surveys, 5 Socio-economic survey and 15 Groups discussion**				

The questionnaire used to collect data on ecosystem services is shown in *Figure 1*. Data was collected on screened in ecosystem services relevant to the community. Information was collated on:

- Type of ecosystem services used by the local community;
- Sources (locations), amounts utilised and availability of alternatives; and
- Condition and trends in resource availability.

Information collected on cultural, and supporting ecosystem services was collected from social surveys and biodiversity surveys. Screened ecosystem services for erosion and non-use value of biodiversity (e.g. existence, bequest value) have been determined based on data collected on soil, water and biodiversity for this ESIA.

Figure 1 Ecosystem Services Questionnaire

ES Screened in	Questions
Food: wild meat	• Does the local community hunt for animal to supply wild meet in the forest? (e.g. Deer). Record the type and amounts. • Discuss what other sources of protein are used by households. Record the type and amounts. • Record the type and trend (increasing or decreasing)
Food: cultivated crops	• Discuss the crops that are cultivated in the forest by the household. Record the number and area of plots. • Discuss what other crops are used by households. Record the type and amounts. • Discuss any trends in quality or quantity. Record the type and trend (increasing or decreasing)
Food: herbs, mushrooms and plants	• Discuss what herbs, mushrooms and plants are collected from the forest. Record the species, places where they are collected, their use and frequency of collection. • Discuss what other plants, mushrooms or herbs are used by households. Record the type and amounts. • Discuss the type of plants and herbs consumed and whether there is a trend in quality or quantity. Record the type and trend (increasing or decreasing)
Livestock farming	• Discuss the livestock used and the location of grazing areas. Not if grazing areas are within natural forest areas • Discuss what other livestock are used by households. Record the type and amounts. • Discuss the type of livestock tended and whether there is a trend in quality or quantity. Record the type and trend (increasing or decreasing)
Timber and wood products	• Discuss the types of wood and timber products collected in the forest by the household and their primary uses (house building/canoe building). Record the amount and location of the collection point. • Discuss what other sources of wood are used by households. Record the type and amounts. • Discuss the yield of wood and timber products and whether there is a trend in quality or quantity. Record the type and trend (increasing or decreasing)
Non- Timber Forest Products (NTFP)	• Discuss the collection of NTFP in the forest by the household. Record the type and amount. • Discuss what other NTFP are used by households. Record the type and

ES Screened in	Questions
	amounts. • Record the type and trend (increasing or decreasing) of NTFP collected.
Freshwater	• Discuss the use of freshwater by the household. Record the location of freshwater collection and uses. Record the type of use (potable, wastewater, irrigation etc.) • Discuss alternatives locations for water collection for the household • Determine if any changes have occurred and over what time period and any trends.

1.1.5 Results

The results of the survey for screened ecosystem services are outlined below.

1.1.5.1 Provisioning Services

Food – Wild Meat

The results of the survey in relation to provisioning services for Food – Wild meat are outlined in *Table 3* below.

Table 3 Results of survey in relation to Food – Wild meat

Name of Village	Food- Wild Meat					
	Wild meat caught from the forest (per month)		Other sources of protein consumed (per month)		Resource condition and trends	
	Type	Amount	Type	Amount (kg)	Size	Trend
Kubin	-	-	Chicken	20 kg	Normal	Increase
	-	-	Pig	10 kg	Normal	Increase
Pyinnaung	Wild goat	1	Chicken	16 kg	Normal	Increase
			Beef	7 kg	Normal	Increase
			Pig	7.5 kg	Normal	Increase
			Goat	5 kg	Normal	Increase
Chaungsone	Wild Boar	1	Chicken	20 kg	Normal	Increase
	Barking Deer	1	Pig	10 kg	Normal	Increase
Pluzawa	Wild Boar	1	Chicken	5 kg	Normal	Increase
	Barking Deer	1	Pig	6 kg	Normal	Increase
Nanmawke	-	-	Chicken	5 kg	Normal	Increase
			Pig	5 kg	Normal	Increase

Food – Cultivated Crops

The results of the survey in relation to provisioning services for Food – Cultivated Crops are outlined in *Table 4* below.

Table 4 Results of survey in relation to Food – Cultivated Crops

Name of Village	Food: Cultivated Crops						
	Crops cultivated in the forest			Crops used by Household		Resource Condition and Trends	
	Name	Plot No.	Plot area	Type	Amount	Trend	
						Quality	Quantity
Kubin	Rice	1	2 Acre	Rice	80 kg	Same	Increase
Pyinnaung	Rice	1	1 to 3 Acre	Rice	90 kg	Same	Decrease
				Long Bean	5 kg		
				Mango	25 kg		
				Banana	25 kg		
				Avocado	10 pc		
Chaungsone	Rice	1	1 to 3 Acre	Rice	90 kg	Same	Decrease
	Corn	1	1 Acre	Corn	5 kg		
Pluzawa	Rice	1	1-4 acre	Rice	90 kg	Same	Decrease
	Salad	1	1 Acre	Salad		Same	Decrease
	Bean	1	2 Acre	Bean		Same	Decrease
	Sesame	1	3 Acre	Sesame		Same	Decrease
Nanmawke	Rice	1	1-3 Acre	Rice	90 kg	Same	Decrease
	Sun-flower	1	1 Acre	Sunflower			

Food: Herbs, Mushrooms and plants

The results of the survey in relation to provisioning services for Food: Herbs, Mushrooms and plants are outlined in *Table 5* below

Table 5 Results of survey in relation to Food: Herbs, Mushrooms and plants

Name of Village	Food: Herbs, Mushrooms and plants						
	Herbs, Mushroom and plants are collected from the forest			Other collected foods		Resource Condition and Trends	
	Name	Place	Frequency	Type	Amount	Trend	
						Quality	Quantity
Kubin	Bamboo Shoot	Near Forest	10	-	-	Same	Decrease
	Mushrooms	Near Forest	15			Same	Decrease
	Fetid Acacia	Near Forest	20			Same	Decrease
Pyinnaung	Bamboo Shoot	Near Forest	10	Onion	1.63 kg	Same	Decrease
	Mushrooms	Near Forest	10	Garlic	0.9 kg	Same	Decrease
Chaungsone	Bamboo Shoot	Near Forest	10	Onion	1.63 kg	Same	Decrease
	Mushrooms	Near Forest	15	Garlic	0.9 kg	Same	Decrease
	Eastern gooseberry	Near Forest	5	Black Pepper	0.002 kg	Same	Decrease
	Myrobalan	Near Forest	5			Same	Decrease
Pluzawa	Bamboo Shoot	Near Forest	10	Onion	2 kg	Same	Decrease
	Mushrooms	Near Forest	15	Garlic	0.05 kg	Same	Decrease
	Ginger	Near Forest	10	Black Pepper	0.002 kg	Same	Decrease
Nanmawke	Bamboo Shoot	Near Forest	10	Ginger	0.002 kg	Same	Decrease
	Mushrooms	Near Forest	15			Same	Decrease

Food: Livestock farming

The results of the survey in relation to provisioning services for Food: Livestock farming are outlined in *Table 6* below

Table 6 Results of survey in relation to Food: Livestock Farming

Name of Village	Livestock Farming						
	Livestock		Other Livestock		Resource Condition and Trends		
	Name	Grazing area	Type	Amount	Type	Trend	
						Quality	Quantity
Kubin	Buffalo	Around village	Pig	1 to 5	Pig	Same	Increase
			Chicken	5 to 15	Chicken	Same	Increase
Pyinnaung	-	-	Buffalo	1 to 3	Buffalo	-	Increase
			Pig	1 to 5	Pig	Same	Increase
			Goat	1 to 5	Goat	Same	Increase
			Chicken	5 to 20	Chicken	Same	Increase
Chaungsone	-	-	Buffalo	4 to 10			
			Pig	1 to 8	Pig	Same	Increase
			Chicken	12 to 60	Chicken	Same	Increase
Pluzawa	-	-	Buffalo	2 to 7	-	-	-
	-	-	Pig	3 to 4	Pig	Same	Increase
	-	-	Chicken	6 to 10	Chicken	Same	Increase
Nanmawke	-	-	Buffalo	5			
	-	-	Pig	5	Pig	Same	Increase
			Chicken	13	Chicken	Same	Increase

Timber and wood products

The results of the survey in relation to provisioning services for timber and wood products are outlined in *Table 7* below

Table 7 Results of survey in relation to Timber and Wood Products

Name of Village	Timber and wood products						
	Wood and Timber collected from the forest			Other source of wood		Resource Condition and Trends	
	Type	Amount	Location	Type	Amount	Type	Trend Quantity
Kubin	Pyinkado	0.2 ton	Forest			Pyinkado	Decrease
				Latpan	0.5 ton	Latpan	Decrease
				Wood	0.25 ton	Wood	Decrease
Pyinnaung	Pyinkado	0.3 ton	Forest	-	-	Pyinkado	Decrease
	Ingyne	0.05 ton	Forest	-	-	Ingyne	Decrease
	Latpan	0.03 ton	Forest	-	-	Latpan	Decrease
Chaungsone	Pyinkado	0.2 ton	Forest	-	-	-	-
	Ingyne	0.05 ton	Forest	-	-	-	-
	Latpan	0.05 ton	Forest	-	-	-	-
Pluzawa	Pyinkado	0.2 ton	Forest	-	-	-	-
	Ingyne	0.05 ton	Forest	-	-	-	-
	Thit yar	0.06 ton	Forest	-	-	-	-

Name of Village	Timber and wood products						
	Wood and Timber collected from the forest			Other source of wood		Resource Condition and Trends	
	Type	Amount	Location	Type	Amount	Type	Trend Quantity
Nanmawke	-	-	-	-	-	-	-

Non-Timber Forest Product (NTFP)

The results of the survey in relation to provisioning services for Non-Timber Forest Product (NTFP) are outlined in *Table 8* below

Table 8 Results of survey in relation to Non-Timber Forest Product (NTFP)

Name of Village	Non-Timber Forest Product (NTFP)					
	NTFP collected from the forest			Resource Condition and Trends		
	Type	Amount	Location	Type	Trend Quality	Quantity
Kubin	Bamboo	0.2 ton	Near Forest	Bamboo	Same	Decrease
Pyinnaung	Bamboo	0.5 ton	Near Forest	Bamboo	Same	Decrease
Chaungsone	Bamboo	0.3 ton	Near Forest	Bamboo	Same	Decrease
Pluzawa	Bamboo	0.5 ton	Near Forest	Bamboo	Same	Decrease
Nanmawke	Bamboo	0.5 ton	Near Forest	Bamboo	Same	Decrease

Freshwater

The results of the survey in relation to freshwater are outlined in *Table 9* below

Table 9 Results of survey in relation to Freshwater

Name of Village	Freshwater						
	Location	Alternative location			Resource Condition and Trends		
	Type	Type	Location	When	How		Why
					Quality	Quantity	
Kubin	Creek	Purified drinking water	Private Company	Since Cement Project	More Turbidity	Decrease especially in Summer	Cement plant Reservoir
Pyinnaung	Creek	Purified drinking water	Private Company	2 year	Decrease	Decrease	Nearest Gold mine (Asia World)
Chaungsone	Creek	Chindwin River	Nearest	1 year	Decrease	Decrease	Coal Mine
Pluzawa	River	Chindwin River	Nearest	1 year	Decrease	Decrease	Coal Mine
Nanmawke	River	Chindwin River	Nearest	1 year	Decrease	Decrease	Coal Mine

Role of vegetation in regulating erosion on slopes and riparian areas

Vegetation plays an important role in maintaining soil cohesion along riparian areas and on steep slopes. It was observed at the coal mine site that activities had disturbed areas along the riparian zone of the creek and also on areas

associated with mining activities. The vegetation had been removed, exposing soil surfaces to erosion.

Biological value: Species and areas valued globally as of high conservation value

Both project areas are candidate critical habitat areas for global high conservation species.

1.1.6 Ecosystem Services Prioritisation

IFC PS6 requires that Priority Ecosystem Services are identified, and impacts to those services are assessed (IFC 2012). The prioritization process is aimed at identifying those services for which Project impacts would be most likely to result in adverse impacts on Project Affected Communities and other beneficiaries. Using the information collected through the baseline data collection and stakeholder engagement processes, Ecosystem Services were prioritized according to a Priority matrix ranking two criteria:

- Importance of the Ecosystem Service to the beneficiary which considers the intensity of use, degree of dependence and the importance expressed by the Project Affected Communities; and
- Irreplaceability of the Ecosystem Service, which refers to the availability of alternatives, the accessibility, cost and appetite for those alternatives as discussed with the beneficiary.

After compiling baseline information on the importance and irreplaceability of each service, these ratings were combined to assign a priority rating to the service grading from Low to Mayor, as shown in the Ecosystem service Prioritization Matrix in *Figure 2*.

Ecosystem services identified as High Priority or Major Priority were considered Priority Ecosystem Services. The weight given to each of these components varied slightly depending upon the service, but stakeholder values were given precedence over other criteria where the rating was not clear.

In addition to the above, according to the IFC definition of Priority Ecosystem Services, all services for which project dependencies are identified are considered priority services. The importance and irreplaceability of services relied upon by the Project was assessed through the same prioritization process outlined above, with the Project filling the role of the beneficiary.

Figure 2 Ecosystem Service Prioritization Matrix

Importance to Beneficiaries		**Irreplaceability**		
		High	**Moderate**	**Low**
Low	The service is used and valued by parts of the community, but it is not important in maintaining quality of life or livelihoods of Project Affected Communities.	**Low Priority**	**Low Priority**	**Moderate Priority**

Importance to Beneficiaries		Irreplaceability		
		High	**Moderate**	**Low**
Medium	The service is readily used by some members of the Project Affected Communities for income or subsistence, but they are not dependent upon the service for their livelihoods, and not everyone utilises the service.	**Low Priority**	**Moderate Priority**	**High Priority**
High	The service is highly important in maintaining the livelihoods of the Project Affected Communities, and is used by most of the community regularly.	**Moderate Priority**	**High Priority**	**Major Priority**
Essential	The service is essential to maintain the health of the Project Affected Communities, and the service is used by all members of the community.	**High Priority**	**Major Priority**	**Major Priority**
Irreplaceability definition				
High	Many spatial alternatives exist that are readily available to the Project Affected Communities, and there are no major impediments to their usage.			
Moderate	Spatial alternatives exist but are either less accessible than the affected service, or there are other barriers to their use such as distance, cost and skills required to access the service.			
Low	There are few to no spatial alternatives available to the Project Affected Communities.			

In addition to the prioritization exercise, the baseline data collection process provided the opportunity to collect information on the status, trends and sustainability of resource use as they pertain to the habitats and species that support Ecosystem Services. This information was gathered through secondary sources and field studies by the environment team and where appropriate through engagement with local stakeholders. This information is important for the assessment of impacts on Ecosystem Services and therefore on local people as the final receptors of these changes.

Table 10 outlines the beneficiaries, potential sources of impact and project dependence for each service, and whether the service was scoped into or out of the Ecosystem Services assessment.

This *section* provides an assessment of the potential Project impact to ecosystem services using the criteria provided for the impact assessment at *Annex B* and the Project description provided in *Section 2* of the ESIA Report.

Table 10 Results of Prioritization

Ecosystem Services	Trends and Sustainability	Beneficiaries	Importance to Beneficiaries	Irreplaceability	Potential Alternatives	Priority?
Provisioning Services						
Food: wild meat	The populations of wild animals caught for meat appears to be in decline.	All villages within AoIs of both project areas	Medium	High	Both communities have ready access to alternative protein sources such as beef, chicken and pork.	Low
Food: cultivated crops	The amount of crops planted and harvested within the Project AoI is decreasing.	All villages within AoIs of both project areas	Moderate	High	Besides crops from the community agricultural land, the local people can purchase the cultivated crops in the market.	Low
Food: herbs and plants	The amount of herbs and plants available to the community from forested areas within the AoI has been decreasing	All villages within AoIs of both project areas	Medium	High	Replacements for herbs and plants collected are readily available within nearby markets.	Low
Timber and wood products	The amount of timber available to local people has been decreasing. Unsustainable harvesting of timber will lead to continued reductions in availability of timber.	All villages within AoIs of both project areas	High	Moderate	Potential alternatives exist for use by the villages such as bricks and cement; however these are likely to be at a higher price than timber sourced from nearby forests.	High
Non- Timber Forest Products (NTFP)	Bamboo availability has been decreasing at both project AoIs.	All villages within AoIs of both project areas	Low	Moderate	Potential alternatives for use by villagers such as plastic and metals poles exist however they are likely to be a higher price than native bamboo.	Low
Freshwater	Freshwater impacts were reported by all villages within both Project AoIs. Impacts from the coal mining site impacted downstream, especially during the wet season. Decreases in water flows were also reported.	All villages within AoIs of both project areas. Water quality impacts of the coal mine site affected villages downstream.	High	Moderate	Bottled water is available for drinking; however river water is used for irrigation.	High
Regulating Services						
Erosion regulation	The forest at the coal mine site provides stability to the slopes to reduce the chance of land slips and erosion. The coal mine site has had an increased incidence of erosion due to coal mine operations	Erosion impacts of the coal mine site affected villages downstream.	High	Moderate	Careful management of soil surfaces will be required to limit damage caused by erosion and mass movement.	High

Ecosystem Services	Trends and Sustainability	Beneficiaries	Importance to Beneficiaries	Irreplaceability	Potential Alternatives	Priority?
Supporting Services						

1.1.7 Priority Ecosystem Services

The following priority ecosystem services shown in *Table 11* have been identified and will be assessed against the impact assessment procedures.

Table 11 Priority ecosystem services

Priority Ecosystem Service	Description
Timber and wood products	Evidence suggests that wood is harvested from within the Project Area and AoI for use by local people. The project may restrict this activity. The amount of timber available to local people has been decreasing. Unsustainable harvesting of timber will lead to continued reductions in availability of timber.
Freshwater	Evidence suggests that freshwater is used by local people from within the Project Area and AoI. The project may restrict or impact this activity. Freshwater impacts were reported by all villages within both Project AoIs. Impacts from the coal mining site impacted downstream, especially during the wet season. Decreases in water flows were also reported.
Erosion regulation (Coal Mine concession only)	Evidence suggests that the Project area of AoI for the coal mine site has regulating erosion on slopes and riparian areas in the vicinity. The forest at the coal mine site provides stability to the slopes to reduce the chance of land slips and erosion. The coal mine site has had an increased incidence of erosion due to coal mine operations.

Annex D4

Biodiversity Clearance Protocol (Forested Habitats Only)

Biodiversity Clearance Protocol (Forested Habitats Only)

Competencies

Site clearance surveys must be conducted by a suitably qualified person(s) able to enable identification of relevant habitats and species. Suitably qualified personnel must also be present to rescue, relocate and/or treat fauna due to injury. The person should have a background in flora and fauna assessment and management, ecology or biology.

Site Clearance Surveys

Site level clearance surveys should be overseen and approved by site-level management.

There are two levels of survey required for biodiversity during clearing activities:

1) **Pre-clearance survey**

The pre-clearance survey is to occur at a maximum of 14 and minimum of 7 days prior to clearance. The scope of the survey is to consist of a transect survey covering key habitat features within the clearance area. A minimum of 2 hours should be spent for every 5 hectares to be cleared. The survey should commence at dawn and/or dusk for fauna surveys to allow maximum detection of the relevant species. Flora surveys may occur during the day time.

Key habitat and physical features are to be identified and demarcated within and directly adjacent to the area planned for clearing. All efforts should be taken to avoid features where possible.

Habitat Features and Flora

The following habitat features should be identified and marked by physical marker (spray paint or tape) and by GPS during the pre-clearance survey:

- Boundary of agreed clearance area;
- Living and dead trees containing hollows, nests and/or roosts;
- Ground habitats including fallen trees, rocky outcrops, nests and/or roosts;
- Critically Endangered, Endangered and Vulnerable Plant Species and conservation significant flora;
- primate significant feed trees;
- Wetlands, waterways and/or standing water; and
- Other relevant habitat features (such as salt licks).

Physical Features

The following physical features should be marked using GPS:

- Existing roads/tracks;
- Slopes greater than 30 degrees;
- Drainage features, including Strahler stream order;
- Rocky outcrops, cliffs and caves;
- Areas of active soil erosion and deposition;
- Areas of mass movement; and
- Soil characteristics, including type, soil depth, sub-soil depth

2) Clearance survey

The pre-clearance survey should identify mammals, birds and herpetofauna present on the site. The survey should be undertaken to identify tracks and traces; vocalisations; and other indicators of presence of species. Particular attention should be paid to individual species listed in the ESIA as CR and EN.

The survey should occur during clearance activities to identify any habitat features to be retained/removed; to identify and enable fauna to move; and to rescue any fauna if accidentally injured due to clearance activities.

Clearance activities should not occur during periods of high rainfall (**May to October**). Further site specific advice is to be obtained on relevant site conditions prior to clearance activities commencing.

Habitat Features

The following protocol should be observed during clearance activities:

- Clearance should occur progressively towards refugia. This will enable animals to be given the chance to move towards safe habitats through existing habitat corridors/features on the site.
- All habitat features identified during the pre-clearance survey should be inspected for species presence prior to clearance. Where an animal is identified, it should be given the opportunity to move by its own accord. Reasonable coercion can occur to encourage the individual to move. This should be carried out by the nominated qualified person and not by general clearance personnel;
- Where a bird nest and/or roost are identified, if the birds nest is occupied, the tree where the nest occurs must not be cleared (with a buffer of at least 10 metres). The tree may be cleared when the individual has moved from the nest and the nest is deemed empty.
- Where a flowering or fruiting tree is identified, the flowering or fruiting tree is to be left in situ until it has finished flowering/fruiting, including a buffer of at least 30 metres beyond the drip line of the tree. The buffer must not be breached by felling surrounding trees. The tree may be cleared when the tree has finished

fruiting/flowering (It should be noted that tree fruiting/flowering occurs generally in the period May – August annually).

Flora

For conservation significant plant species advice is to be sought from suitably qualified professionals in determining requirement for physical relocation of individuals, seed collection and/or propagation. These activities would require action prior to clearing and may require maintenance, monitoring or propagation during suitable conditions.

Fauna

The following protocol should be observed during clearance activities:

- All workers must be inducted and trained regarding clearance activities prior to commencement, including the following points:
  - All workers must comply with requirements to stop work when directed;
  - No species is to be captured or transported from the site unless authorized during the clearance survey and;
  - No individual is to be captured for consumption.
- Where an individual are identified during clearance activities, clearance should stop immediately until the individual has been given the opportunity to move to refugia. This may include leaving the area overnight;
- Where an individual does not move or is unable to move, the following steps should be used
  1) Reasonable coercion is used to encourage the individual to move;
  2) The area where the individual is located be left overnight to enable the individual to move of its own accord; **OR**
  3) The individual is captured and moved to refugia (Note that capture and movement of fauna should be undertaken by an experienced animal handler).
- Where an individual is injured due to clearance activities the individual is to be assessed as to the nature of the injuries. Where it is determined that the individual is severely injured, the individual is to be captured and taken to a veterinary for treatment.

Annex E

Biodiversity Action Plan March 2018 V.1.5

Shwe Taung Cement Co., Ltd.

Cement and Coal Mine Concessions

Biodiversity Action Plan

October 2018

V.1.5

SHWE TAUNG
CEMENT CO.,LTD.

ERM

The business of sustainability

FINAL REPORT

Shwe Taung Cement Co., Ltd.

Cement and Coal Mine Concessions

Biodiversity Action Plan

October 2018

Reference: DRAFT STC BAP.docx

v.1.5

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Review Log

Rev.	Date (dd/mm/yyyy)	Description	Prepared	Checked	Approved
1.1	14/09/2017	Response to IFC comments on draft	SMC/DN	DN	PT
1.2	06/11/2017	Response to STC comments on draft	DN	DN	PT
1.3	22/12/2017	Response to consultation comments	DN	DN	PT
1.4	01/03/2018	Response to consultation comments on draft	DN	DN	PT
1.5	10/10/2018	Response to comments from FFI	DN	DN	PT

Revision Log

Rev.	Date (dd/mm/yyyy)	Revised Detail			
		Item	Page	Article	Description

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Glossary of Terms

Additionality	Additionality means ensuring that biodiversity management measures undertaken as part of an offset strategy do not take the place of actions that are already funded.
Biodiversity Offsets	Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization and restoration measures have been taken.
Biodiversity Values	Biodiversity values means the values attached to particular biodiversity attributes by relevant local, national and international stakeholders.
Critical Habitats	Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.
Habitat	Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment.
Like-for-like	The principle of "like-for-like or better" indicates that biodiversity offsets must be designed to conserve the same biodiversity values that are being impacted by the project (an "in-kind" offset).
Mitigation Hierarchy	Mitigation Hierarchy is defined as the application of measures to firstly avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimize impacts and restore biodiversity and ecosystem services should be implemented. As a last resort, biodiversity offsets may be considered but only after appropriate avoidance, minimization, and restoration measures have been applied.
Natural Habitats	Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.
Net Gain	Net gains are additional conservation outcomes that can be achieved for the biodiversity values for which the critical habitat was designated.
No-Net-Loss	No net loss is defined as the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimize the project's impacts, to undertake on-site restoration and finally to offset significant residual impacts, if any, on an appropriate geographic scale (e.g., local, landscape-level, national, regional).

1 *INTRODUCTION*

This Biodiversity Action Plan (BAP) has been prepared to assist Shwe Taung Cement (STC) comply with the requirements of the International Finance Corporation (IFC) Performance Standard (PS) 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources and the associated Environmental and Social Action Plan (ESAP) prepared for STC's operations.

The PS and ESAP require a number of specific management actions to be prepared to manage biodiversity and ecosystem service values at STC's sites, which are outlined and addressed in this BAP.

The BAP consolidates the biodiversity and ecosystem service mitigation actions as outlined in the Supplementary Environmental and Social Impact Assessment (ESIA) prepared by ERM (ERM 2017).

STC's operations referred to in this BAP and subject to the actions listed include:

- Cement production facility, including the extraction of raw materials (mud stone and limestone) and accommodation area located at Pyi Nyaung Village, Thazi Township in the Mandalay region of Myanmar (Limestone concession); and
- Coal mine developed in the Kalaywa Township of the Sagaing region of Myanmar (Coal mine concession).

1.1 *STRUCTURE OF THIS BAP*

The BAP includes the following components:

- STC Biodiversity and Ecosystem Services policy;
- STC Anti-illegal logging policy (ESAP item 16.);
- STC Zero tolerance policy for the possession of wildlife and forest resources (ESAP item 17.);
- Residual Impact Summary and No-Net-Loss/Net Gain Definition;
- Biodiversity Management Plan (BMP) for Limestone Concession and Coal Mine Concession (ESAP item 18.) including Biodiversity mitigation actions;
- Biodiversity Offset Management Plan (BOMP) for Limestone and Coal Mine Concessions including (ESAP item 18.) including biodiversity offset management actions; and
- Biodiversity Monitoring and Evaluation Plan (BMEP) (ESAP item 19.) for the BMP and BOMP.

1.2 *RELEVANT ESAP ACTIONS*

The following Environmental and Social Action Plan (ESAP) items are relevant to this BAP (***Table 1.1***). The ESAP items have been published by the IFC and disclosed on April 7, 2017.

Table 1.1 Relevant ESAP Actions

ESAP Item	Task	Indicator of Completion	Date	Section of this plan
14.	Develop and implement a policy that ensures no access at all times by non-authorized personnel and mechanized vehicles/equipment on company owned roads and areas under its control inclusive of the road to the coal mine so as to limit the potential for illegal loggers to access the company's concessions or adjacent areas via the concessions.	Evidence of effective access control points set up and check point statistics available. Submission of corporate policy. Policy implementation results as part of AMRs submitted.	31/12/2017 By March 31 of each year	*Section 5* of this plan
15.	Develop and implement a policy and associated systems and procedures inclusive of appropriate sanctions/contract termination actions that prohibit employees and/or contractors from possession, purchase, trade or collection of wildlife or forest resources that are legally protected, CITES listed, or classed as threatened by the IUCN Red List.	Submission of agreed policy, system and procedures. Evidence of effective staff and contractor training, implementation of system and procedures and monitoring statistic submitted as part of AMRs.	31/12/2017 By March 31 of each year	*Section 4* of this plan
16.	Commission a qualified independent consultant and/or organization/NGO to support development and implementation of the Biodiversity Action Plan (BAP) so as to achieve no net loss of Natural Habitats, and net gain of Critical Habitat values aligned with the Biodiversity Strategy as compiled in the ESIA. The BAP will include a Biodiversity Monitoring and Evaluation Plan (BMEP). Development and implementation of the BAP and BMEP will involve qualified independent consultants and supporting organization/NGOs.	Approved Terms of Reference / appointment of consultant. BAP and BMEP reviewed and approved by IFC. First BAP and BMEP implementation monitoring report by independent consultant; subsequent reports in AMRs	30/06/2017 30/11/2017 First report 31/03/2018; thereafter by March 31 of each year.	*Section 7.1* and *7.2* of this plan

1.3 CONSULTATION

ERM conducted consultation with Myanmar Government officials and NGOs in Myanmar in June 2017. ERM consulted with the following parties:

- Flora and Fauna International (FFI), Myanmar;
- Wildlife Conservation Society (WCS), Myanmar;
- International Union for the Conservation of Nature (IUCN) (Bangkok Office);
- Myanmar Ministry of Environmental Conservation and Forestry (MONREC);

- Mahamyaing Wildlife Sanctuary Forest Office; and
- Panlaung-Pyadalin Cave Sanctuary Forest Office.

Notes from this consultation are contained at *Annex A*.

Additional public consultation occurred in November 2017 with the following NGO parties:

- Flora and Fauna International Myanmar Office (face-to-face);
- World Wildlife Fund (WWF) (by email);
- Wildlife Conservation Society (WCS) (by email);
- International Union for the Conservation of Nature (IUCN) (by email); and
- Myanmar Centre for Responsible Business (MCRB) (face-to-face).

Written comments were received from FFI, WWF and WCS.

Consultation in November 2017 also occurred with the following Myanmar Government representatives:

- Nature and Wildlife Conservation Division of MONREC (NWCD);
- Ministry of Mines; and
- Forestry Department of MONREC.

Written comments were received from NWCD.

Consultation with in May 2018 occurred with FFI and NWCD regarding requirements of the BAP to establish the offset and financial mechanisms under Myanmar Legislation.

Consultation with NWCD regarding preparation of a Letter of Agreement ot implement the Biodiversity Offset.

Consultation with FFI and NWCD in October 2018 regarding reptile fauna within the Paunglaung Pyaladin Cave Wildlife Sanctuary and the extent of protection within the offset area.

Summaries of the results of consultation are contained in *Annex A*.

1.4 *INSTITUTIONAL FRAMEWORK*

The following institutional framework has been outlined to enable the definition of laws and policies that apply to this BAP.

Where relevant laws and policies contain provisions that are relevant to this BAP, they are included below the description. Relevant laws and policies are also referenced in the provisions of the BAP in *Chapters 5* and *6*.

1.4.1 *Relevant International Policy Frameworks*

This BAP has been prepared according to the Business and Biodiversity Offset Program (BBOP) Biodiversity Offset Design Handbook (BBOP, 2009)[1].

1.4.2 *Relevant International Agreements/Commitments*

In addition to national legislation, the Project will need to comply with a range of international standards, including the IFC Performance Standards (IFC PS), and the World Bank EHS Guidelines. The IFC Standards and World Bank Guidelines complement and reinforce national legislation and ensure the Project is conducted under best practices in a way that minimizes risks, impacts and ensures compliance and fair practices. The international performance standards and guidelines provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

CITES Convention

The CITES convention[2] (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Myanmar is a signatory of the CITES convention. There are 822 species listed on the CITES convention that have been recorded within Myanmar.

Convention on Biological Diversity

The Convention on Biological Diversity[3] (1992) (CBD) is an international treaty and includes the requirement for the development of a National Biodiversity Strategy and Action Plan (NBSAP) as well as legislative measures to manage biodiversity within countries bounds. Myanmar is a signatory to the CBD.

International Finance Corporation Performance Standards

The relevant IFC Performance Standards to this BAP are listed in ***Table 1.2***.

Table 1.2 IFC Performance Standards

Performance Standards	Objectives
Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts underscores the importance of managing social and environmental performance throughout the life of a project (any business activity	• *Impact identification and assessment.* To identify and assess social and environmental impacts, both adverse and beneficial, in the project's area of influence

[1] http://www.forest-trends.org/documents/files/doc_3126.pdf Retrieved 22 December 2017

[2] https://www.cites.org/eng/disc/what.php Retrieved 22 August 2017

[3] https://www.cbd.int/convention/ Retrived 22 August 2017

Performance Standards	Objectives
that is subject to assessment and management).	• *Mitigation.* To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment • *Stakeholder engagement.* To ensure that affected communities are appropriately engaged on issues that could potentially affect them • *Effective management.* To promote improved social and environment performance of companies through the effective use of management systems.
Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources recognizes that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve, is fundamental to sustainable development	• To protect and conserve biodiversity • To maintain the benefits from ecosystem services • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities

1.4.3 *Relevant Laws in Myanmar*

The following laws are relevant to the establishment and management of biodiversity at the STC sites:

- Forest Law, 1992 and associated Forest Policy, 1995;
- Forest Department Notification No. 583/94;
- Community Forest Instruction, 1995;
- Protection of Wildlife and Conservation of Natural Areas Law No. 6/94;
- Burma Wild Life Protection Rules, 1941;
- National Biodiversity Strategy and Action Plan (NBSAP), 2012;
- Environmental Conservation Law, 2012; and
- National Environmental Policy, 1994.

Forest Law, 1992

The Forest Law, 1992 contains the requirements for the management of forest resources in Myanmar. It outlines the required administrative framework for the Government as well as outlining offences for extracting, moving, keeping in possession unlawfully any forest produce, including fauna and flora. For offences relating to teak trees the punishment is heavier. The Courts are empowered to confiscate all forest produce, vehicles, vessels, animals, machinery, tool and equipment in addition to the punishment for the related offence. Forest Officers are also empowered to take administrative actions in respect of forest produce seized.

The objectives of the Forest Law include to:

- Implement the forestry policy of the Government;
- Implement the environmental conservation policy of the Government;

- Promote public co-operation in implementing the forestry policy and the environmental conservation policy of the Government;
- Develop Myanmar's economy, satisfy public food, clothing, and shelter needs, and ensure enjoyment of the forests
- Carry out in accordance with international agreements relating to conservation of forests and of environment;
- Prevent the dangers of forest destruction and biodiversity loss, fire outbreaks, insect infestation, and plant disease;
- Simultaneously carry out natural forest conservation and forest plantations development; and
- Contribute towards the fuel requirement of the country.

The 1995 Forest Policy sets specific objectives and measures addressing environmental protection and management, reforestation, forest industry and trade, forest research, institutional strengthening, and people's participation and public awareness. The 1995 Policy identified six imperatives necessary to achieve Sustainable Forest Management (SFM) certification, which the government must give the highest priority, in order to achieve broader national goals and objectives. These imperatives are:

- Protection of soil, water, wildlife, biodiversity and environment
- Sustainability of forest resources to ensure perpetual supply of both tangible and intangible forest benefits for all generations
- Basic needs of the people for fuel, shelter, food and recreation
- Efficiency to harness, in a socio-environmentally friendly manner, the full economic potential of the forest resources
- Participation of the people in the conservation and utilization of the forests
- Public awareness about the vital role of the forests in the well-being and socio-economic development of the nation.

The Forest Policy states that Myanmar's protected area must cover at least 5% of the total land area of the country. This was revised in 2000, creating a thirty-year target of protecting 10% of total land area. Currently there are 39 protected areas covering an area of 38906.49 km^2 which equates to about 5.75% of the Myanmar's total land area.

The Nature and Wildlife Conservation Division (NWCD) have been set up within MONREC to administer protected areas in Myanmar. A specific procedure has been defined to guide additions to the protected areas in Myanmar. This procedure is shown in *Annex B*. This procedure is relevant to the additions to the protected area system that are proposed as an offset for the Limestone Concession.

Forest Department Notification 583/94:

The Forest Department Notification 583/94 outlines requirements for the Myanmar Government to comply with International Conventions in respect of the protection and conservation of wildlife, ecosystems and migratory birds.

Section (15) requires that the Director General shall, with the approval of the Minister determine and declare endangered species of wild animal which are to be protected according to the following categories, being:

(i) completely protected species of wild animals;
(ii) normally protected species of wild animals; and
(iii) seasonally protected species of wild animals.

Community Forest Instruction, 1994

This policy gives legal backing for rural communities to co-manage forests, so that economic development can expand throughout the country and provide basic needs to local communities, while encouraging active participation of rural populations and greater environmental conservation. The policy also encourages tree planting and reforestation in barren and degraded lands to help it reach its goal of net-forest growth over the next 30 years. The overall principles in the 1995 Community Forestry Instructions (CFI) are for local communities to fulfil basic livelihood needs while also reforesting degraded areas. This recognizes the rights of communities to have to have equitable use of forest adjacent to their villages because of its importance to their livelihoods. In addition, CFI law states that community forestry certificates can be issued to a forest user group (FUG) for a 30 years lease. To qualify for a community forestry certificate, a FUG must commit itself to manage the forest, according to the forest management plan they develop.

The use of CFI may occur within biodiversity offset areas in order to garner community support for the management of fauna and flora.

Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 6/94

The Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, provides for:

- A Committee for the Protection of Wildlife and Wild Plants and Conservation of Natural Areas, which is to serve as an advisory body to the Minister of Forestry; supervise implementation of the Law; give guidance in matters of research, conserving species in danger of extinction and international cooperation;
- Categories of 'natural areas' and zoological and botanical gardens, their declaration and uses;
- Categories of protected wild animals: protected, normally protected and seasonally protected;
- Hunting licences;
- Establishment of zoological and botanical gardens;
- Registration of ownership of completely protected animals or trophies thereof;
- Administrative actions;
- Appeals; and
- Offences and penalties.

The categories of so-called 'natural areas' are defined in the Law above as:

- Scientific Nature Reserve;
- National Park;
- Marine National Park;
- Nature Reserve;
- Wildlife Sanctuary;

- Geo-Physically Significant Reserve; and
- Other Nature Reserve Determined by the Minister.

Under the Law, the following actions are considered crimes: hunting without a license, breeding protected animals without permission, causing water and air pollution, poisoning water, possessing, selling, transporting or transferring wildlife or any part thereof without permission.

These provisions of the Law may be used by managers to enforce the requirements of any illegal activity that may occur within the Project areas and biodiversity offset areas.

Burma Wildlife Protection Rules, 1941

The Burma Wild life Protection Rules Act, 1941 regulates the taking of wildlife and the removal and export of Wildlife from Myanmar. The Act contains provisions for penalties to be applied. Note that the *Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 6/94* appears to supersede this Act however the Act is listed under general Myanmar laws related to the conservation of biodiversity.

National Biodiversity Strategy and Action Plan (NBSAP)

The National Biodiversity Strategy and Action Plan (NBSAP) of Myanmar was adopted in 2012 and contains 10 strategic directions on the following themes: (i) strengthening conservation of priority sites; (ii) mainstreaming biodiversity into other policy sectors; (iii) implementing focused conservation actions for priority species; (iv) supporting local NGOs and academic institutions; (v) creating capacity to coordinate conservation investment in Myanmar; (vi) scaling up the implementation of in situ and ex situ conservation of agriculture, livestock and fisheries biodiversity and genetic resource management; (vii) expediting the process of implementing the national biosafety framework; (viii) promoting the initiative to manage IAS; (ix) facilitating the legislative process of environmental protection and environmental impact assessment; (x) enhancing communication, education and public awareness on biodiversity conservation.

Priority actions have been established for each strategic direction, as have the major agencies responsible for implementation. In addition, a set of 9 action plans, based on the above strategic directions, has been established for five-year periods toward the sustainable management of the following sectors: forests; wildlife conservation and protected areas; freshwater resources; coastal, marine and island ecosystems; land resources; agriculture, livestock and fisheries; ecotourism; environmental quality and biosafety; mineral resource utilization. The NBSAP has been aligned with the National Environmental Policy, Myanmar Agenda 21, and the National Sustainable Development Strategy.

The provisions of STC's Biodiversity Policy are required to be consistent with the Myanmar NBSAP.

Environmental Conservation Law, 2012

The Environmental Conservation Law (also known as the Pyidaungsu Hluttaw Law) No. 9/2012, implements the Myanmar National Environmental Policy. The Law contains provisions to manage environmental resources and enables MOCAF to: develop plans to protect the environment; prescribe environmental standards in relation to emissions and wastes; develop economic incentive mechanisms; environmental dispute resolution; management of hazardous waste; implementation of international agreements; development of a system of Environmental Impact Assessment; development of guidance in relation to the management of biodiversity, coastal environment, climate change and ozone depleting substances; develop polluter pays approaches; and the establishment of an Environmental Management Fund. An Environmental Impact Assessment Procedure was published by MONREC in January 2015.

National Environmental Policy (1994)

This Policy was drafted in 1994 to establish sound environment policies, utilization of water, land, forests, mineral, marine resources and other natural resources, in order to conserve the environment and prevent its degradation. Additional objectives of Myanmar's National Environmental Policy include achieving harmony and balance between its people, their cultural heritage, the environment and its natural resources. The Government of Myanmar is obliged to take environmental considerations into account when developing anything that may enhance the quality of the life of all its citizens.

2 *STC BIODIVERSITY AND ECOSYSTEM SERVICES POLICY*

The purpose of STC's Biodiversity and Ecosystem Services Policy (Policy) is to outline practical steps to assist the STC Group to meet obligations required by the IFC Performance Standards and associated Environmental and Social Action Plan (ESAP). The policy outlines the associated procedures and actions for biodiversity management at STC sites.

The following commitments are made by STC in relation to the management of biodiversity and ecosystem services:

- Reduce impacts of STC sites on biodiversity values to first avoid, then minimising where possible and then restore. As a last resort offset impacts;
- Assess and manage the values of nature for people at the project sites in conjunction with the community;
- Implement a zero tolerance policy against poaching and hunting for all STC Staff and Contractors;
- Implement a policy of "anti-illegal logging" in conjunction with the community and Myanmar Government;
- Respect the requirements of legally designated protected areas;
- Assess and manage Critical Habitats and Natural Habitats within STC controlled and managed areas in line with IFC PS6 requirements;
- Adopt practices that are practical and easily implementable whilst meeting the objectives of sustainably managing biodiversity; and
- Work with local communities and key stakeholders to restore biodiversity values.

The Policy is designed to apply to all STC sites, including new projects.

2.1 *SCOPE OF POLICY*

This Policy and the associated shall apply to all STC sites across the STC project life cycle, including

- Development sites (includes exploration and project developments);
- Operational sites;
- Those on care and maintenance; and
- Reclaimed mines and quarry sites.

Biodiversity management addresses the actions required to reduce the impacts on biodiversity values and ecosystem services, for example: biodiversity management; managed land clearance; prevention of water, air and soil pollution; and habitat restoration and progressive rehabilitation.

All STC employees, contractors and consultants undertaking work for or on behalf of STC shall comply with this Policy.

2.2 *POLICY REQUIREMENTS*

Risks to biodiversity values shall be assessed and documented in a Risk Register across the project life cycle for all STC sites.

Biodiversity risks must be assessed by:

- Developing baseline data on existing and new sites acquired by STC and ongoing monitoring on existing sites with respect to biodiversity values within the vicinity of STC sites that cover:
  - Fauna and flora of terrestrial and aquatic habitats;
  - IUCN Red List Species, National Conservation List Species and habitats of high biodiversity value;
  - Critical habitats;
  - Linkages with habitat corridors, protected areas, and key biodiversity areas;
  - Assessment of the human livelihood dependence (ecosystem services) upon biodiversity values;
  - Local communities knowledge of biodiversity values; and
  - Costs and benefits of ecosystem services for development sites.
- Determining the likely risk on biodiversity values posed by new projects based on an assessment of the sites likely impact on biodiversity values. The likely risk to biodiversity values must be based on the nature and extent of activities undertaken on the site during the project lifecycle; and
- Documenting the likely risks to biodiversity values in the Risk Register.

2.2.1 *Legal and Other Requirements*

Each STC site must comply with all applicable laws and other legal requirements and provide proof of such compliance as required.

Where applicable laws and other legal requirements do not require performance at least to the level of this Policy and/or to IFC PS6, activities must be conducted in a manner that is consistent with this Policy, taking into consideration any social and cultural sensitivity of communities.

Where an offset is required as a last resort to compensate for a project's residual impact, legal and financial mechanisms must be put in place to ensure the effective financing and management of the offset for at least as long as the project impacts endure.

2.2.2 *Objectives and Targets*

With a focus on continual improvement to avoid and mitigate against residual impacts on biodiversity values, all STC sites must:

- Develop site-specific applicable biodiversity objectives and performance targets;
- Review annually all site-specific biodiversity objectives and performance targets; and

- Confirm performance targets are consistent with STC biodiversity targets, once these are in place.

2.2.3 *Operational Control*

Biodiversity Values and Ecosystem Services for New Projects

The assessment of biodiversity values and ecosystem services for all new projects must:

- Apply the mitigation hierarchy, based on the baseline data and risk assessment, to avoid and mitigate against impacts to biodiversity values;
- Consider biodiversity offsets, as a last resort in cases where there is a residual impact following implementation of the mitigation hierarchy, to compensate for the potential loss of biodiversity values;
- Any biodiversity offset related to an STC project shall have an effective long-term financing and governance mechanism in place;
- Assess ecosystems services where they are likely to be impacted by the project; and
- Engage the community when assessing biodiversity values and ecosystem services.

Management of Biodiversity Values at Existing Sites

As part of the management of biodiversity values, all STC sites must:

- Develop management measures for biodiversity values that respond to identified risks and residual impacts;
- Support local, regional, national and international biodiversity management measures where appropriate;
- Integrate the assessment of biodiversity values and biodiversity management into the planning, decision making and reporting processes throughout the project lifecycle;
- Develop processes and procedures to manage unplanned conditions or unexpected impacts to biodiversity;
- Support ongoing management and research through publicly disclosing and disseminating biodiversity baseline and monitoring data and promoting practices and experiences in biodiversity assessment and management where appropriate;
- Manage biodiversity values through consultation, constructive relationships and partnerships with stakeholders, including the community and conservation NGOs; and
- Integrate biodiversity management within the Life of Asset (LoA) planning process and the site Closure Plan.

Development of Biodiversity Action Plan for STC sites

As part of the management of biodiversity values, STC sites must:

- Develop a Biodiversity Action Plan for sites with Critical Habitat or high risk Natural Habitats

- Develop a Biodiversity Action Plan based on biodiversity baseline data and risk assessment that includes management measures:
  - Defining Critical Habitats, Natural Habitats, habitat corridors and, where these are used, biodiversity offsets;
  - Implementation of weed and pest control programs;
  - Species recovery and habitat restoration;
  - Rehabilitation requirements;
  - Responses to impacts from contamination, soil, water, waste, air and other harmful substances;
  - Other measures necessary to manage biodiversity values.
- Links to social investment plans and/or partnerships with the community;
- Links to conservation partners active within affected landscapes, including conservation NGOs;
- Management of people, equipment and infrastructure;
- Assignment of clear accountabilities and responsibilities (resources and roles);
- Competence, training and awareness;
- Communication requirements;
- Legal requirements;
- Monitoring requirements; and
- Documentation, maintenance and retention requirements.

2.3 *MONITORING AND EVALUATION*

All STC sites must:

- Review and update the Biodiversity Action Plan annually;
- Regularly monitor biodiversity offset areas and areas of high biodiversity value within the Limestone and Coal Mine Concession included in the biodiversity action plan; and
- Regularly monitor status of IUCN Red List Species and National conservation list species present within the area of influence of the site.
- Regularly monitor and validate management measures as outlined in the Biodiversity Action Plan for Critical Habitats, Natural Habitats, protected areas, key biodiversity areas, biodiversity offsets, resilience of habitat restoration and rehabilitation programs based on agreed success criteria within the area of influence of the site;
- Regularly monitor and report on the implementation of the "no-poaching and no-hunting" and "anti-illegal logging" policy; and
- Establish data collection and reporting systems to meet both internal and external reporting requirements in relation to biodiversity baseline and monitoring data required for the annual STC Sustainability Report.

All requirements for monitoring and evaluation are outlined in the *Biodiversity Monitoring and Evaluation Plan* at *Section 8*.

3 *STC ZERO TOLERANCE POLICY ON POSSESSION OF WILDLIFE AND FOREST RESOURCES*

3.1 *POLICY REQUIREMENTS*

STC will commit to the following zero tolerance policy to possession of wildlife and forest resources for all operations:

All STC staff and contractors are strictly prohibited from the possession, purchase, trade or collection of wildlife or forest resources that are legally protected under Myanmar Law, are CITES[4] listed, or classed as threatened by the IUCN Red List[5].

The purpose of the policy is to prohibit the collection of wildlife and forest resources by STC staff and contractors.

3.2 *OPERATIONAL CONTROL*

STC shall implement the following actions in relation to the Policy:

- All staff must be educated during induction training and on an annual basis regarding STC's "no-poaching and no-hunting" policy;
- A register is to be kept of staff's completion of the training and any refresher training attended;
- All staff work agreements and Code of Conduct must contain a clause that states that the staff member agrees to comply with STC's "no-poaching and no hunting" policy;
- All STC properties are to have access control facilities at entrances;
- 24-hour vehicle inspections are to occur at the entrance of all STC controlled properties to detect fauna and flora. Thorough, random vehicle inspections are also to occur on a regular basis. Evidence of such inspections to be recorded and available for review;
- Where flora or fauna are identified during inspections, these are to be confiscated and photographed. Wherever possible, the flora and fauna are to be returned to their point of origin;
- Undertake ongoing monitoring to control access to STC sites. Inspections are to occur at least on a six (6) monthly basis to identify any unauthorised access. Boundary inspections may consist of physical inspections or aerial photographs/video taken from a drone;

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[4] CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

[5] Threatened species are considered to be listed as Critically Endangered, Endangered, Vulnerable, on the IUCN Red List of Threatened Species.

- Posters and signage are to be developed and placed at STC controlled properties stating the policy, outlining the species prohibited from poaching/hunting; and
- Staff identified to have participated in the possession, purchase, trade or collection of wildlife or forest resources will be dismissed from employment and not re-employed at any later date.

Species targeted for inspections are outlines in *Table 3.1*. This list is based on species that were detected on site. There may be other species that may be considered threatened or listed on CITES that may occur on the sites, including plants (e.g. orchids). Inspections should identify ANY flora and fauna being transported from the site and subsequent action taken as described above if they are detected being removed from the site. Inspections should include collection of supporting photographic evidence of any flora and fauna transported from the site.

Posters to apply the No Poaching – No Hunting Policy are contained at *Annex C*.

Table 3.1 Species Targeted for Wildlife Hunting/Poaching Inspections

SN	Species	Common Name	IUCN Listing/Endemism	CITES Listing	National Listing
Limestone Concession					
1	*Manis pentadactyla*	Chinese Pangolin	CR	Yes (App. I.)	CP
2	*Trachypithecus phayrei* spp. *shanicus*	Shan State Langur*	EN	Yes (App. II)	P
3	*Hoolock leuconedys*	Eastern Hoolock Gibbon**	VU	Yes (App. I)	P
4	*Nycticebus bengalensis*	Bengal Slow Loris	VU	Yes (App. I)	-
5	*Arctonyx collaris*	Hog Badger	VU	No	-
Coal Mine Concession					
1	*Manis pentadactyla*	Chinese Pangolin	CR	Yes (App. I.)	CP
2	*Hoolock hoolock*	Hoolock Gibbon**	EN	Yes (App. I.)	P
3	*Trachypithecus phayrei phayrei*	Phayre's Langur*	EN	Yes (App. II.)	P
4	*Cuon alpinus*	Dhole	EN	Yes (App. II.)	P
5	*Bos gaurus*	Gaur	VU	Yes (App. I.)	CP
6	*Nycticebus bengalensis*	Bengal Slow Loris	VU	Yes (App. I.)	
7	*Capriconis sumatraensis*	Southern Serow	VU	No	CP
8	*Naemorhedus baileyi*	Red Goral	VU	Yes (App. I.)	CP
9	*Ursus thibentanus*	Asiatic Black Bear	VU	No	P

1) National Listings are obtained from the Protected List of Wildlife (1994) with the following categories (i) Completely Protected; (ii) Normally Protected and (iii) Seasonally Protected.
2) * Classified under Forest Department Notification No. 583/94, II Protected Animals, Leaf-Monkeys
3) ** Classified under Forest Department Notification No. 583/94, II Protected Animals, Old World Monkeys

4 *STC ANTI-ILLEGAL LOGGING POLICY*

4.1 *POLICY REQUIREMENTS*

STC will commit to the following policy for all operations:

A "no access" rule is to be applied at all times to prohibit non-authorized personnel, their vehicles and/or any equipment used for illegal logging in all areas under STC control.

The purpose of the policy is to prevent access to illegal loggers accessing via STC's concessions and adjacent areas via the concessions (including protected areas).

4.2 *OPERATIONAL CONTROL*

STC shall implement the following actions in relation to the Policy:

- All staff must be educated during induction training and on an annual basis regarding STC's "anti-illegal logging" policy;
- A register is to be kept of staff's completion of the training and any refresher training attended;
- Local community forums are to occur on an annual basis to educate the local community on STC's policy;
- All staff work agreements and Code of Conduct must contain a clause that states that the staff member agrees to comply with STC's "anti-illegal logging" policy;
- All STC properties are to have access control facilities at site entrances;
- 24-hour vehicle inspections are to occur at the entrance of all STC controlled sites to detect the movement of vehicles and equipment. Thorough, random vehicle inspections are also to occur on a regular basis;
- Undertake ongoing monitoring to control access to STC sites. Inspections are to occur at least on a six (6) monthly basis to identify any unauthorised access; Boundary inspections may consist of physical inspections or aerial photographs/video taken from a drone;
- Posters and signage are to be developed and placed at STC controlled properties stating the policy, including in local villages;
- STC staff or contractor identified to have participated in illegal logging activities will be dismissed from employment and not re-employed at any later date; and
- STC is to refer any staff member of contractor identified of conducting illegal logging to relevant authorities for investigation.

Posters to apply the *STC Anti-Illegal Logging Policy* are contained at *Annex D*.

Species targeted for illegal logging activities are listed in *Table 4.1*. Other species may also be targeted for illegal logging activities within the sites and surrounds.

Table 4.1 Species targeted for illegal logging activity inspections

SN	Species	Common Name	IUCN Listing
Limestone Concession			
3	*Dalbergia oliveri*	Burmese Rosewood	EN
Coal Mine Concession			
5	*Dalbergia oliveri*	Burmese Rosewood	EN
6	*Dipterocarpus baudii*	-	CR
7	*Dipterocarpus costatus*	-	EN

Note: that there are no current flora listed under the Protected List of Wildlife 1994
http://www.fdMONREC.gov.mm/eng/protection/policy-laws-and-rules

5 BIODIVERSITY OFFSET DEFINITION

Residual impacts are significant project-related impacts to biodiversity and ecosystem services that might remain after on-site mitigation measures have been implemented. Under the IFC PS, significant residual impacts on Natural Habitats are required to be offset to achieve a no-net-loss of biodiversity values. Residual impacts to Critical Habitats are required to be offset to achieve a net-gain of biodiversity values. These residual impacts have been determined as required by IFC PS6 through the application of the Mitigation Hierarchy. Residual impacts on biodiversity values are assessed in the Supplementary ESIA for STC's Cement Plant and Associated facilities (ERM 2017).

5.1 RESIDUAL IMPACTS TO BIODIVERSITY VALUES

5.1.1 Habitat Values

The residual impacts to biodiversity largely relate to unavoidable habitat loss within the footprint of the Project. The Critical/Natural habitat lost is outlined in *Table 5.1* below. As outlined in the ESIA, calculations in relation to the requirement to achieve no-net-loss/net gain have been undertaken using an appropriate offset metric[6]. The estimated values of the required offset area are also show in the table.

Table 5.1 Habitat lost due to project activities and offset required to achieve NNL

Habitat Type	IFC Habitat Classification	Area	Required Offset Area
Limestone Concession			
Limestone Habitat	Critical Habitat	235.58ha	1,420ha
Forested Natural Habitat	Natural Habitat	32.59ha	127ha
Coal Mine Concession			
Forested Natural Habitat	Critical Habitat	899.95ha	5,420ha

5.1.2 Species Values

Significant residual impacts to species are primarily habitat loss impacts. On-site residual impacts from hunting and poaching, mortality (from vehicle/machinery strike) and changes in habitat quality were deemed to be sufficiently addressed through on-site management measures for both the limestone and coalmine concessions. No significant residual impacts are expected to remain after successful on-site mitigation.

[6] The required offset area has been determined using an averted loss metric with a compound interest rate of 1.35% and offset management period of 25 years. The full offset assessment can be found in *Supplementary ESIA for STC Cement Plant & Associated Facilities in Myanmar (06 April 2017), Section 1.3, Annex F-3.*

In relation to species identified as Critical Habitat species, the following species were assessed to trigger the Critical Habitat thresholds within IFC PS6. Offsets requiring Net Gain outcomes are required for these species. Most species are likely to be managed sufficiently through habitat-level conservation actions as part of an offset and hence do not require species-specific management actions. The exception to these is species where targeted hunting and poaching is occurring (e.g. Chinese pangolin, Western Hoolock Gibbon). The Critical Habitat species and the residual impact type are outlined in *Table 5.2*.

Table 5.2 Species Requiring Net-Gain Offsets

SN	Species	Common Name	IUCN Listing/Endemism	Key Residual Impacts
Limestone Concession				
1	*Manis pentadactyla*	Chinese Pangolin	CR	Habitat loss; hunting and poaching
2	*Trachypithecus phayrei* spp. *shanicus*	Shan State Langur	EN	Habitat loss
3	Snails: *Anauchen sp., Diplommatina sp. 3, Diplommatina sp. 4 and Diplommatina sp. 5 aff. crispata.*	-	Local endemic	Habitat loss
4	Flora: *Impatiens sp., Amorphophallus sp. and Arisaema sp.*	-	Local endemic	Habitat loss
5	Reptiles: *Cyrtodactylus shwetaungorm, and C. ywanganensis, and Hemidactylus sp. nov.*	-	Local endemic	Habitat loss
Coal Mine Concession				
1	*Manis pentadactyla*	Chinese Pangolin	CR	Habitat loss; hunting and poaching
2	*Hoolock hoolock*	Western Hoolock Gibbon	EN	Habitat loss; hunting and poaching
3	*Dipterocarpus baudii*	-	CR	Habitat loss

In relation to species that are not Critical Habitat species but are considered as species of concern by the project, a no-net-loss is to be achieved where feasible for these species as part of efforts to deliver no-net-loss for Natural Habitats. These species are listed below in *Table 5.3* and outline where specific management actions are required to be implemented at the offset sites.

Table 5.3 Species Requiring No-Net Loss offsets

SN	Species	Common Name	IUCN Listing/Endemism	Key Residual Impacts
Limestone Concession				
1	*Hoolock leuconedys*	Eastern Hoolock Gibbon	VU	Habitat loss; hunting and poaching
2	*Nycticebus bengalensis*	Bengal Slow Loris	VU	Habitat loss
3	*Arctonyx collaris*	Hog Badger	VU	Habitat loss
Coal Mine Concession				

SN	Species	Common Name	IUCN Listing/Endemism	Key Residual Impacts
1	*Trachypithecus phayrei phayrei*	Phayre's Langur	EN	Habitat loss
2	*Cuon alpinus*	Dhole	EN	Habitat loss
3	*Bos gaurus*	Gaur	VU	Habitat loss
4	*Nycticebus bengalensis*	Bengal Slow Loris	VU	Habitat loss; hunting and poaching
5	*Capriconis sumatraensis*	Southern Serow	VU	Habitat loss
6	*Naemorhedus baileyi*	Red Goral	VU	Habitat loss
7	*Ursus thibentanus*	Asiatic Black Bear	VU	Habitat loss
8	*Dipterocarpus baudii*		CR	Illegal Logging
9	*Gastrochilus calceolaris*		CR	Illegal Logging

5.2 *ACHIEVING NO-NET LOSS/NET GAIN*

Demonstration of the implementation towards the offset goals is provided within the monitoring and evaluation framework and the reporting mechanisms in the BAP, as per PS6 requirements.

Achieving no-net-loss for Natural Habitats has been calculated based on the averted loss metric. This metric calculates the area to be managed that would avert the background rate of that loss over the offset management period (25 years).

Achieving a No-net-loss (NNL) for Natural Habitat (and associated species of concern) and Net gain (NG) for Critical Habitat will be required to address the key residual impacts identified in the impact assessment phase and any additional/new threats identified at the chosen offset locations.

Generally, the offset goals can be achieved through a combination of the following:

- Demonstrated increases in species populations for Critical Habitat species within the areas managed;
- Demonstrated reduction in the impact of threats within offset areas (such as illegal logging, hunting and poaching);
- Improvements in the quality/condition of habitats for species against a baseline condition (considering background loss rates); and
- Demonstrated increases in the extent of habitats based on a baseline condition.

A summary of the residual impacts and key mitigation actions for habitats and species to achieve the offset goals are outlined in the BOMP (Section 7) and *Table 5.5*. Reference should be made to the specific management actions contained within the BOMP.

The monitoring and evaluation framework has been developed to set appropriate goals for habitats and species. These goals, recommended monitoring techniques, contingencies and reporting requirements are outlined in the BMEP for each offset site at *Section 8*. A summary of the monitoring KPIs are also outlined in *Table 5.5*.

5.3 *BIODIVERSITY OFFSET OPTIONS*

Two relevant protected areas for offsetting for the STC Project include: the Mahamyaing Wildlife Sanctuary and the Panlaung-Pyadalin Cave Wildlife Sanctuary. Further information on the assessment of adequacy and costs for management of the identified biodiversity offsets can be found in *Annex F-3* of the Supplementary ESIA (ERM 2017).

The Panlaung-Pyadalin Cave Wildlife Sanctuary was established in 2002 and is 334km^2 (33,400ha) in size. It is an IUCN Category IV Protected Area and is located 6km north of the Limestone concession. The Sanctuary contains limestone geology that is connected and considered ecologically equivalent to the limestone range associated with the STC Limestone Concession. During surveys undertaken for the Supplementary ESIA, snail and flora species were identified within the Sanctuary and the proposed concession that were the same species as those impacted by the Project. In addition to supporting ecologically equivalent values as the impact site, the Sanctuary also supports important cultural values and biodiversity values including habitat for the Asian Elephant, Banteng, Gaur, Clouded Leopard, Chinese Pangolin, Shan State Langur and Serow. It is listed as having an annual operation plan and management actions in place, however it is considered to be significantly underfunded. Threats identified include illegal logging and settlement encroachment.

The Mahamyaing Wildlife Sanctuary was established in 2002 and is 1180km^2 in size (111,900ha). It is an IUCN Category IV Protected Area and Important Bird Area (IBA) and is located 24km east of the Coal mine concession. It has important biodiversity values, including an important population of Eastern Hoolock Gibbon. Additional species present include the Chinese Pangolin, Banteng, Sambar Deer and Asiatic Wild Dog, Small Asian Mongoose, Wild Boar, Mongoose, Asian Elephant and Jungle Cat. The Sanctuary has not been appropriately gazetted under Myanmar law and has a draft management plan that has not been funded.

These offset sites were chosen in order to build the capacity of the protected area network in Myanmar. As outlined in Emerton et al (2015), significant future funding of the Myanmar reserve system is required to ensure adequate protection and conservation gains. Management of the existing reserve system as a biodiversity offset in the short to medium term will enable current funding shortfalls to be reduced. Offsetting within protected areas also builds on legal protections afforded by existing laws. The capacity of protected area managers can also be enhanced to tackle threats, building long term experience in protected area management.

The additional funding and resources provided as part of an offset must be additional to existing funding levels. It is also not intended that the existing funding provided by the Myanmar Government be reduced at the offset sites. In the long-term, it would be expected that the Myanmar Government would play a greater role in managing protected areas. Sustainable funding of the Myanmar protected area system should be pursued by the Myanmar Government, including considering developer contributions as a method to ensure future funding arrangements.

5.4 *BIODIVERSITY OFFSET DEFINITION*

5.4.1 *Offset management timeline*

As outlined in the Supplementary ESIA, offset management will occur for a period of at least 25 years, with ongoing in-kind support provided beyond that timeframe. This timeframe is equivalent to the remaining concession agreement period.

5.4.2 *Additionality*

It is noted also that both wildlife sanctuaries are significantly larger than the required offsets as defined by the offset metric. As a result of desktop review and consultation with conservation experts, it has been assessed that undertaking management of protected areas has potential benefits in comparison to establishing and managing new conservation areas in Myanmar given current conservation threats on private land.

Protected areas in Myanmar currently do not receive substantive funding to support ongoing management. Instituto Oikos and BANCA (2011) report that significant underfunding of protected areas has led to a long-term decline in the management of threats. Ongoing illegal logging, poaching, hunting and overuse of natural resources have seen the decline of habitat quality. Emerton et al (2015) report that protected area financing in Myanmar is currently limited due to significant budget shortfalls, narrow funding sources, uneven funding allocations and lack of capital spending. Emerton also recommends biodiversity offsets as an option to improve funding of protected areas in Myanmar.

Building capacity with government in managing protected areas within Myanmar is recommended by international NGOs (WCS and FFI) as likely to achieve gains in conservation through effective funding. The Myanmar Ministry of Forestry, Nature and Wildlife Conservation Division, has established administrative frameworks for Protected Areas. Relevant laws are established to enable gazettal of protected areas and the regulation and enforcement of forest and wildlife laws. On-site management resources such as staff, skills and capital equipment are currently under-resourced. Building on this framework is considered as an effective means to achieve required offset management. Such capacity building would be additional to current conservation efforts of Government and NGOs.

5.4.3 *Limestone Concession*

The biodiversity offset definition for the limestone concession is as follows:

- Addition of a minimum of at least 1420ha of limestone habitat to the Panlaung-Pyadalin Cave Wildlife Sanctuary;
- Contributions for the management of at least 127ha of forested habitat of the Panlaung-Pyadalin Cave Wildlife Sanctuary; and
- Species management actions for species listed as requiring specific offsets in *Tables 5.2* and *5.3* above.

Given the economies of scale and management requirements to achieve the offset, the management of the entire PPCWS will occur to achieve the required offset.

The location of the limestone identified to be subject to offset actions is shown in *Figure 5.1*.

5.4.4 *Coal Mine Concession*

The biodiversity offset definition for the coal mine concession is as follows:

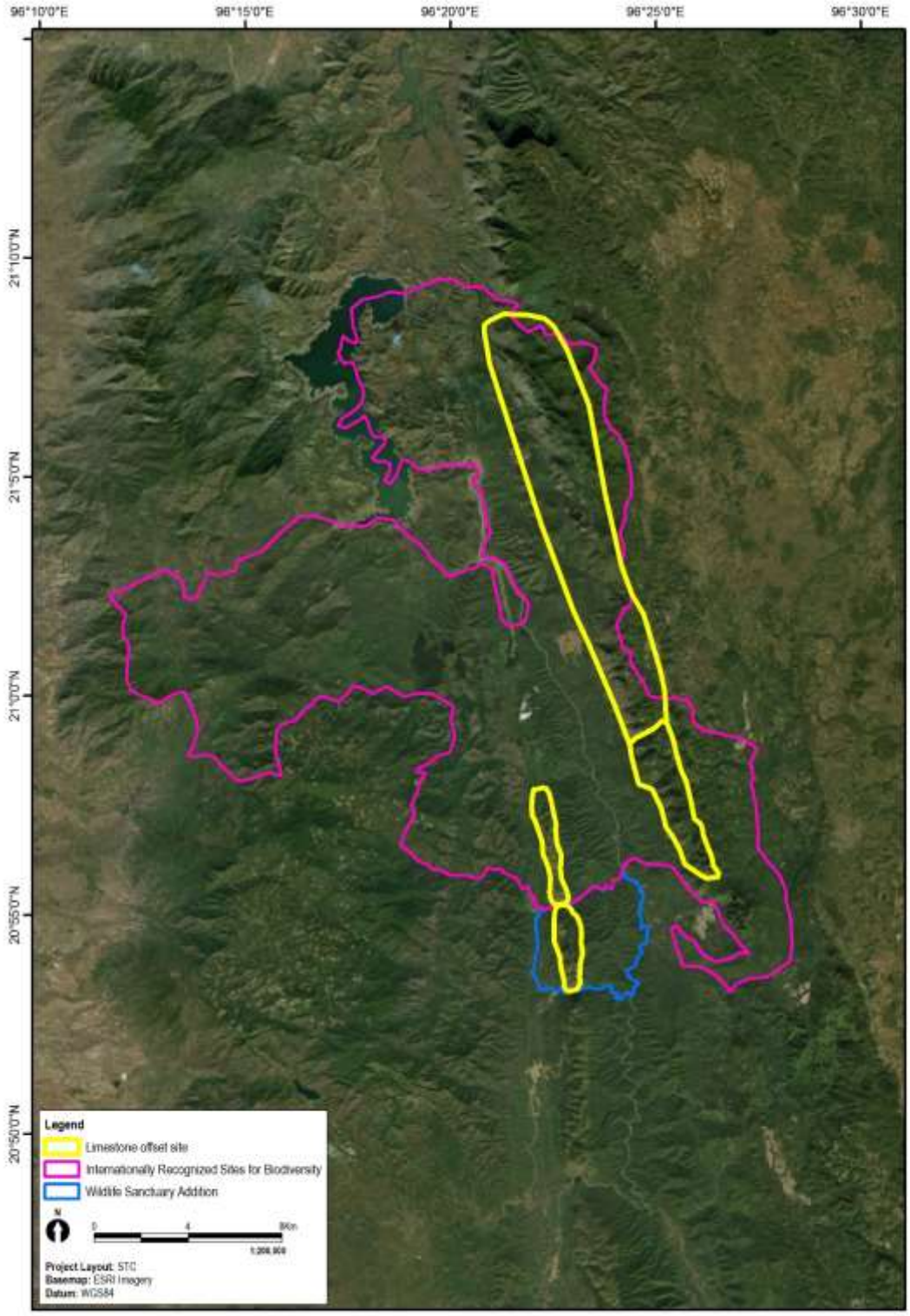
- Management of at least 5420ha of forested habitat within the Mahamyaing Wildlife Sanctuary; and
- Species management actions for species listed as requiring specific offsets in *Tables 5.2* and *5.3* above.

It should be noted that additional specific actions are required for the population of Western Hoolock Gibbon (*Hoolock hoolock*) located near the coal mine concession on the Western side of the Chindwin River as the species within the Mahamyaing Wildlife Sanctuary offset site is different, being the Eastern Hoolock Gibbon (*Hoolock leuconedys*). A specific offset for this species has been defined in the BOMP.

Given the economies of scale and management requirements to achieve the offset, the management of the entire MWS will occur as the required offset.

The specific requirements for implementing and delivering on offset management are outlined in the BOMP for both concessions in *Chapter 7*.

Figure 5.1 Limestone range components within the Paunlaung-Pyaladin Wildlife Sanctuary



5.4.5 *Offset Cost Analysis*

As outlined in guidance provided by the Business and Biodiversity Offset Program (BBOP 2012), the scale of offsets should be linked to the magnitude of residual impacts. The offset size of 6,967ha has been calculated to compensate for the residual impacts of the STC Project. However, the size of the offsets is much larger than the required offset (being a total of 145,300ha). This creates an equity issue in terms of defining how much conservation "effort" or cost is the responsibility of STC in managing these protected areas against what would be the responsibility of other stakeholders and the Myanmar Government. STC will also be required to demonstrate that the conservation actions being undertaken within the protected areas are meeting the offset goals (no-net-loss/net gain), meaning that the level of funding required will need to be sufficient over the offset management period to sustain required management actions. Adaptive management will need to be employed in order to focus conservation efforts.

ERM has completed a cost assessment to compare the costs associated with the management of the two protected areas (current and projected required actual costs) with the estimated costs of the management actions to manage the offset sites. The assessment is outlined in *Table 5.4*.

It should be noted that STC may be required to provide additional funds above the estimated level if monitoring and evaluation identify shortfalls in achieving the offset goals. Longer term protected area funding models will also need to be pursued by the Myanmar government to provide more certainty across the protected area system. Continued funding allocations after the 25 year offset period should also be considered by STC.

A summary of key offset management and monitoring actions to achieve NNL/NG for habitats and species is outlined in *Table 5.5*.

Table 5.4 Costs for Managing Panlaung-Pyadalin Cave Wildlife Sanctuary and Mahamyaing Wildlife Sanctuary as Offset Sites

			Current Protected Area Spend			Estimated Offset Management Cost*					Required Protected Area Cost			Deficit
	Offset Site	**Protected Area Size (A) ha**	**Actual Cost/ha (B)****	**Annual Cost (C) AxB=C**	**25 Year Cost (D) Cx25=D**	**Offset Size (E) ha**	**Offset Cost (F) $/ha/yr**	**Annual Offset Cost (G) ExF=G**	**25 year Offset cost (H) (D+G)x25= H**	**Total 25 year Cost (I) D+H=I**	**Annual Required Estimate (J) $/ha+**	**Annual Required Estimate (K) AxJ=K**	**Total Required spend (25 years) (L) Kx25=L**	**Total Cost Deficit (25 years) (M) L-I=M**
Scenario A	PPCWS													
	MWS													
	Totals													
Scenario B	PPCWS													
	MWS													
	Totals													

Notes:

* Based on estimation of actual costs of implementing the offset management actions contained in the BOMP

** Based on actual costs for management of the protected areas (provided during consultation, 2017)

\+ Based on the scenarios outlined in Emerton 2015 for protected area management in Myanmar:

(a) $x/ha for 75% staffing and basic management (Scenario A); or

(b) $x/ha for full staffing and improved management (Scenario B)

PPCWS – Panlaung-Pyadalin Cave Wildlife Sanctuary

MS – Mahamyaing Wildlife Sanctuary

Table 5.5 Summary of Key Offset Management and Monitoring Actions to Achieve NNL/NG for Habitats and Species

	Species	Common Name	Habitat Loss	Key Residual Impact	Offset Description	Offset Management Action Summary	Monitoring KPI
Limestone Concession							
Net Gain	*Manis pentadactyla*	Chinese Pangolin	32.59ha	• Habitat loss • Hunting and poaching	Management of at least 127ha of forested habitat required within the PPCWS.	• Population Census • Community Engagement • Patrols and Enforcement • Threat Reduction Campaigns • Wildlife Management Actions	• Annual population estimation • Implementation of management actions • Identification of threats and additional management actions
	Trachypithecus phayrei spp. *shanicus*	Shan State Langur	32.59ha	• Habitat loss			
	Diplommatina sp. 3, new sp.	-	235.58ha	• Habitat loss	Management of at least 1420ha of limestone habitat within the PPCWS (or addition of equivalent habitat to the PPCWS).	• Habitat protection and monitoring	• Annual fauna monitoring report • Annual population estimation • Implementation of management actions • Identification of threats and additional management actions (as required)
	Diplommatina sp. 4, new sp.	-	235.58ha	• Habitat loss			
	Diplommatina sp. 5, aff. *Crispate*	-	235.58ha	• Habitat loss			
	Anauchen new sp.	-	235.58ha	• Habitat loss			
	Cyrtodactylus shwetaungorm	-	235.58ha	• Habitat loss			
	C. ywanganensis	-	235.58ha	• Habitat loss			
	Hemidactylus sp. nov.	-	235.58ha	• Habitat loss			
No-Net-Loss	*Hoolock leuconedys*	Eastern Hoolock Gibbon	32.59ha	• Habitat loss • Hunting and poaching	Management of at least 127ha of forested habitat required within the PPCWS.	• Population Census • Community Engagement • Patrols and Enforcement • Threat Reduction Campaigns • Wildlife Management Actions	• Annual population estimation • Implementation of management actions • Identification of threats and additional management actions (as required)
	Nycticebus bengalensis	Bengal Slow Loris	32.59ha	• Habitat loss			
	Arctonyx collaris	Hog Badger	32.59ha	• Habitat loss			

	Species	Common Name	Habitat Loss	Key Residual Impact	Offset Description	Offset Management Action Summary	Monitoring KPI
Coal Mine Concession							
Net Gain	*Manis pentadactyla*	Chinese Pangolin	899.95ha	• Habitat loss • hunting and poaching	Management of at least 5420ha of forested habitat within the MWS.	• Population Census • Community Engagement • Patrols and Enforcement • Threat Reduction Campaigns • Wildlife Management Actions	• Annual population estimation • Implementation of management actions • Identification of threats and additional management actions (as required)
	Hoolock hoolock	Hoolock Gibbon	899.95ha	• Habitat loss • Hunting and poaching		• Specific Wildlife Sanctuary for identified population • Population Census • Community Engagement • Patrols and Enforcement • Threat Reduction Campaigns • Wildlife Management Actions	• Establishment of the Western Hoolock Gibbon Wildlife Sanctuary • Annual population estimation • Implementation of management actions • Identification of threats and additional management actions (as required)

	Species	Common Name	Habitat Loss	Key Residual Impact	Offset Description	Offset Management Action Summary	Monitoring KPI
No-Net-Loss	*Trachypithecus phayrei phayrei*	Phayre's Langur	899.95ha	• Habitat loss	Management of at least 5420ha of forested habitat within the MWS.	• Population Census • Community Engagement • Patrols and Enforcement • Threat Reduction Campaigns • Wildlife Management Actions	• Annual population estimation • Implementation of management actions • Identification of threats and additional management actions (as required)
	Cuon alpinus	Dhole	899.95ha	• Habitat loss			
	Bos gaurus	Gaur	899.95ha	• Habitat loss			
	Nycticebus bengalensis	Bengal Slow Loris	899.95ha	• Habitat loss • Hunting and poaching			
	Capriconis sumatraensis	Southern Serow	899.95ha	• Habitat loss			
	Naemorhedus baileyi	Red Goral	899.95ha	• Habitat loss			
	Ursus thibentanus	Asiatic Black Bear	899.95ha	• Habitat loss			
	Dipterocarpus baudii	-	899.95ha	• Habitat loss			• Success of propagation actions • Success of rehabilitation planting • Identification of threats and additional management actions (as required)
	Gastrochilus calceolaris	-	899.95ha	• Habitat loss			

Notes: PPCWS - Panlaung-Pyadalin Cave Wildlife Sanctuary
MWC - Mahamyaing Wildlife Sanctuary

6 *BIODIVERSITY MANAGEMENT PLAN*

6.1 *APPLICATION*

This Biodiversity Management Plan (BMP) applies to activities during both construction and operation at the STC Limestone and Coal Concessions.

6.2 *BIODIVERSITY MANAGEMENT ACTIONS*

Biodiversity management actions are proposed in the Supplementary ESIA prepared for the limestone and coalmine concession (ERM 2017). These mitigations and specific actions are to occur within the concession areas to reduce impacts to biodiversity values during the operation of the facilities.

The actions are to occur for the life of the concession agreement (25 years). The tasks, mitigation actions and responsibilities are outlined in *Table 6.1* below.

Both tables are outlined in accompanying Microsoft Excel spreadsheets to facilitate amendments and tracking of these actions by STC staff.

The timeline for implementation of biodiversity mitigation actions is shown in *Table 6.2*.

6.3 *MONITORING AND EVALUATION*

Monitoring and evaluation measures are to be implemented for all of the biodiversity mitigation actions are outlined the Biodiversity Monitoring and Evaluation Plan (BEMP) at *Section 8*.

6.4 *ROLES AND RESPONSIBILITIES*

To ensure action ownership, each measure has been assigned to a particular designation within STC. A list of responsible persons is provided in *Table 6.3*.

6.5 *BUDGET*

The following budget in *Table 6.4* has been estimated for the implementation of the *Biodiversity Mitigation Actions, Monitoring and Evaluation Plan.* All values are in 2017 United States Dollars. Future year allocations will need to be adjusted for inflation. All expenditure is estimated in addition to existing budget expenditure on relevant items.

6.6 *PLAN REVIEW AND UPDATE*

The BAP is to be reviewed and updated on an annual basis with consideration of changes to project operations or areas where refinement is required. Annual changes to the BAP must be approved by the Board of Members prior to implementation.

Table 6.1 Biodiversity Management Plan Actions

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
BMP1	Pre-Construction	General Planning & Management	All Environmental Aspects	Designate a Environment Process Senior Executive and set up an on-site SHE Team with minimum 3 personnel with responsibility for: I. Implementation of the BAP, including oversight corrective action and BAP implementation auditing; II. Coordination of stakeholder engagement between key personnel in STC with local communities and government officials as specified within the BAP III. Conduct annual reporting as specified within the BAP	STC to implement staffing requirements at both concessions within 3 months of approval of this BAP.	BOD (Board of Directors)
BMP2	Pre-Construction	General Planning & Management	All Environmental Aspects	STC to implement process for adaptive management measures where BAP measures require refinement or upon changes to its operations that might call for changes to the BAP.	See accompanying *Excel spreadsheet STC BAP V1.XLSX*	EHSS Department Environment Process Senior Executive Construction Manager
BMP3	Pre-Construction	General Planning & Management	Fauna Mortality	Develop protocols for the management of injured wildlife, which will include: I. Process of communication to forestry officers of injured wildlife. II. Recording procedures for injured wildlife/ investigations (Incident Reporting Mechanism). III. Identification of management of change measures necessary to reduce the risk of future events.	See *Annex E* for *Wildlife Incident Reporting Protocol*	Environment Process Senior Executive
BMP4	Pre-Construction	Incident Reporting	All Environmental Aspects	Establish a SHE and wildlife incident reporting mechanism for site staff. This reporting mechanism should have provisions for:	See *Annex E* for *Wildlife Incident Reporting Protocol*	Environment Process Senior Executive

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				I. SHE-related events; II. wildlife sightings and encountered roadkill; and III. poaching/illegal logging activity. As part of this mechanism, a recording and evaluation system, including collection of photographic evidence wherever possible, will be established and reviewed on a monthly basis.		
BMP5	Pre-Construction	General Planning & Management	All Environmental Aspects	Issue an environmental policy and rules for compliance by all employees and contractors. The policy will clearly spell out Do's and Don'ts within the project area, including prohibition of poaching, illegal logging and involvement in the wildlife trade.	See *Biodiversity and Ecosystem Service Policy* (*Section 1* of this BAP)	Environment Process Senior Executive EHSS Department
BMP6	Construction Operation	Awareness Training	Disturbance & Displacement of Wildlife	All construction personnel and STC staff will undertake biodiversity awareness training to raise their awareness of the: I. ecological sensitivity of the site, importance of forest habitats, protected and threatened plants and animals within the Project area; II. proper protocols to adopt when wildlife is encountered; III. need to be cautious when operating machinery to avoid injury/mortality to fauna; and IV. STC's zero tolerance policy to possession of wildlife and forest resources. This is applicable to both staff and contractors. Refresher training will be provided every year.	To be provided by third-party contractor	EHSS Department Environment Process Senior Executive Construction Manager
BMP7	Construction Operation	Penalisation	Disturbance & Displacement of Wildlife	Upon discovery of employees and/or contractors involvement in poaching, illegal logging and wildlife trade*, corrective measures will be taken	See *No-Hunting and No Poaching Policy* (See *Section 4* of this BAP);	Environment Process Senior Executive

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				where necessary including appropriate actions against infringements. STC to develop appropriate levels of penalisation against degree of infringement ranging from fines, suspension and employment termination, and reporting to local authorities for prosecution (for most severe cases). ** Punishable actions include the possession, purchase, trade or collection of wildlife or forest resources that are legally protected, CITES listed, or classed as threatened by the IUCN Red List.*	and *Anti-illegal Logging Policy* (See *Section 5* of this BAP) and *Annex C* and *D* for posters.	Security Supervisor SHE Corporate Manager Managing Director
BMP8	Pre-Construction	Clearance	Disturbance & Displacement of Wildlife	Conduct biodiversity surveys by qualified experts for fauna and flora species of conservation value before expansion of quarry or factory footprint. Findings are to be communicated with the site team and appropriate actions taken where necessary to minimise impacts.	See *Wildlife Shepherding Protocol* (*Annex F*)	EHSS Manager or Environmental Manager Biodiversity Experts
BMP9	Pre-Construction	Clearance	Disturbance & Displacement of Wildlife	Prior to the start of expansion of the mudstone quarry and coal mine, ensure that wildlife is shepherded from the Project area into adjacent refuge areas, and that temporary fencing/hoarding is erected around wildlife-cleared areas (if required) to limit access to fauna. Identified wildlife refuge areas include: I. Panlaung-Pyadalin Cave Wildlife Sanctuary, north of the concession (Limestone Concession Only); II. Adjacent forests outside the affected areas. Upon detection of any dead or injured animal, Environment Process Senior Executive and Construction Manager shall be notified and the action suspected to have caused the injury to be	See *Wildlife Shepherding Protocol* (*Annex F*)	Environment Process Senior Executive Construction Manager

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				suspended. An incident should be logged via an incident reporting mechanism, which includes photographic evidence wherever possible. Construction and expansion activities shall also precede with greater caution in the event that any injury to key terrestrial fauna (CH species triggers, in particular large mammals and primates) encountered within the site are avoided. Construction staff shall notify the Environment Process Senior Executive and Construction Manager.		Contractor
BMP10	Pre-Construction	Clearance	Disturbance & Displacement of Wildlife	General guidance to land clearance protocol: I. When planning for expansion, ensure land clearance is undertaken in a phased approach such that it complements wildlife shepherding activities. II. All proposed clearance areas will be marked in the field prior to any vegetation being cleared. The marking can use spray paint or marking tape. A briefing is to occur with personnel to outline the area proposed for clearing. III. An inspection is to occur following clearing to determine if clearing has been limited to the identified clearance area. Any clearing outside of the marked area is to be reported to the Environment Process Senior Executive and Construction Manager.	See *Wildlife Shepherding Protocol* (*Annex F*)	Environment Process Senior Executive Construction Manager Contractor
BMP11	Pre-Construction	Clearance	Disturbance & Displacement of Wildlife	Prior to wildlife shepherding activities, undertake a briefing with all involved personnel so they are aware of their roles and responsibilities; measures	See *Wildlife Shepherding Protocol* (*Annex F*)	Environment Process Senior Executive

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				to deal with injured wildlife; occupational health and safety requirements; and requirements regarding the prohibition of hunting/catching/taking of fauna and flora. This will include incident reporting measures to relevant forestry authorities and stakeholders, and the reporting of any individual suspected or caught with fauna and flora to the relevant authority. Random inspections of personnel arriving and leaving the Project area can be considered. Refresher training is to occur with new employees.		Construction Manager
BMP12	Pre-Construction	Biodiversity Offset Planning	Biodiversity Offset	A Biodiversity Offset Plan is to be prepared and implemented. The Offset Plan to be designed using participatory processes with Shwe Taung management, government officials, and local communities who will be included in the implementation as far as possible.	See *Section 7.3 Biodiversity Offset Management, Monitoring And Evaluation*	Offset Design: Administration and Communication Executive Offset Implementation: Environment Process Senior Executive
BMP13	Construction	Awareness Training	Disturbance & Displacement of Wildlife	Continue local community engagement with villages that the Project liaised with during the ESIA stage to: I. Continue raising awareness of the conservation value of the forest and surrounding areas; and II. encourage local people not to conduct illegal logging activities and poaching. This engagement program will be developed by STC and the NGO implementing partner, in	See *Annex G: Community Engagement Protocol*	Social Accountability Manager Environment Process Senior Executive NGO partner

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				consultation with, the local government and customary leaders. STC and the NGO implementing partner will engage communities formally to communicate and consult on developments within the Project relevant to them. Where appropriate, this engaegmnt can be completed in conjunction with engaegmnt in relation to the implementation of the BOMP. These meetings are to be formally minuted.		
BMP14	Construction Operation	Transportation	Invasive Species	Wheel wash bays installed at guardhouse at cement plant and entrance to coal mine and coal mine access road to remove dirt and plant material from vehicle wheels prior to entering and leaving project area. Inspections are to occur prior to any wheel washing. Only vehicles with visible material on them are to be subject o washing. Washing vehicles is to focus on the wet season when material is more likely to be attached to vehicles. Water from wheel wash bays should not be discharged directly into natural watercourses, but instead passed through the existing weir to remove suspended particles.	To be installed by STC.	Environment Process Senior Executive Security Supervisor
BMP15	Construction	Transportation	Fauna Mortality	Undertake regular monitoring of all access roads (including all quarries and the cement plant) to secure them from poaching activity.	See *No-Hunting and No Poaching Policy* (See *Section 4* of this BAP); and *Anti-illegal Logging Policy* (See *Section 5* of this BAP)	Security Supervisor
BMP16	All Phases	Transportation	Fauna Mortality	Continue to control access road users through use of security gates. Security gates are to be manned by at least 1 security officer 24 hours per day who will record the particulars (name, address, address,	See *No-Hunting and No Poaching Policy* (See *Section 4* of this BAP); and *Anti-illegal Logging*	Security Supervisor

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				vehicle registration number, personal identification number) of all vehicles who are allowed into the access road. Visitors must also be accompanied by a company representative at all times. The security officers should be trained to identify behaviour associated with poachers and vehicle searches. The security gate should be equipped with 24 hour CCTV cameras. Evidence of such inspections/ vehicle searches to be recorded and available for review.	*Policy* (See *Section 5* of this BAP)	
BMP17	Construction Operation	Fauna & Flora Surveys	Monitoring	Conduct regular monitoring of flora and fauna in Project areas. The surveys will be undertaken by experts with assistance (including guides) from local villages. The information collected is to be used as a basis for habitat and population management.	See *Table 7.2 Monitoring and Evaluation Requirements for STC Cement Concession*	Environment Process Senior Executive Biodiversity Offset Implementation Partner
BMP18	Operation	Fauna & Flora Surveys	Monitoring	Data from camera trap surveys, transects and community monitoring to be used to measure long term population changes and trends for key species (such as the Hoolock Gibbon, Shan Langur, Pangolin) within the project site. STC will liaise with local authorities and experts to provide any relevant ecological monitoring data to integrate in the long term monitoring and management of the broader area, the concession within Panlaung-Pyadalin Cave Wildlife Sanctuary, and with the other surrounding developments.	See *Annex H Biodiversity Survey Program*	EHSS Department Environment Process Senior Executive Process Senior Executive Biodiversity Experts

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
BMP19	All Phases	Fauna & Flora Surveys	Monitoring / Engagement	Set up a database following the pre-expansion monitoring work to store all biodiversity monitoring data. From this database: I. Prepare habitat maps and monitor changes within the project area using aerial imagery obtained via satellite or drone. II. As part of the evaluation of management action, analyse results of field surveys, biodiversity monitoring, and opportunistic sightings to understand more detailed and specific distribution of species. The database is to be shared between STC, forest department officials and ecologists upon approval of request. It is to be updated annually or when major findings from surveys call for updates.	See *Annex H Biodiversity Survey Program*	EHSS Department Biodiversity Experts Biodiversity Offset Implementation Partner
BMP20	Construction Operation	Awareness Training	Disturbance & Displacement of Wildlife	Put up and maintain information posters and literature in the STC site office to increase awareness of ecological issues affecting the Project.	See *No-Hunting and No Poaching Policy* (See *Section 4* of this BAP); and *Anti-illegal Logging Policy* (See *Section 5* of this BAP) and *Annex C* and *D* for posters.	Social Accountability Manager EHSS Department Environment Process Senior Executive
BMP21	Construction	Fauna & Flora Surveys	Fauna Mortality	Regular monitoring of project site and associated quarries for signs of potential wildlife conflict, illegal logging and poaching. Frequency of monitoring to increase if signs of these have been identified.	See *No-Hunting and No Poaching Policy* (See *Section 4* of this BAP); and *Anti-illegal Logging Policy* (See *Section 5* of this BAP)	Environment Process Senior Executive Security Supervisor
BMP22	All Phases	General Planning & Management	Fauna Mortality	Establish a communication system with the local authorities and report to authorities immediately any signs of illegal hunting and deforestation,	See *Annex E: Injured Wildlife Protocol* and *Annex G Community Engagement Protocol*	Environment Process Senior Executive Process Senior

S/N	Phase	Task	Aspect, Potential Impact /Issue	Required Mitigation	Implementation Requirements	Responsible Person For Ensuring Action Implementation
				wildlife conflict and forest fires within the project area. Furnish this report with photographic documentation where possible and the date and time of observation. Incident also to be recorded via STC's incident reporting mechanism.		Executive Security Supervisor
BMP23	Pre-Construction	Fauna & Flora Surveys	Invasive Species	Undertake surveys to identify locations where invasive species are particularly abundant and maintain an inventory. Where necessary, work with specialists to develop a plan to prevent invasive species introduction and/or proliferation due to Project activities. At areas deemed suitable, invasive species within natural habitats should be eradicated with the appropriate use of herbicides (in accordance with the safe use and label directions). Monitoring of invasive species is to occur within the Project Area on an annual basis. New infestations identified are to be controlled.	See *Annex I: Invasive Species Management Plan*	Environment Process Senior Executive Process Senior Executive
BMP24	Operation	General Planning & Management	Site rehabilitation	Rehabilitation of habitat will occur within the landscape disturbed by project operations. All rehabilitation is to occur using native indigenous species as appropriate. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring.	See *Annex J: Site Rehabilitation Plan*	Environment Process Senior Executive Process Senior Executive

Table 6.2 Timeline for the Implementation of Biodiversity Mitigation Actions

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
Item Ref	**ACTIVITY**	**Responsibility**	**Notes**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
BMP1	Appointment of Environment Process Senior Executive	BOD (Board of Directors)	Within 1 month of acceptance of BAP actions	X																								
BMP2	Adaptive management measures (BAP review)	1. EHSS Department 2. Environment Process Senior Executive 3. Construction Manager	Ongoing throughout operations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP3	Protocol documentation (injured wildlife protocol)	Environment Process Senior Executive	Within 1 month of acceptance of BAP actions	X																								
BMP4	Protocol documentation (communication protocol)	Environment Process Senior Executive	Within 1 month of acceptance of BAP actions	X																								
BMP5	Issuance of environmental policy and briefing of all staff on the rules	1. EHSS Department 2. Environment Process Senior Executive	Within 1 month of acceptance of BAP actions	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP6	Biodiversity awareness training	1. EHSS Department 2. Environment Process Senior Executive 3. Construction Manager	Prior to commencement of works and for all new workers; refresher training to occur per annum basis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP7	Incident reporting log and documentation of follow-up actions	1. Environment Process Senior Executive 2. Security Supervisor 3. SHE Corporate Manager 4. Authorized STC senior staff	Upon acceptance of BAP actions	X																								
BMP8	Wildlife surveys	1. Environment Process Senior Executive 2. Biodiversity Experts	To be conducted prior to clearance	Not applicable, please refer to notes for specific timeline instructions																								
BMP9	Wildlife shepherding surveys	1. Environment Process Senior Executive	Daily following erection of fencing/ hoardings	Not applicable, please refer to notes for specific timeline instructions																								

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
		2. Construction Manager																										
BMP10	Development of land clearance protocol and implementation of actions	1. Environment Process Senior Executive 2. Construction Manager 3. Contractor	To be implemented during land clearance activities	Not applicable, please refer to notes for specific timeline instructions																							
BMP11	Clearance briefing	1. Environment Process Senior Executive 2. Construction Manager	Prior to wildlife shepherding activities, with refresher training to occur with new employees	Not applicable, please refer to notes for specific timeline instructions																							
BMP12	Biodiversity offset plan	Offset Design: Administration and Communication Executive Offset Implementation: Environment Process Senior Executive	To be prepared by end-2018	X																							
BMP13	Community Engagement	1. Social Accountability Manager 2. Environment Process Senior Executive	Engagement to be held on an annual basis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP14	Wheel wash bays	1. Environment Process Senior Executive 2. Security Supervisor	Monthly checks to ensure wheel wash bays are utilized	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP15	Access road monitoring	Security Supervisor	Daily monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP16	Access controls	Security Supervisor	Monthly checks of access logs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP17	Fauna and flora monitoring	1. Environment Process Senior Executive 2. Biodiversity Experts	Surveying, reporting and mapping to be undertaken (i) before construction; (ii) every 3 years after operations commence; and thereafter		X			X			X			X			X			X			X			X		X

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
BMP18	Assessment of monitoring data	1. EHSS Department 2. Environment Process Senior Executive 3. Process Senior Executive 4. Biodiversity Experts	Review to be conducted every 3 years, intensity of review may change based on findings		X			X			X			X			X			X			X			X		X
BMP19	Establishment of flora and fauna database	1. EHSS Department 2. Biodiversity Experts	After establishment, to be verified after pre-expansion monitoring work		X																							
BMP20	Placement of posters and literature	1. Social Accountability Manager 2. EHSS Department 3. Environment Process Senior Executive	Upon acceptance of BAP actions	X				X					X					X					X					X
BMP21	Monitoring for conflict, illegal logging and poaching	1. Environment Process Senior Executive 2. Security Supervisor	Monthly, intensity to increase based on findings	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP22	Establishment of a communication system with local authorities	1. Environment Process Senior Executive 2. Process Senior Executive 3. Security Supervisor	Upon acceptance of BAP actions	X																								
BMP23	Invasive species survey and management	1. Environment Process Senior Executive 2. Process Senior Executive	Management actions to be undertaken during construction and operation, map of invasive species aggregations to be generated by 2019		X	Not applicable, please refer to notes for specific timeline instructions																						
BMP24	Site Rehabilitation	1. Environment Process Senior Executive 2. Process Senior Executive	During construction and operation. Three (3) months after restoration activities: weekly inspections. One (1) year after restoration inspections: 3 monthly inspections.	Not applicable, please refer to notes for specific timeline instructions																								

Table 6.3 List of Responsible Persons

S/N	Designation	Role Description, in the context of the BMEP
Internal Parties		
1	Director, Board of Directors	Responsible for the establishment of the on-site SHE team, oversight of the action implementation progress against the BAP, and leadership of stakeholder engagement with local communities and government agencies.
2	EHSS Department Head	Responsible for adaptive management processes, developmental of environmental policies, training and infringement management
3	Environment Process Senior Executive	Responsible for day-to-day implementation of BAP measures on site during all project phases. Maintains coordination and oversight over all BAP communication protocols and incidents.
4	Construction Manager	Responsible for day-to-day implementation of BAP measures during construction activities, particularly land clearance activities.
5	Process Senior Executive	Responsible for day-to-day implementation of BAP measures during operational activities, particularly species surveys and reforestation activities.
6	Security Supervisor	Responsible for securing project site and resources from illegal activities.
7	Managing Director	Responsible for the final decision on the level of penalisation for employees and/or contractors involved in illegal wildlife activities.
8	Administration and Communication Executive	Responsible for the development and design of the Biodiversity Offset Plan, working in hand with the IFC, environmental consultant, and implementing NGO.
9	CSR Executive	Responsible for local community engagement coordination and planning.
External Parties		
10	Contractor	Responsible for day-to-day implementation of BMP measures on site during contracted activities.
11	Biodiversity Expert	Responsible for ecological monitoring of the site and capacity building.
12	Biodiversity Offset Implementation Partner	Responsible for assisting with the implementation of the BMP measures

Figure 6.1 Organogram Shwe Taung Cement Environment, Health, Safety and Social Department

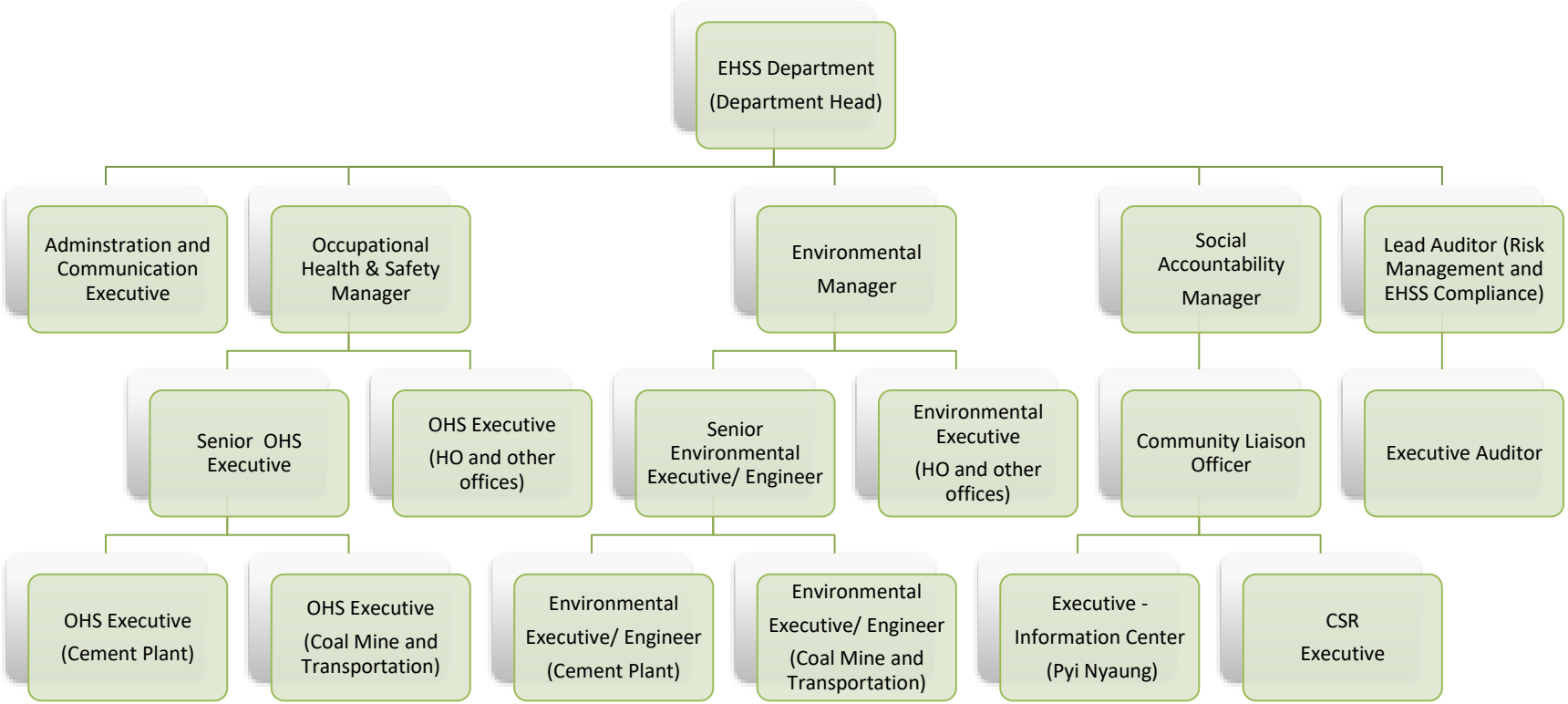


Table 6.4 Biodiversity Management Plan Budget (2017 US Dollar values)

S/N	Item	Year 1	Years 5, 10, 15, 20 & 25 (Per Year)	Years 2-4, 6-9, 11-14,16-19,21-24 (Per Year)	Total (25 Years)
BMP1	Appointment of Environment Process Senior Executive (one per site)				
BMP2	Adaptive management measures (BAP review) (5 year frequency)				
BMP3	Protocol for injured wildlife				
BMP4	Wildlife incident reporting mechanism				
BMP5	Environmental policy				
BMP6	Biodiversity awareness training				
BMP7	Incident reporting log and documentation of follow-up actions				
BMP8	Wildlife surveys				
BMP9	Wildlife shepherding surveys				
BMP10	Land clearance protocol				
BMP11	Clearance briefing				
BMP12	Biodiversity offset plan				
BMP13	Community Engagement				
BMP14	Wheel wash bays				
BMP15	Access road monitoring protocol				
BMP16	Access controls				
BMP17	Fauna and flora monitoring				
BMP18	Assessment of monitoring data				
BMP19	Establishment of flora and fauna database				
BMP20	Placement of posters and literature				
BMP21	Monitoring for conflict, illegal logging and poaching				
BMP22	Establishment of a communication system with local authorities				
BMP23	Invasive species survey and management				

S/N	Item	Year 1	Years 5, 10, 15, 20 & 25 (Per Year)	Years 2-4, 6-9, 11-14,16-19,21-24 (Per Year)	Total (25 Years)
BMP24	Site Rehabilitation (Excludes capital costs)				
	Sub Total (Per Year)				
	Total				

7 BIODIVERSITY OFFSET MANAGEMENT PLAN

7.1 APPLICATION

This Biodiversity Offset Plan applies to the biodiversity offsets for the limestone concession and coal mine concession. The biodiversity offsets are defined below.

7.2 LIMESTONE CONCESSION

The Panlaung-Pyadalin Cave Wildlife Sanctuary was established by notification no. 2/2002 (dated 18 March 2002). It is an IUCN Category IV Protected Area of 334km^2 (33,400ha) in size and is located 6km north of the Limestone quarry. It has important cultural values and biodiversity values including habitat for the Asian Elephant (recorded as locally extinct), Shan State Langur, Banteng, Gaur, Clouded Leopard and Serow. The Panglaung-Pyadalin Cave is a human archaeological heritage site. The location of the proposed offset site is shown in *Figure 7.1*.

7.2.1 *Habitat Management Actions*

The proposed offset site will consist of an addition of 1779ha of limestone habitat (1420ha required) to the Sanctuary and associated management funding. Given that the forested habitat of the Sanctuary is larger than the requirement to offset impacts to forested habitats (127ha), priority management actions are proposed to be funded within the existing Sanctuary boundary for 25 years to manage specific threats. These actions are outlined at *Table 7.1* below and are based on existing management actions proposed for the Sanctuary in the draft "Habitat Re-establishment Plan" (See *Section 7.3.2* below for a summary of this Plan).

The location of the biodiversity offset site and the proposed limestone range addition (Option A) is shown in *Figure 7.2*.

7.2.2 *Species Management Actions*

As outlined in *Section 5.1.2 Species Values*, it is requirement of IFC PS6 that management actions are applied in relation to species that have triggered Critical Habitat, or are species of concern within the Limestone Concession.

7.2.3 *Existing Management Arrangements*

Consultation with the management of the Panlaung-Pyadalin Cave Wildlife Sanctuary was undertaken by ERM in June 2017. The Sanctuary is currently managed by the Forestry Department, with two (2) offices located near to the Sanctuary. There is currently 40 staff with responsibility for the management of the Sanctuary. Currently, the focus of the staff has been on wildlife patrols. No capital equipment (such as patrol vehicles, uniforms or other equipment) is available for staff. No specific rehabilitation programs or species recovery programs are undertaken.

Ecological research has been undertaken in the Sanctuary by the National Institute of Biological Resources (NIBR), South Korea and Makino Botanical Garden-MBK, Japan. The purposes of this survey were to define the baseline biodiversity values of the Sanctuary. The results of the surveys were not available to ERM for review.

A *Habitat Re-establishment Plan* (MONREC 2017) for the Sanctuary has been prepared by the Forestry Department in January 2017. This plan outlines measures to re-establish habitats and conserve endangered species as well as to protect the Shan State Bent Toed Gecko (*Cyrtodactylus chrysopylos*) and limestone range within the Sanctuary. The Plan highlights that the key threats to biodiversity within the sanctuary include:

- Over extraction of forest resource;
- Squatting and pasturing;
- Bush fires; and
- Indirect causes such as over-exploitation of ecosystem services and lack of capacity to implement adequate management.

The Plan outlines a range of measures for a 10 year term (two 5 year periods) to reduce threats. The key measures include:

- Reestablishment of habitat: reestablishment of pastures (previously used by elephant population); creation of salt licks/pits; creation of ponds; reestablishment of forests in cleared areas; and reestablishment of orchid species;
- Protection and conservation: creation of core, buffer and recreation zones; Boundary preparation; regular patrols; and building conservation stations; prevention of fire; providing community awareness through education programs; setting sign posts; building patrol road; developing eco-tourism; distribution of high powered stoves; providing model mixed-crops forest; extending protected area; training and extending ASEAN heritage site;
- Organisational preparation: formation of oversight and implementation committee; cooperation for technical development; planning for 5 yearly activities and resourcing.

Certain actions have been utilised from this plan in the development of the Biodiversity Offset Management Actions. The actions chosen are primarily related to non-capital items such as education, patrols and enforcement.

7.3 *COAL MINE CONCESSION*

The Mahamyaing Wildlife Sanctuary was established in 2002 and is 1180km^2 in size (111,800ha). It is an IUCN Category IV Protected Area and Important Bird Area (IBA) and is located 24km east of the Coal mine site. It has important biodiversity values, including an important population of Chinese Pangolin, Eastern Hoolock Gibbon, Banteng, Sambar Deer and Asiatic Wild Dog, Small Asian Mongoose, Wild Boar, Mongoose, Asian Elephant and Jungle Cat. The location of the proposed offset site is shown in *Figure 7.3*.

7.3.1 *Habitat Management Actions*

The proposed offset site will consist of the management of 5,420ha of forested habitat within the Mahamyaing Wildlife Sanctuary. Given that the forested habitat of the Sanctuary is much larger than the requirement to offset impacts to forested habitats (111,900ha), priority management actions are proposed to be funded within the existing Sanctuary boundary for 25 years to manage specific threats. These actions are outlined at *Table 8.2* below.

The location of the biodiversity offset site and the proposed limestone range addition is shown in *Figure 7.1* and *7.2*. Note that the villages listed in the figures are listed in *Annex G*.

7.3.2 *Species Management Actions*

As outlined in *Section 6.1.2 Species Values*, it is requirement of IFC PS6 that management actions are applied in relation to species that have triggered Critical Habitat or are species of concern within the Coalmine Concession. In relation to species that are not Critical Habitat species but are species of concern, a no-net-loss is to be achieved for these species as part of efforts to deliver no-net-loss for Natural Habitats, where feasible. These species are listed below in *Table 7.1* and outline where specific management actions are required to be implemented at the offset sites.

7.4 *EXISTING MANAGEMENT ARRANGEMENTS*

Consultation with the management of the Mahamyaing Wildlife Sanctuary was undertaken by ERM in June 2017. The Sanctuary is currently managed by the Forestry Department, with one office located at Kalaywa.

There are currently an estimated 48 households within the Sanctuary who are currently undertaking a process to submit applications regarding future entitlements for land and forest products. Illegal logging was identified as a major threat, as is hunting and poaching occur for subsistence purposes. It is also likely that communities on the periphery of the Sanctuary will enter to extract resources. Current management is limited and no regular patrols or management occurs within the Sanctuary.

It is noted also that the mechanism to deem the land as a Wildlife Sanctuary under the Forest Act is in draft form. A recommendation to facilitate the gazettal of the Sanctuary is a specific offset action.

7.5 *BIODIVERSITY OFFSET MANAGEMENT ACTIONS*

The biodiversity offset management actions are contained in *Table 7.1*. The timeline for implementation of offset management actions is shown in *Table 7.2*.

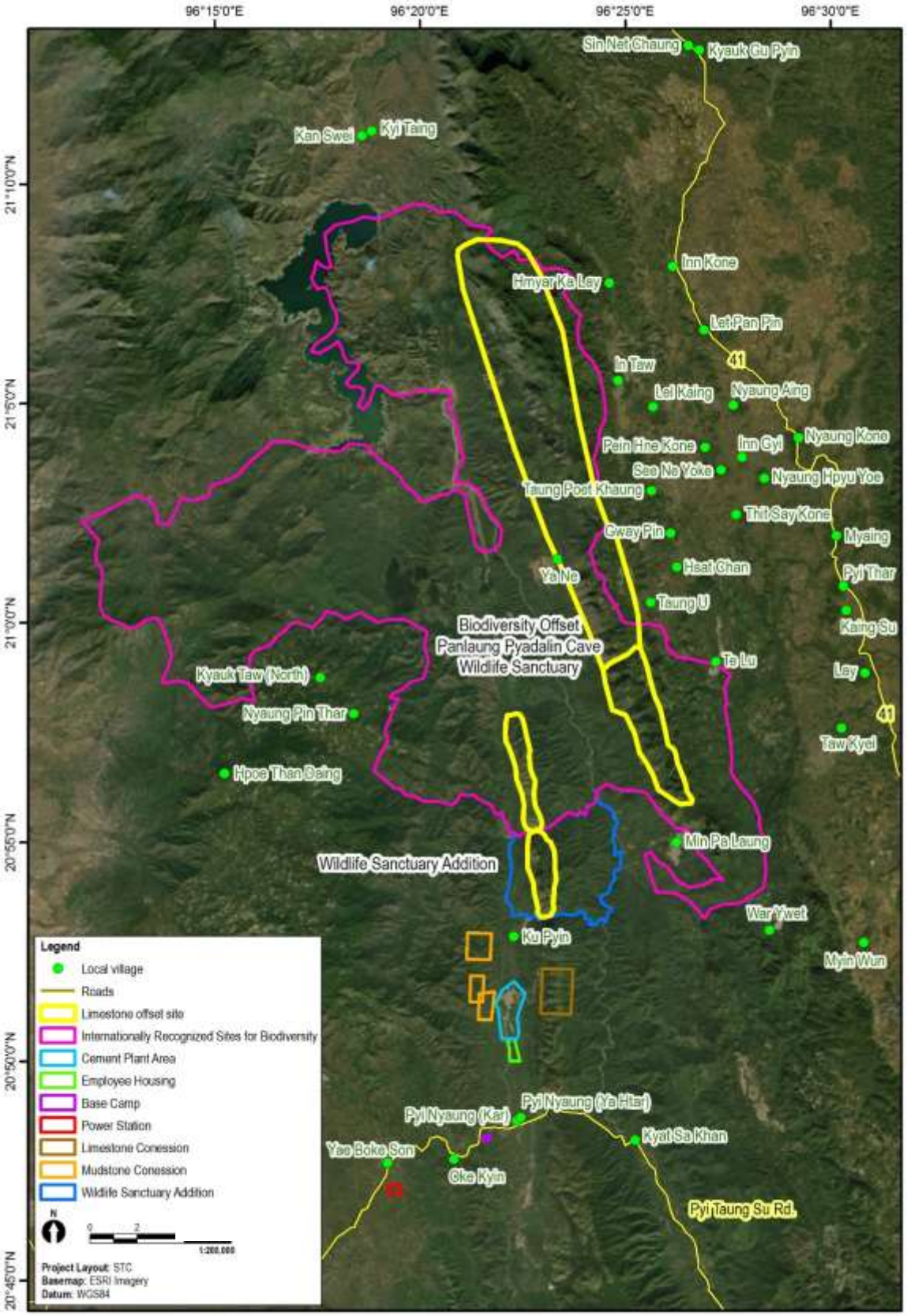
7.5.1 *Monitoring and Evaluation*

The monitoring and evaluation framework for the offset management actions is contained in the BMEP (*Section 8*).

7.5.2 *Budget*

The budget in *Table 7.3* has been estimated for the implementation of the BOMP. All values are in 2017 United States Dollars. All values are in 2017 United States Dollars. Future year allocations will require to be adjusted for inflation.

Figure 7.1 Location of Proposed Offset for Limestone Concession



Note: Villages listed by number are outlined in *Annex G Community Engagement Protocol*

Figure 7.2 Location of Proposed Extension to the Panlaung-Pyadalin Cave Wildlife Sanctuary

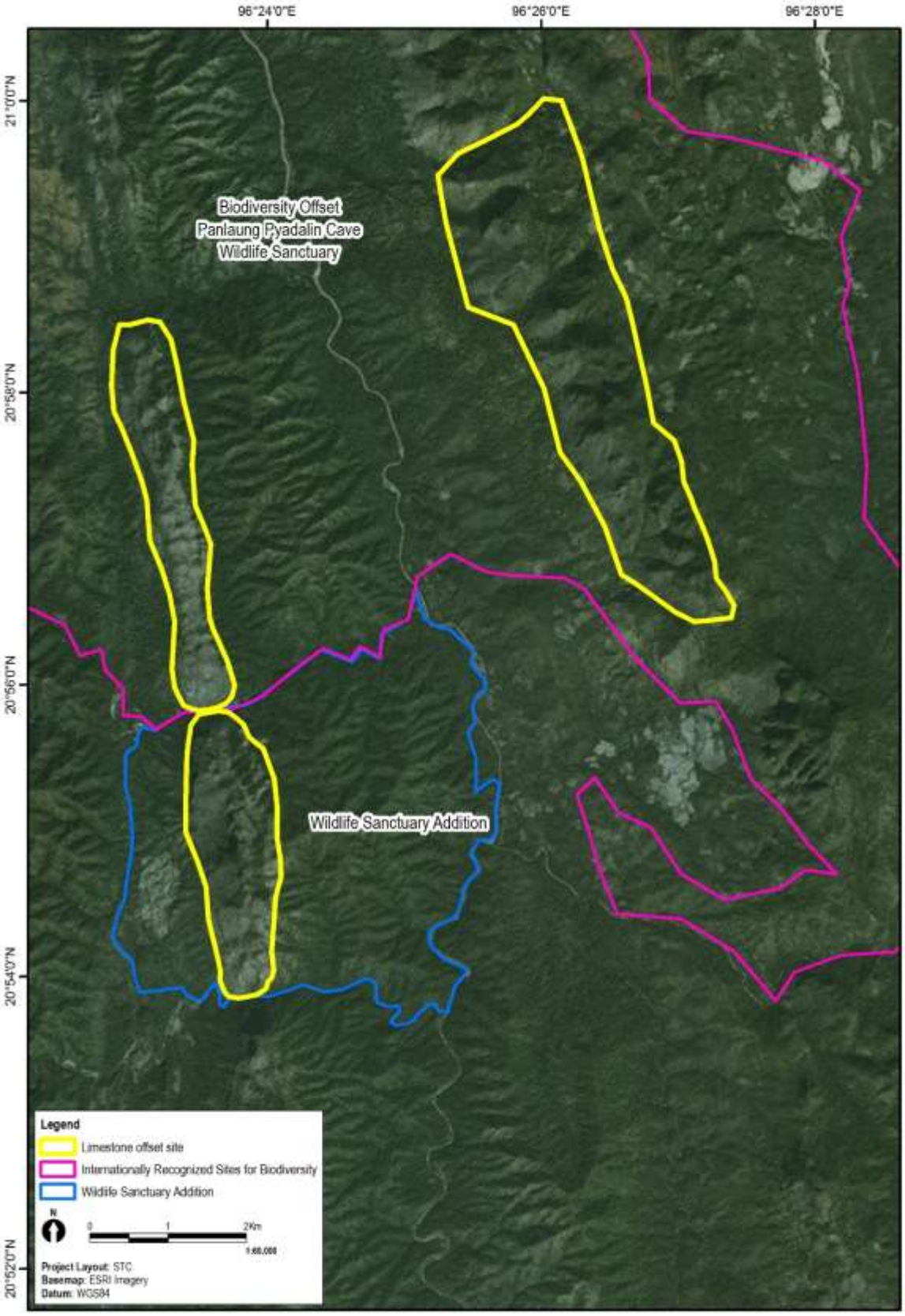
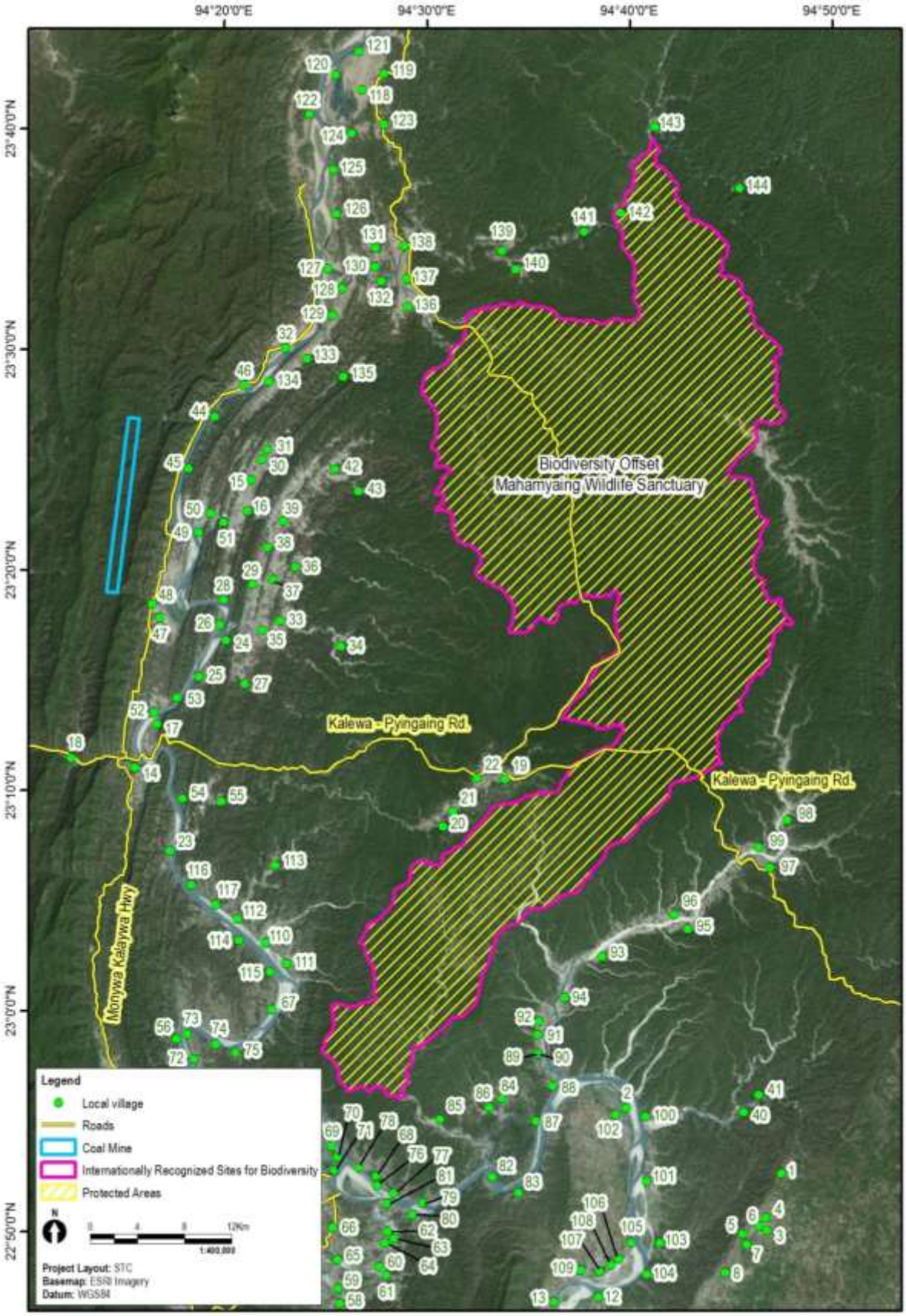


Figure 7.3 Location of Proposed Offset for Coal Mine Concession



Note: Villages listed by number are outlined in *Annex G Community Engagement Protocol*

Table 7.1 Biodiversity Offset Plan Management Actions (Habitat and Species)

<table>
<tr><th>S/N</th><th>Mitigation and / or Management Measures/Procedures</th><th>Responsibility</th><th>Implementation Requirements</th><th>Timeframe</th></tr>
<tr><td>BOMP1.0</td><td>Addition of the Limestone Range to the Panlaung-Pyadalin Cave Wildlife Sanctuary (Limestone Concession Only)
Additions to the Sanctuary are to follow the requirements outlined in the "Procedure of Establishment of Natural Area" (Annex B) as required by the Protection of Wildlife and Conservation of Natural Areas Rules, 2002 to establish the extension. The steps recommended to STC to undertake the process to establish the Sanctuary extension are outlined in Table 7.7.1.
Table 7.7.1 Steps Required to establish Wildlife Sanctuary Extension
<table>
<tr><th>Step</th><th>Action</th><th>Timeframe</th></tr>
<tr><td>1.</td><td>STC to write a letter to the Minister of the Ministry of Natural Resource and Environmental Conservation seeking the addition of 1779ha to the Panlaung-Pyadalin Cave Wildlife Sanctuary, the area of which is shown in Figure 7.1</td><td>By 1 October 2018</td></tr>
<tr><td>2.</td><td>STC to support the Nature and Wildlife Conservation Division (NWCD) of MONREC to establish the "Initial Examination Body" to undertake review and consultation with the local community and undertake actions listed under 8. – 11. of the Procedure (Annex B).</td><td>By 1 May 2019</td></tr>
<tr><td>3.</td><td>STC to support the gazettal of the addition to the Sanctuary with MONREC.</td><td>By 1 September 2019</td></tr>
</table></td><td>EHSS Department</td><td>See "Procedure of Establishment of Natural Area" (Annex B)</td><td>By 1 September 2019</td></tr>
<tr><td>BOMP2.0</td><td>Gazettal of the Mahaimyang Wildlife Sanctuary (Coal Mine Concession Only)
STC are to support MONREC in the gazettal of the Mahaimyang Wildlife Sanctuary. This will include undertaking the steps as outlined in Table 7.7.7.
Table 7.7.7 Steps Required to support Gazettal of the Mahaimyang Wildlife Sanctuary
<table>
<tr><th>Step</th><th>Action</th><th>Timeframe</th></tr>
<tr><td>1.</td><td>STC to write a letter to the Minister of the Ministry of Natural Resource and Environmental Conservation seeking support to gazette the Mahaimyang Wildlife Sanctuary, the area of which is shown in Figure 7.2.</td><td>By 1 October 2018</td></tr>
<tr><td>2.</td><td>STC to support the Nature and Wildlife Conservation Division (NWCD) of MONREC to gazette the Wildlife sanctuary</td><td>By 1 May 2019</td></tr>
</table></td><td>EHSS Department</td><td>Provide support to MONREC to gazette the Wildlife Sanctuary</td><td>By 1 May 2020</td></tr>
<tr><td>BOMP 3.0</td><td>Management and Administrative Framework</td><td></td><td></td><td></td></tr>
<tr><td>BOMP 3.1</td><td>Management Committee
STC is to convene a management committee consisting of:
STC Staff;
MONREC Forestry Department;</td><td>EHSS Department</td><td>Establish a management committee</td><td>By February 2019</td></tr>
</table>

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
	• Panlaung-Pyadalin Cave and Mahaimyang Wildlife Sanctuary Management; • Community representatives; • External conservation expert; • International Finance Corporation (observer); and • Contracted conservation NGO(s). The tenure of members of the management committee is to be reviewed every 7.5 years to enable sufficient time for the committee to oversee implementation of one 5 yearly review. The review process can occur during the mid-point of two reviews, enabling efficient use of the committee's time and to manage workload during the member's tenure. The role of the management committee is to oversee the implementation of management actions in this Plan. The committee is to: • Provide strategic advice on the conservation management actions contained in this Plan; • Provide recommendations on the monitoring and evaluation framework; • Review reports submitted by the contracted conservation NGO on progress in implementing this Plan; • Recommend and approve changes in management actions and expenditure; • Prepare the 5 yearly review of the Plan; and • Resolve any disputes with the community and other concerned parties.			
BOMP 3.2	**Meeting Frequency** It is recommended that meetings be initially held on a bi-monthly basis for the first 8 months, followed by 6 monthly meetings thereafter. More frequent meetings may be employed during review and/or tendering processes. Meetings frequencies may vary over the 25 year implementation timeframe.	EHSS Department	Convene meetings as required.	Bi-monthly meetings for 8 months followed by 6 monthly meetings thereafter
BOMP 3.3	**Contracting Service Providers** STC is to convene a tender for the supply of services associated with the implementation of this management plan. The tender is to target suitably qualified National and International NGOs to implement the management plan on 5 yearly terms. One tender is recommended to undertake implementation of the BOMP. The successful tenderer is to be subject to contractual terms based on the delivery on the objectives of this Plan and agreed funding structure. It is intended that the contracts be a maximum of 10 years duration to enable capacity building with the community and Myanmar Government. The duration may be extended, however this would be at additional cost to that budgeted.	EHSS Department	Convene a tender for supply of services in relation to this plan.	By August 2018 with tenderer appointed by April 2018

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
BOMP 3.4	**Funds administration** The following rules will apply to the management of funds associated with this Plan: • Funds to implement this plan will be controlled by STC; • All funds will be expended to the Management Committee, Contracted Conservation NGO and Forestry Department on an annual basis; • Funds expended will be subject to successful implementation of management actions; • STC may retain funds if it is determined that unsatisfactory implementation activities have occurred; • Any additional funds sought by the management committee, Forestry Department, and Contracted Conservation NGO will be at the discretion of STC; • All funding arrangements will be subject to standard accounting and auditing practices; and • All funding arrangements will be subject to legal contracts between relevant parties and STC.	EHSS Department	Annual Budget and administration	Budget allocation on an annual basis
BOMP 3.5	**Report requirements** The following rules apply to reporting on performance associated with the implementation of this plan: • An Annual Report is to be prepared by the Contracted Conservation NGO on performance against the objectives and actions contained within the Plan; and • A five-yearly report on the fifth anniversary of this plan (in place of the Annual Plan) commencing is to be prepared by the Contracted Conservation NGO for the previous 5 years. The report is to report on performance against the objectives and actions contained within the Plan for the previous 5 years and include a review of the success of implementation.	Contracted Conservation NGO Management Committee	Annual report 5 yearly report	Annually 5 yearly
BOMP 3.6	**Five Yearly Review** After the initial five (5) year implementation, a review is to be conducted of the Plan. This review is to determine successes and weaknesses of plan implementation; determine future implementation arrangements (including ongoing tendering arrangements for the Contracted Conservation NGO). The review is to be undertaken by the Management Committee. The review is to be commence 6 months prior to the 5 yearly anniversaries and conclude any recommendations prior to the 5 year anniversary.	Management Committee	5 yearly review	6 months prior to the 5 yearly anniversary
BOMP 4.0	**Staffing** Current staffing is to be supplemented with an addition of a maximum of five (5) Forest Officers per Sanctuary. These officers are to be appropriately qualified and experienced in wildlife conservation in Myanmar. The role of the officers will be to supplement existing resources and implement the actions contained in this Plan. The officers are to be employed by the Wildlife Sanctuaries as temporary staff for up to 5 years with extensions.	Wildlife Sanctuary Management	Employment of up to 5 additional Forest Officers per Sanctuary.	By November 2018
BOMP 5.0	**Community Engagement (Years 1-5 and ongoing dependant on review to Year 25) (15.2.6 of draft Habitat Management Plan)**			

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
BOMP 5.1	**Determining community opportunities and threats** Community stakeholder interviews are to be undertaken with villages within the Sanctuary and within 5km of the Sanctuary boundary. The stakeholder interviews are to occur within 6 months of the commencement of this plan and repeated at 5 year intervals. The interviews are to determine: • Livelihoods and alternative income sources; • Current trends in the use of biodiversity/ecosystem services within the Sanctuary, including any trends in resource availability and the availability of alternative ecosystem services; • Current trends in wildlife hunting/poaching and illegal logging; • Current trends in threats posed by fire, invasive species, soil erosion etc.; • Wildlife observations within the Sanctuary, particularly conservation significant species; and • Interest in participation in community led conservation activities.	Contracted Conservation NGO & Wildlife Sanctuary Management	Preparation of materials for stakeholder engagement interviews; preparation of report and findings.	Within 6 months of plan commencement and at 5 yearly intervals.
BOMP 5.2	**Threat Reduction Campaigns** Based on the results of the community stakeholder interviews, threat reduction campaigns are to be prepared, targeting the threats identified. These threat reduction campaigns may target: • Community Forests; • Alternative livelihoods; • Sustainability of ecosystem service use and alternatives; • Wildlife poaching and hunting; • Illegal logging; • Illegal land-use; • Extractive industries; • Fires; • Soil erosion; • Invasive species; and • Any other threats identified (during community stakeholder interviews). The threat reduction campaigns will aim to educate and empower the community to reduce conservation threats. The threat reduction campaign may consist of: • Government engagement on alternative livelihoods, threats (particularly illegal logging and wildlife trafficking); • Community education meetings focussing on: – Community Forests; – Alternative livelihoods; – Sustainable ecosystem service use and alternatives; – Fire prevention;	Contracted Conservation NGO & Wildlife Sanctuary Management	Preparation of materials required for threat reduction campaigns/ community meetings	Annual campaigns, including a minimum of 6 direct community engagement activities per annum

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
	– Sustainable agricultural practices; – Invasive species introduction and transmission; – Soil erosion causes and management; – Wildlife conservation • Education posters and materials; • Field days with local people regarding species of conservation significance, threats and management; • Joint patrols with community members; • Wildlife siting reports/"citizen surveys"; • Community hotline; • Community relationships and dialogue; and • Other recommended methods. The threat reduction campaigns are to occur on an annual basis. A minimum of six (6) direct community engagement activities are to occur annually with local communities.			
BOMP 5.3	**Stakeholder Engagement Survey** A stakeholder engagement survey is to occur on an annual basis to determine attitudinal change in conservation. The survey is to be conducted within 6 months of the start of the offset program to benchmark current attitudes to conservation. Reference should be made to *Annex G Community Engagement Protocol (Conservation and Wildlife).*	Contracted Conservation NGO & Wildlife Sanctuary Management	Preparation of materials and implementation of engagement survey	Minimum of 20 households surveyed as part of engagement survey
BOMP 6.0/6.1	**Patrols and Enforcement (Years 1-5 and ongoing dependant on review to Year 25) (15.2.3 of draft Habitat Management Plan)** Patrols are to be conducted on a monthly basis within the Wildlife Sanctuary. The patrols are to: • Engage with community leaders on conservation and threats; • Detect illegal activities, including illegal logging and poaching of wildlife; and other illegal activities (such as mining/quarrying); • Inspection of any potential sources of fire; • Inspect the condition of roads and tracks; • Inspection to identify invasive species; • Inspection to identify areas of erosion; • Investigation and warning on any illegal activities; and • Identify any new threats. Patrols are to occur on a monthly basis. A minimum of 10% of the Nature Reserve Area is to be patrolled per deployment. Any illegal activities are to be reported to the Management Committee and relevant authorities for action.	Contracted Conservation NGO & Wildlife Sanctuary Management Contracted Conservation NGO & Wildlife	Monthly patrols of at least 10% of wildlife sanctuary per deployment. Procurement and installation of sign-posts	Monthly Sign posts to be established by August 2018 and

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
	Biodiversity conservation sign posts, posters, warnings, boundary signs in accord with the updated Law and Rules will be set up beside the path to the Sanctuary and public areas.	Sanctuary Management		maintained on a regular basis.
BOMP 7.0/7.1	**Staff Training (15.4 of draft Habitat Management Plan)** Training is to be conducted of all Wildlife Sanctuary staff, including: • Wildlife management training • Sustainable use of natural resources • Survey technique on flora and fauna • SMART patrol technique • Law enforcement training • Computer and international language (English) training	Contracted Conservation NGO & Wildlife Sanctuary Management	All staff trained	By August 2019 and all new staff within 1 month of arrival.
BOMP 8.0/8.1	**Capital Equipment (Purchased and maintained for 10 years; renewal depending on condition after 10 years)** Capital equipment is to be assessed and provided to Wildlife Sanctuary Management as required. The Capital equipment is to consist of (one (1) set each for each Wildlife Sanctuary): • 1x4x4 Pick-up truck; • 10xMotorbikes; • 40 uniforms (replaced as required); • 4 laptop computers, including software; • 10 tents and associated camping equipment; • 10 high powered torches; • 10 field cameras; • 10 walky talky sets; • 10 binoculars; • 20 camera traps; • Stationary and materials	EHSS Department	Purchase and provision to Conservation NGO & Wildlife Sanctuary Management	Once per 10 years on review of condition of capital equipment.
BOMP 9.0/9.1	**<u>Species Management (Limestone Concession)</u>** **Critical Habitat Species (Requiring Net-Gain)** • Chinese Pangolin *Manis pentadactyla* (CR) • Shan State Langur *Trachypithecus phayrei* spp. *shanicus* (EN) • Karst Snails*: Anauchen sp., Diplommatina sp. 3, Diplommatina sp. 4 and Diplommatina sp. 5 aff. crispata*. • Karst Flora: *Impatiens sp., Amorphophallus sp. and Arisaema sp*. • Karst Reptiles: *Cyrtodactylus shwetaungorm, and C. ywanganensis, and Hemidactylus sp. nov.* **Species of concern (Requiring No-net-loss where feasible)** • Eastern Hoolock Gibbon *Hoolock leuconedys* (VU)			

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
	• Bengal Slow Loris *Nycticebus bengalensis* (VU) • Hog Badger *Arctonyx collaris* (VU) **<u>Species management (Coal Mine Concession)</u>** **Critical Habitat Species (Requiring Net-Gain)** • Chinese Pangolin *Manis pentadactyla* (CR) • Western Hoolock Gibbon (*Hoolock Hoolock*) • *Dipterocarpus baudii* (CR) **Species of concern (Requiring No-net-loss where feasible)** • Phayre's Langur *Trachypithecus phayrei phayrei* (EN) • Dhole *Cuon alpinus (*EN) • Gaur *Bos gaurus* (VU) • Bengal Slow Loris *Nycticebus bengalensis* (VU) • Southern Serow *Capriconis sumatraensis* (VU) • Red Goral *Naemorhedus baileyi* (VU) • Asiatic Black Bear *Ursus thibentanus* (VU)			
BOMP 9.1	**Wildlife Management Actions (Both concessions)** The following requirements will be implemented within the Panlaung-Pyadalin Cave Wildlife Sanctuary and Mahaimyang Wildlife Sanctuary regarding the protection of these species: • A minimum of two (2) targeted education programs will be conducted per annum with the local community to provide information on the current conservation risks posed to the species as part of the Threat Reduction Campaigns. Reporting wildlife crime through the community hotline is to be encouraged. • Local community involvement in monitoring surveys (see *Table 7.7*) is to occur to improve knowledge and conservation awareness of the local community. • Wildlife rangers are to be trained on the species conservation, including identification, biology and management. • Targeted market surveys are to occur at markets within 5km of the Wildlife Sanctuaries or settlements along access routes at least 2 times per year. If individual threatened species are detected in the market, investigations are to occur on the source of the individual. Education of the seller is to occur on the conservation status of the species. The market surveys are to focus on: Bengal Slow Loris; Chinese Pangolin; Shan State Langur; Phayre's Langur; Western Hoolock Gibbon; and Eastern Hoolock Gibbon. • Identification of known core habitat within the Wildlife Sanctuary is to occur as part of the monitoring program (see *Table 7.7*). Where breeding habitats are identified, they are to be subject of regular patrols and protection.	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Two targeted education programs per annum Two targeted market surveys per annum

<table>
<tr><th>S/N</th><th>Mitigation and / or Management Measures/Procedures</th><th>Responsibility</th><th>Implementation Requirements</th><th>Timeframe</th></tr>
<tr><td></td><td>• Targeted enforcement activities are to occur if information is obtained about illegal poaching or hunting of the species (including through informants, market surveys or regular patrols).
• Where illegally poached/caught individuals are identified, the individuals are to be assessed for their condition/health. Re-release within the wildlife sanctuary is to occur, considering the distribution of individuals to avoid conflict.
• Monitoring of populations are to occur (see Table 7.7)</td><td></td><td></td><td></td></tr>
<tr><td>BOMP 9.2</td><td>Critical Habitat Species (Net Gain):

Western Hoolock Gibbon (Coal mine concession)
The following actions are to occur West of the Thanlywin River within 10km regarding the population of Western Hoolock Gibbon (Hoolock hoolock) (IUCN EN) identified within the vicinity of the Coal Mine concession:
• A population census is to be undertaken of the Western Hoolock Gibbon population to identify the size of the troop.
• Identification of core habitat, including feeding, breeding and resting habitats, including any seasonal movement patterns within the forest.
• Identification of current threats posed to the population.
• A written report is to be prepared on the population, including recommendations for the species conservation and management, identified threats and viability of the population.
• The written report is to be provided to the Nature and Wildlife Conservation Division of MONREC, including recommendations to establish a Wildlife Sanctuary or Nature Reserve to protect the population.
• The steps recommended to STC to undertake the process to establish the Sanctuary extension are outlined in Table 7.7.1.
• Management measures outlined at Row 9.1 Wildlife Management Actions above are to be applied to the Sanctuary, once established.
Table 7.7.1 Steps Required to establish Wildlife Sanctuary for Western Hoolock Gibbon
<table>
<tr><th>Step</th><th>Action</th><th>Timeframe</th></tr>
<tr><td>1.</td><td>STC to write a letter to the Minister of the Ministry of Natural Resource and Environmental Conservation seeking the creation of a Nature Reserve/Wildlife Sanctuary within the core Western Hoolock Gibbon Habitat.</td><td>By 1 January 2019</td></tr>
<tr><td>2.</td><td>STC to support the Nature and Wildlife Conservation Division (NWCD) of MONREC to establish the “Initial Examination Body” to undertake</td><td>By 1 May 2019</td></tr>
</table></td><td>Contracted Conservation NGO & Wildlife Sanctuary Management</td><td>Management actions implemented</td><td>Population census by August 2019

Report prepared by November 2019</td></tr>
</table>

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
	review and consultation with the local community and undertake actions listed under 8. – 11. of the Procedure (*Annex B*). 3. STC to support the gazettal of the Sanctuary with MONREC. By 1 September 2019			
BOMP 9.3	**Karst Snails:** ***Anauchen sp., Diplommatina sp. 3, Diplommatina sp. 4 and Diplommatina sp. 5 aff. crispata.*** The following actions are to occur regarding karst snails: • A population census is to be undertaken to determine the distribution of the karst snail fauna within the limestone biodiversity offset area. • A written report is to be prepared on the population, including recommendations for the species conservation and management, identified threats and viability of the population. • Additional specific actions (apart from the actions listed above in both Habitat and Species Management actions) are to be applied as necessary.	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Population census by August 2019
BOMP 9.4	**Karst Flora:** ***Impatiens sp., Amorphophallus sp. and Arisaema sp.*** The following actions are to occur regarding karst flora: • A population census is to be undertaken of the distribution of karst flora within the limestone biodiversity offset area. • A written report is to be prepared on the population, including recommendations for the species conservation and management, identified threats and viability of the population. • Additional specific actions (apart from the actions listed above in both Habitat and Species Management actions) are to be applied as necessary.	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Population census by August 2019
BOMP9.5	**Karst Reptiles:** ***Cyrtodactylus shwetaungorm, and C. ywanganensis, and Hemidactylus sp. nov.*** The following actions are to occur regarding karst reptiles: • A population census is to be undertaken the karst reptiles within the limestone biodiversity offset area. • A written report is to be prepared on the population, including recommendations for the species conservation and management, identified threats and viability of the population. • Additional specific actions (apart from the actions listed above in both Habitat and Species Management actions) are to be applied as necessary.	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Population census by August 2019
BOMP 9.6	**Shan State Langur (Limestone concession)** The following actions are to occur regarding the Shan State Langur:	Contracted Conservation		Population census by August 2019

S/N	Mitigation and / or Management Measures/Procedures	Responsibility	Implementation Requirements	Timeframe
	• A population census is to be undertaken of the Shan State Langur population within the Panlaung-Pyadalin Cave Wildlife Sanctuary to identify the size of the troop. • An assessment is to be undertaken to identify core habitat, including feeding, breeding and resting habitats, including any seasonal migratory patterns. • A written report is to be prepared on the population, including recommendations for the species conservation and management, identified threats and viability of the population. • Additional specific actions (apart from the actions listed above in both Habitat and Species Management actions) are to be applied as necessary.	NGO & Wildlife Sanctuary Management	Management actions implemented	
BOMP 9.7	**Chinese Pangolin (identified within both concessions)** • A census of Chinese Pangolin is to occur within both wildlife concessions (see *Table 7.7*) • Community engagement is to occur regarding the Chinese Pangolin population within both offset sites. Specific engagement is to occur regarding illegal poaching and trafficking of the species. Awareness raising on the conservation of the species is to occur; • Targeted enforcement activities are to occur within the wildlife sanctuaries regarding the poaching of the Chinese Pangolin.	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Population census by August 2019
BOMP9.8	***Dipterocarpus baudii* (Coal Mine Concession)** • A census of *D. Baudii* is to occur within the Coal Mine Concession and the Mahamyaing Wildlife Sanctuary (see *Table 7.7*). • Propagation of *D. Baudii* is to be trialed using seed stock from individual plants within the Coal Mine Concession. • Propagation is to occur within the site nursery and used in site rehabilitation (See *Management Action 24 in Table 7.1*)	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Population census by August 2019
BOMP9.9-BOMP9.14	**Threatened Species (No net loss):** • A census is to occur for all threatened species. • All actions at *Row 9.1* above are to be implemented.	Contracted Conservation NGO & Wildlife Sanctuary Management	Management actions implemented	Population census by August 2019

Table 7.2 Timeline for Implementation of Biodiversity Offset Management Actions

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
Item Ref	**ACTIVITY**	**Responsibility**	**Notes**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
Table 7.6	**Biodiversity Offset Management Actions (Habitat and Species)**																											
BOMP1.0, Step 1	Seek MONREC approval for the addition of 1779 ha to the Panlaung-Pyadalin Cave Wildlife Sanctuary	STC HSE Manager		X																								
BOMP1.0, Step 2	Support NWCD, MONREC to establish the Initial Examination Body and undertake reviews and consultations with the local community	STC HSE Manager			X																							
BOMP1.0, Step 3	Support gazettal of addition to the Sanctuary with MONREC	STC HSE Manager			X																							
BOMP3.1 - 3.2	Management committee meeting	STC HSE Manager	Tenure of each member is 7.5 years maximum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP3.3	Appointment of service provider	STC HSE Manager			X																							
BOMP3.4	Budget Allocation	STC HSE Manager		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP3.5	Annual Report	Contracted Conservation NGO			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP3.5	5-yearly Report	Contracted Conservation NGO						X					X					X					X					X
BOMP3.6	5-yearly review	Management Committee						X					X					X					X					X
BOMP4.0	Support staffing of Forest Officers and review of employment extensions	Wildlife Sanctuary Management			X			X					X					X					X					X
BOMP5.1	Community stakeholder interviews	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management			X			X					X					X					X					X
BOMP5.2	Threat reduction campaigns	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP5.3	Stakeholder engagement survey	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP6.0	Patrols and enforcement within the Wildlife Sanctuary (monthly basis)	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
BOMP7.0	Wildlife Sanctuary staff training	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	All new staff are to be trained within 1 month of arrival		X																							
BOMP8.0	Capital Equipment purchase and maintenance	STC HSE Manager	Renewal of equipment depending on condition after 10 years		X								X										X					
BOMP9.1	Targeted education programs with the local community	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	To occur at least 2 times per annum		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.1	Targeted market surveys	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	To occur at least 2 times per annum		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.2	Population census of Western Hoolock Gibbon (*Hoolock hoolock*)	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Coal Mine Concession		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.2	Report on status of Western Hoolock Gibbon	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Coal Mine Concession		X																							
BOMP9.2, Step 1	Seek creation of nature reserve/wildlife sanctuary within core Western Hoolock Gibbon habitat	STC HSE Manager	Only applicable to Coal Mine Concession			X																						
BOMP9.2, Step 2	Support NWCD, MONREC to establish the Initial Examination Body and undertake reviews and consultations with the local community	STC HSE Manager	Only applicable to Coal Mine Concession			X																						
BOMP9.2, Step 3	Support gazettal of the Sanctuary with MONREC	STC HSE Manager	Only applicable to Coal Mine Concession			X																						

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
BOMP9.3	Population census of Shan State Langur (*Trachypithecus phayrei spp. shanicus*)	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Apache Cement Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.4	Population census of Chinese Pangolin (*Manis pentadactyla*)	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Applicable to both Coal Mine and Apache Cement Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.5	Population census for Karst Snails: *Anauchen sp., Diplommatina sp. 3, Diplommatina sp. 4 and Diplommatina sp. 5 aff. crispata.*	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Apache Cement Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.6	Population census for Karst Flora: *Impatiens sp., Amorphophallus sp. and Arisaema sp.*	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Apache Cement Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.7	Population census for Karst Reptiles: *Cyrtodactylus shwetaungorm, and C. ywanganensis, and Hemidactylus sp. nov.*	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Apache Cement Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.8	Population census of *Dipterocapus baudii*	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Coal Mine Concession		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.9-9.16	Population census for threatened species (no net loss) - Phayre's Langur (*Trachypithecus phayrei phayrei*) - Dhole (*Cuon alphinus*) - Gaur (*Bos gaurus*) - Bengal Slow Loris (*Nyctecibus bengalensis*) - Southern Serow (*Capriconis sumatraensis*) - Red Goral (*Naemorhedus baileyi*) - Asiatic Black Bear (*Ursus thibentanus*)	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Coal Mine Concession		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BOMP9.16 - 9.19	Population census for threatened species (no net loss) - Eastern Hoolock Gibbon (*Hoolock leuconedys*)	1. Contracted Conservation NGO 2. Wildlife Sanctuary Management	Only applicable to Apache Cement Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
	- Bengal Slow Loris (*Nycticebus bengalensis*) - Hog Badger (*Artctonyx collaris*)																											

Table 7.3 Biodiversity Offset Management Plan Budget (2017 US Dollar values)

S/N	Item	Year 1	Year 10	Years 5, 15, 20 & 25 (Per Year)	Years 2-4, 6-9, 11-14,16-19,21-24 (Per Year)	Total (25 Years)
BOMP1.0	**Addition of the Limestone Range to the Wildlife Sanctuary**					
BOMP2.0	**Gazettal of Maihamyang Wildlife Sanctuary**					
BOMP 3.0	**Management and Administrative Framework+**					
BOMP 3.1	Management Committee					
BOMP 3.2	Contracting Service Providers++					
BOMP 3.3	Funds administration					
BOMP 3.4	Report requirements					
BOMP 3.5	5 Yearly Review					
BOMP 4.0	**Staffing***					
BOMP 4.1	Staffing (5 additional staff per offset site)					
BOMP 5.0	**Community Engagement****					
BOMP 5.1	Community engagement					
BOMP 5.2	Determining community opportunities and threats					
BOMP 5.3	Threat Reduction Campaigns					
BOMP 5.4	Set up of community hotline					
BOMP 5.5	Community Engagement Survey					
BOMP 6.0	**Patrols and Enforcement**					
BOMP 6.1	Patrols and Enforcement					
BOMP 7.0	**Staff Training**					
BOMP 7.1	Staff Training					
BOMP8.0	**Capital Equipment**					
BOMP 8.1	Capital Equipment~					
BOMP 9.0	**Species Management~~**					
BOMP 9.1	Species Management (Limestone Concession)					

S/N	Item	Year 1	Year 10	Years 5, 15, 20 & 25 (Per Year)	Years 2-4, 6-9, 11-14,16-19,21-24 (Per Year)	Total (25 Years)
BOMP 9.2-BOMP 9.11	Species Management (Coal Mine Concession)					
	Sub Total					
	Total					
	Estimated Total for Coal Mine Concession					
	Estimated Total for Limestone Concession					

Notes:

\+ Labour support for the management and administrative framework is to be provided by STC. This has not been costed in the BOMP budget. Costings are for material costs only.

++ Based on an estimated $XUSD per annum for 10 years as indicated by WCS during consultation.

* Based on an estimated $X per person per year. Labour costs assume that these additional staff resources will support the implementation of the community engagement, patrols and enforcement and monitoring and evaluation components of the BOMP.

** Material costs only. Labour costs are assumed to be covered by salary costs

~ Estimated capital equipment costs as listed in *Table 7.1*. Capital equipment to be replaced at 10 yearly intervals (if required). Cost includes maintenance costs.

~~ Estimated costs of undertaking species actions, including reporting, assessment, monitoring and evaluation costs. This may include costs of external consultants to undertake the required actions.

8 *BIODIVERSITY MONITORING AND EVALUATION PLAN*

8.1 *APPLICATION*

This Biodiversity Monitoring and Evaluation Plan (BMEP) applies to both the BMP and BOMP for the STC limestone concession and coalmine concession. The purpose of the BMEP is to outlined the requirements to measure the success (or failure) of the implementation of the BMP and BOMP and enable adaptive management where failures are identified.

8.2 *MONITORING AND EVALUATION REQUIREMENTS*

The required monitoring and evaluation requirements are outlined in *Table 8.1.* The location of biodiversity monitoring locations will be determined in the field during the implementation of this plan.

Table 8.1 BMP Monitoring and Evaluation Requirements

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BMP1	Appointment of Environment Process Senior Executive (1 for each site)	Within 1 month of acceptance of BAP actions	Required mitigation outlined within this BAP	Coal Mine and Limestone Concession	Not applicable	Environment Process Senior Executives to be appointed within a month of acceptance of BAP actions
BMP2	Records of change management actions undertaken against each incident; defined date for regular update of BMP	Ongoing throughout operations	Required mitigation outlined within this BAP	At relevant locations where BAP actions will be implemented	Minutes of any meetings conducted during operation in relation to BAP implementation and corrective actions	Each Management of Change process to be addressed within 4 weeks of incident; annual
BMP3	Protocol documentation (e.g. Injured wildlife reporting and recording process, communication process)	Starting within 1 month of acceptance of BAP actions and ongoing	Required mitigation outlined within this BAP	Not applicable	Incident records summary	Each injured wildlife encounter to be resolved and closed within 3 days.
BMP4	Protocol documentation (e.g. Injured wildlife reporting and recording process, communication process)	Starting within 1 month of acceptance of BAP actions and ongoing	Required mitigation outlined within this BAP	Not applicable	Incident records summary	All wildlife injuries/mortality attributed to Project actions over Project lifespan are to be recorded.
BMP5	Issuance of Environmental Policy and briefing of all staff on rules	Within 1 month of acceptance of BAP actions	Required actions outlined within this BAP and any additional relevant actions	Not applicable	Not applicable	Zero incidences of poaching, illegal logging and wildlife trade involvement by employees and contractors
BMP6	Training Records	Prior to commencement of works and for all new workers; Refresher training every year	Number of workers trained	Not applicable	Training records maintained	All workers trained at induction and refresher training every year.
BMP7	Incident reporting log and documentation of follow-up actions	On acceptance of BAP actions	Required specifications outlined within this BAP	Within project area	Incident records summary	Zero incidences of poaching, illegal logging and wildlife trade involvement by employees and contractors

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BMP8	Survey reports	1 day prior to clearance	Presence/absence, abundance, ecological observations, sex, maturity	At proposed expansion areas	Survey report	Zero injured or dead wildlife attributed to land clearance.
BMP9	Wildlife shepherding surveys	Daily following erection of fencing/hoardings (if required) Survey in conjunction with shepherding activities Throughout construction and/ or operation (if possible)	Erected fencing/hoardings (if required) 1. Species requiring relocation within the Project area. 2. Habitat features such as hollow trees, dens, nests and roosts, caves 3. Record all habitat features observed using a GPS. Large terrestrial CH trigger species such as the Shan Langur	Work package boundaries Work package area to be cleared Refuge areas	Wildlife shepherding records	Zero injured or dead wildlife attributed to land clearance.
BMP10	Clearance briefing attendance records Inspection of cleared areas	During clearance activities	Areas marked for clearance	Work package area to be cleared	Weekly SHE inspection report	100% of clearance occurs within marked cleared area.
BMP11	Clearance briefing attendance records	Prior to clearance activities	Number of persons briefed and particulars	Not applicable	Quarterly SHE report	100% of contractors, workers and staff involved in land clearance briefed.
BMP12	Biodiversity offset plan and commencement of offset project	Biodiversity Offset Plan to be prepared by end-2017	Details of plan will be dependent on offset requirements and outcome of consultation	Primary location for offset is at Panlang-Pyadalin Cave Wildlife Sanctuary, north of project concession	To be determined in Biodiversity Offset Plan	Offset plan prepared by 2017, prior to project expansion and implementation to commence in mid-2018
BMP13	Minutes of meetings	Yearly	Not applicable	Not applicable	Annual SHE report	Meetings to be held for community members in villages around project area. All minutes of meetings to be documented.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BMP14	Utilisation of wheel wash bay	Monthly during rainy season	Condition of wheel wash (if maintenance is required) and where water is being discharged to	Wheel wash bay	Quarterly SHE report	All vehicles washed prior to entering and leaving
BMP15	Monitoring records, as reviewed by Environment Process Senior Executive	Daily	Signs of poaching activity	All STC access roads within project concession	To report to relevant authorities, including police department if necessary, and lodge an incident internally	Zero incidences of poaching, illegal logging and wildlife trade involvement by employees and contractors
BMP16	Proof of well-maintained access log Training records of security officers	Monthly review of access log	Required specifications outlined within this BAP	At road access points	Non-compliance to be addressed on the spot and if necessary, raised at company meetings and minuted	*Note STC Apache Cement Plant already has a manned security gate.* Zero unregistered vehicles within STC premises.
BMP17	Updated species database of the Project area	Surveying, reporting and mapping to be undertaken (i) before construction; (ii) every 3 years after operations commence; and thereafter	Flora (seedlings, saplings, trees), mammals, birds, reptiles & amphibians, fish Flora: Presence of protected species, pioneer species, invasive species Fauna: Presence, abundance and distribution of species of conservation significance, endemic species	Project area using transects and vegetation plots where baseline surveys have been carried out.	Survey report	Not applicable
BMP18	Review of long term monitoring records	Every 3 years and intensity to change as needed based on findings	Ecological monitoring data for key species, including CH trigger species	Project Area	Annual SHE report	Continued utilisation of Project area by CH trigger species during Project construction and operation.
BMP19	Establishment of database	Database set up to be verified after pre-expansion monitoring work	Required specifications outlined within this BAP	Not applicable	Annual SHE report	Database to be established within 1 year of construction commencement.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BMP20	Placement of posters and literature in the site office and staff assembly areas (e.g. canteen, toilets, accommodation, recreational rooms etc.).	On acceptance of BAP actions	Posters and literature at the STC site offices	PT SEML site office and staff assembly areas	Annual SHE report	Refresh posters and literature in site office a minimum of once a year.
BMP21	Monitoring reports and records	Monthly, intensity to increase based on findings	Signs of wildlife conflict, illegal logging, poaching (e.g. new trails and roads into forest, dead wildlife)	Within project area	Weekly SHE inspection report	100% of all signs of potential wildlife conflict, illegal logging and poaching to be communicated to local forestry officers and relevant authorities within 3 days.
BMP22	Establishment of a communication system with reporting parameters	Upon acceptance of BAP actions	Protocol to be determined and agreed with local authorities	Within project area	Incident Report	Each incident to be submitted to local authority within 3 days.
BMP23	Survey report and inventory development	During construction and operation	Species, abundance, GPS location	Around worksite areas, in particular area where restoration is targeted to occur	Survey report	Map of invasive species aggregations prior to March 2018
BMP24	Site rehabilitation	During construction and operation. Three (3) months after restoration activities: weekly inspections. One (1) year after restoration inspections: 3 monthly inspections.	Soil erosion with rehabilitated areas; planting success rates	Within rehabilitated areas	Quarterly SHE report	All rehabilitated areas successfully rehabilitated with a mix of native indigenous species. Soil erosion controlled within rehabilitated areas.

Table 8.2 BOMP Monitoring and Evaluation Requirements

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BOMP1.0	**Option A: Addition of the Limestone Range to the Wildlife Sanctuary** Provision of final gazettal notice/letter from MONREC that an addition of 1779ha has been made to the Panlaung-Pyadalin Cave Wildlife Sanctuary.	By 1 September 2019	Not applicable	Not applicable	To be included in Annual Report	Addition of 1179ha of land to the Panlaung-Pyadalin Cave Wildlife Sanctuary.
BOMP2.0	**Gazettal of the Mahaimyang Wildlife Sanctuary (Coal Mine Concession Only)** Provision of final gazettal notice/letter from MONREC that the Mahaimyang Wildlife Sanctuary has been gazetted.	By May 2019	Not applicable	Not applicable	To be included in Annual Report	Gazettal of the Mahaimyang Wildlife Sanctuary
BOMP3.0	**Management and Administrative Framework**					
BOMP3.1	Management Committee Set up and appointment of members to the Management Committee. Tenure is for 7.5 years maximum.	By February 2019	Not applicable	Not applicable	To be included in Annual Report	Set up and appointment of members completed.
BOMP3.2	Contracting Service Providers Tender and contracting service provider. Contractual arrangements with service provider.	By March 2019 By April 2019	Not applicable Not applicable	Not applicable Not applicable	To be included in Annual Report Not applicable	Service Provider contracted Contract entered into by Service Provider
BOMP 3.3	Funds administration Setup and administration of funds.	By May 2019	Relevant accounting standards	Not applicable	Not applicable	Fund set up and allocated to service provider
BOMP 3.4	Report requirements Completion of Annual Report.	On anniversary of contract appointment (April 2020)	Completion of relevant KPIs	Not applicable	Preparation of Annual Report	Completion of Annual Report
BOMP 3.5	Completion of 5 Yearly Reports.	On anniversary of 5th year of contract	Not applicable	Not applicable	Preparation of 5 Yearly Report	Completion of 5 yearly report

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
		appointment (April 2024)				
BOMP3.6	5 Yearly Review Completion of 5 yearly reviews.	To commence 6 months prior to 5th year contract anniversary	Not applicable	Not applicable	Not applicable	Completion of 5 yearly review
BOMP 4.0	**Staffing** Employment of five (5) Forest Officers per site (Total of 10)	By June 2020	Suitably qualified and experienced staff employed	5 staff per wildlife sanctuary (Total of 10)	Not applicable	5 suitably qualified and experienced staff employed by June 2019 for each sanctuary
BOMP 5.0	**Community Engagement**					
BOMP 5.1	**Determining community opportunities and threats** Determining community opportunities and threats Completion of community engagement survey	Year 1 and at 5 yearly intervals	Results of survey	Local villages within 5km of Sanctuary	Survey report	Completion of community engagement survey
BOMP 5.2	**Threat Reduction Campaigns** Number of community engagement activities undertaken	Bimonthly	Changes in community behaviour	Local villages within 5km of Sanctuary	Included in Annual Report	Minimum of 6 engagement activities to occur annually
	Changes in community attitudes towards conservation through engagement survey (50 households)	Annually	Results of engagement survey	50 households	Included in Annual Report	Community attitude survey completed for 50 households
	Number of Government engagement activities undertaken	Tri-monthly	Government engagement on conservation	Relevant Government agencies	Included in Annual Report	Minimum of 4 government engagement activities to occur annually

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
	Number of joint patrols undertaken	Tri-monthly	Number of surveys	Local villages within 5km of Sanctuary	Included in Annual Report	Minimum of 4 citizen surveys conducted
	Number of citizen surveys/wildlife reporting conducted	Annually	Number of surveys	Local villages within 5km of Sanctuary	Included in Annual Report	Minimum of 4 citizen surveys conducted
	Set up of community hotline	One time/daily monitoring	Number of phone calls to hotline	Both wildlife sanctuaries	Included in Annual Report	Minimum of 50 calls received annually
BOMP 5.3	**Community Engagement Survey** Conduct community engagement survey	Annually	Questionnaire prepared on conservation attitudes	20 random households per wildlife sanctuary	Included in Annual Report	Minimum 20 households surveyed and survey report prepared.
BOMP 6.0	**Patrols and Enforcement** Number of patrols undertaken	Annually	Number of patrols	Within Wildlife Sanctuary	Included in Annual Report	Minimum of 12 patrols conducted annually
	Number of warnings reported	Annually	Number of warnings	Within Wildlife Sanctuary	Included in Annual Report	All warnings issued
	Number of illegal activities reported	Annually	Number of activities	Within Wildlife Sanctuary	Included in Annual Report	All illegal activities investigated
	Number of successful prosecutions	Annually	Number of prosecutions	Within Wildlife Sanctuary	Included in Annual Report	All prosecutions successful
BOMP 7.0	**Staff Training** Training of staff	By June 2019 and as required on employment of new staff	Attendance of staff at training	At each Wildlife Sanctuary	Included in Annual Report	All staff trained by June 2019.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BOMP 8.0	**Capital Equipment** Purchase and maintenance of capital equipment	Year 1 and review at year 12.5	Purchase of capital equipment	Not applicable	Included in Annual Report	All capital equipment purchased and maintained
BOMP 9.0	**Species Management***					
BOMP 9.1	**General Survey Requirements** The following general survey requirements apply to Critical Habitat and Threatened Species: • A village and market survey is to occur for all species listed below of all villages and markets within 5km of the offset site location, and/or villages along major access routes. • A benchmark report followed by an annual report is to be prepared for all targeted species. • The reporting requirements for each species listed below.	Yearly	Results of village and market survey, including number of individuals and photographs	All villages and markets within 5km of Wildlife Sanctuary	Annual fauna monitoring report	All villages/markets surveyed annually.
BOMP 9.2	**Critical Habitat Species:** Western Hoolock Gibbon (*Hoolock Hoolock*) (Coal Mine Concession area only) Undertake a species census using the following methods: • Triangulating listening surveys are to be conducted at dawn and dusk. When located, population counts are to occur. • Report identifying results; population, troop size, population mix (juveniles/adults), threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.4*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.3	Shan State Langur *Trachypithecus phayrei spp. shanicus* (EN) Undertake a species census using the following methods: • Diurnal transect surveys to identify individuals, calls, tracks and traces. When a troop is identified, population counts are to occur. The transects are to comprise of 2 persons along a 2km transect in identified habitats.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
	• Report identifying results; population, troop size, population mix (juveniles/adults), threats and trends.					
BOMP 9.4	Population census for Karst Snails: *Anauchen sp., Diplommatina sp. 3, Diplommatina sp. 4 and Diplommatina sp. 5 aff. crispata.* Undertake a species census using the following methods: Microhabitats are to be sampled including: • 'Deathtraps' below slightly overhanging limestone cliffs. • Soil accumulated around the root systems of plants growing on cliff faces. • Accumulations of organic soil in rock crevices. • Leaf litter at the foot of limestone outcrops. • Litter samples from sites where empty shells may accumulate The following samples are to be taken for taxonomy: • Shells over 6 mm long are handpicked. • Soil-samples, small amounts of soil from as many different microhabitats at a sampling site as possible. • All taxonomy shall be undertaken by suitably qualified persons.	Five yearly	Results of surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.5	Population census for Karst Flora: *Impatiens sp., Amorphophallus sp.* and *Arisaema sp.* • Habitat transect surveys are to occur during spring and early summer (June to September) to enable floristics to be visible • A minimum of 5 days searches are to occur of limestone hills	Five Yearly	Results of surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.6	Population census for Karst Reptiles: *Cyrtodactylus shwetaungorm, and C. ywanganensis, and Hemidactylus sp. nov.* Undertake as species census using the following methods: • Surveys are to be conducted in the dry season (November to March)	Yearly	Results of surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
	• Morning (8am to noon) and evening (7.30pm - 10.30pm) habitat searches consisting of 5-7 persons over a period of 5 days • Capture individuals resting using a net or other apparatus • All taxonomy shall be undertaken by suitably qualified persons.					
BOMP 9.7	Chinese Pangolin *Manis pentadactyla* (CR) (Both Concessions) Undertake a species census using the following methods: • Diurnal transect surveys to identify dens, individuals and traces. The transect survey is to cover a minimum of 5km within the offset areas. The transects are to comprise of 2 persons covering an area of 700x60m along the 5km transect. • Report identifying results; pangolin density, population, threats and trends. • Permanent camera trap survey to be utilised with a minimum of 1 trap/100ha.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.8	*Dipterocarpus baudii* (CR) Undertake a species census using the following methods: • Flora transects within identified forest type. The transect is to consist of four (4) 1km random walking transects to identify individuals.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.4*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.9	**Species of concern:** Eastern Hoolock Gibbon *Hoolock leuconedys* (VU) Undertake a species census using the following methods: • Triangulating listening surveys are to be conducted at dawn and dusk. When located, population counts are to occur. • Report identifying results; population, troop size, population mix (juveniles/adults), threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BOMP 9.10	Bengal Slow Loris *Nycticebus bengalensis* (VU) Undertake a species census using the following methods: • Nocturnal transect surveys to identify individuals through spotlights. The transects are to comprise of 2 persons along a 2km transect in identified habitats. • Report identifying results; population, troop size, population mix (juveniles/adults), threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.11	Hog Badger *Arctonyx collaris* (VU) Undertake a species census using the following methods: • Permanent camera trap survey to be utilised with a minimum of 1 trap/100ha. • Report identifying results; population, troop size, population mix (juveniles/adults), threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.3*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.12	Phayre's Langur *Trachypithecus phayrei phayrei* (EN) Undertake a species census using the following methods: • Diurnal transect surveys to identify individuals, calls, tracks and traces. When a troop is identified, population counts are to occur. The transects are to comprise of 2 persons along a 2km transect in identified habitats. • Report identifying results; population, troop size, population mix (juveniles/adults), threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.4*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
BOMP 9.13	Bengal Slow Loris *Nycticebus bengalensis* (VU) Undertake a species census using the following methods: • Nocturnal transect surveys to identify individuals through spotlights. The transects are to comprise of 2 persons walking along a 2km transect in identified habitats. • Report identifying results; estimated population size, threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.4*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.

S/N	Means Of Verification That Commitment Has Been Met	Monitoring / Inspection / Spot Check Parameters				KPIs
		Timing And Frequency Of Monitoring	Parameters	Location	Reporting Requirements	
BOMP 9.14	Dhole *Cuon alpinus* (EN); Gaur *Bos gaurus* (VU); Southern Serow *Capriconis sumatraensis* (VU); Red Goral *Naemorhedus baileyi* (VU) Asiatic Black Bear *Ursus thibentanus* (VU) Undertake a species census using the following methods: • Permanent camera trap survey to be utilised with a minimum of 1 trap/100ha of up to 20 traps. • Report identifying results; population, estimated population size, threats and trends.	Yearly	Results of transect surveys, including GIS data on individuals detected.	See *Figure 7.4*	Annual fauna monitoring report	Annual population estimated. Identification of threats and additional management actions.
Notes: * For 9.0 Species Management, the same monitoring techniques can be used for multiple species. Camera trapping surveys at the coal mine concession can be employed for the monitoring of the Chinese Pangolin, Hog Badger, Dhole, Gaur, Southern Serow, Red Goral and Asiatic Black Bear. Transect surveys can be employed for the monitoring of arboreal species such as the Bengal Slow Loris, Shan State Langur, Eastern and Western Hoolock Gibbon.						

REFERENCES

BBOP 2012a **Biodiversity Offset Design Handbook-Updated**. Business and Biodiversity Offset Program, Washington, D.C.

BBOP 2012b **Biodiversity Offset Implementation Handbook**. Business and Biodiversity Offset Program, Washington, D.C.

Emerton. L, U Aung Kyin, and Tizard R (2015) **Sustainable Financing of Protected Areas in Myanmar** Wildlife Conservation Society, Myanmar

ERM (2017) **Environmental and Social Impact Assessment: Shwe Taung Cement Cement Plant and Shwe Taung Mining Paluzawa Coal Mine** Prepared by Environmenal Resources Management.

ERM (2017a) **Occupational Health and Safety review and revised Environmental Social Management Plan**

IFC 2012 **Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**. International Finance Corporation, January 1, 2012

MONREC (2017) **Habitat Management Plan, Panlaung-Paladlyin Cave Wildlife Sanctuary**

ANNEX A – Consultation Results Summary

A.1 CONSULTATION RESULTS SUMMARY (JUNE 2017)

Consultation Details	
Date	12 June 2017, Monday, 10:00 am
Location	WCS Office Yangon
Consultation	WCS Myanmar – Robert Tizard
Personnel Present	
ERM	David Nicholson; Cheong Shu Min

ERM provided an introduction about the project sought input from WCS on the (i) proposed funding mechanism, (ii) potential fund governance processes that can be adopted and (iii) WCS' capacity to support the implementation of the offset plan.

Offset Fund Administration and Management

WCS recommended that the contracting and biodiversity offset fund disbursement be carried out in 5-year tranches instead of a one-off disbursement at the onset of the project. The latter represents a longer time horizon which may be unpredictable due to inflation and economic changes. ERM agreed as it may not be feasible for STC to release the funds upfront as it represents a large capital impost on the company's finances in a short time period. The subsequent release of the funds would also need to be contingent on the management of the offset areas.

WCS suggested ERM look at how the Shan State government is managing the Inlay Lake trust fund, a pool of money gathered through tourism revenue from the Inlay Lake Biosphere zone. There is an avenue to work with the state government where the offset will be located to manage and administer the funds. WCS also advised ERM to consult with the Finance Ministry and Planning Ministry to understand if these ministries have any feedback on how the funds will be disbursed.

Considerations around Offset Plan Implementation

Cost

WCS provided some insight into the costs of implementing similar projects. At least $60,000 USD a year would be required for a local representative to run a project; this is likely to be higher if foreigner staff are utilized and of a larger scale. The rough overhead per project fee is 26.8%.

Social Aspects

WCS highlighted the importance of considering the social aspects of implementing biodiversity conservation plans in Myanmar. WCS shared that they dedicate a lot of effort into educating and working with the local people as these groups are most reliant on ecosystem services in the protected area in question. A consultative process is typically

undertaken and constituencies for conservation are built within the community. Themes of community engagement revolve around the resources the community is reliant on, location of these resources, traditional use boundaries, awareness assessments and accessibility to these resources within the general landscape. WCS recommended that mapping be carried out to understand land tenure status of the area. Based on an understanding of the tenure in the area, a community forest plan for each village can be set up where there is a legal system of management rights. This will allow these villagers to manage these plots and have the authority to prevent people from other areas to enter for harvesting.

Panlaung-Pyadalin Cave Wildlife Sanctuary

WCS shared that the Panlaung-Pyadalin Cave Wildlife Sanctuary is chronically underfunded and understaffed. On the potential for the Forest Department rangers to implement the offset plan, WCS commented that they should be able to conduct patrols and undertake enforcement, but building capacity and developing technical skills (e.g. smart spatial monitoring, computer databases, GPS logging) will require more commitment in terms of funds and effort.

WCS advised ERM to clarify with relevant authorities on the actual timeline to amend the boundaries of Panlaung-Pyadalin Cave Sanctuary. From WCS' experience in Myanmar, this requires a lengthy government consultation and potentially a resettlement process. There may be several requirements to seek approvals on various levels from the township, district, and state to cabinet levels. ERM will seek more clarity on this from the Forest Department.

Monitoring

WCS suggested the following parameters for monitoring:

- Regular point monitoring for langurs on limestones outcrops;
- Audio surveys for gibbons involving triangulation and density estimation;
- Permanent camera traps that can also double up as trust building tools by allowing local communities to deploy the traps. Data can also be run through with these communities.

In open deciduous forest such as the vegetation in the proposed Mahamyaing wildlife reserve, line transects is the most straightforward way to conduct monitoring.

The level of expertise required to undertake monitoring could be fairly low. The basic requirements would be that an individual can ensure data is entered correctly.

Capital Expenditure

ERM ran through a list of potential capital expenditure with WCS and sought for their opinion:

- Vehicles – WCS said these are typically difficult to procure. To effectively manage a wildlife reserve, a team will probably require a mixture of four wheel drives and motorbikes.
- Basic office equipment such as telephones will be required
- Generators and car batteries will be required to generate electricity
- Communication equipment such as UHF radios are necessary but procurement of these requires permission from the military
- Ranger uniforms and jungle boots are also typically required
- Firearms may be required on a case by case basis
- Per Diem and food – ERM may wish to consider a per diem and food disbursement structure that is aligned to the physical requirements of the tasks – e.g. field person may receive more as compared to an administrative worker.

WCS agreed to review the biodiversity offset plan that ERM will develop for STC. They advised that ERM should consider translating it to the Myanmar language but cautioned that it was hard to find technical translators.

Consultation Details	
Date	12 June 2017, Monday, 3:00 pm
Location	FFI Office Yangon
Consultation	FFI Myanmar – Frank Momberg
Personnel Present	
ERM	David Nicholson; Cheong Shu Min

Comments on the Proposed Biodiversity Offset Plan

FFI commented that the preliminary proposal for the offset plan was not like-for-like. The proposed plan targets the offset for the coal mine at the Saigaing region to occur at Mahamyaing wildlife reserve. However FFI pointed out that the Hoolock gibbon species at Mahamyaing consists of the Eastern Hoolock gibbon which is different from the Western Hoolock gibbon found at the coal mine. Mahamyaing also faced several problems such as uncontrolled logging, hunting, and lack of staff and funding. In addition, at 60,000 ha, Mahamyaing presents a very large area to manage.

Suggestion for Pauk Sa

FFI shared that the protected area gazettal process could take over 2 years. They suggested ERM look to offset at Pauk Sa (Na Yet Kan), a similar rainforest type on the same ridge as the coal mine but approximately 370 km south. This area also exhibits similar species composition including the Asiatic black bear, Malayan sun bear, Western Hoolock gibbon, gaur, Phayre's langur, Plain-pouched, Great and Rufous-necked Hornbill.

Pauk Sa is currently run on a community-led conservation model where communities maintain and harvest from Community Forests (CF). This CF contains integrated pepper, coffee and chili production areas for alternative income and is laid around a core conservation area. A community forestry institution has been formed in the village that issues CF certificates for each CF. A management plan has also been developed for each CF.

Using Pauk Sa as a benchmark, FFI estimated that the operational cost for managing 1 site a year to be $50,000 USD. The key issue is to be able to influence communities not to hunt. FFI suggested that a grassroots approach may be more effective, citing that it took them 3-4 years to set up a local conservation constituency at Pauk Sa and obtain community consensus to set aside a core conservation area.

FFI shared that a conservation needs assessment has already been undertaken for Pauk Sa; a fauna survey has also been conducted to feed into the proposal to justify the creation of a protected area at Pauk Sa (main reason being the need to set aside a conservation area for the Western Hoolock gibbon). A management plan has not been developed yet. FFI suggested that ERM can develop the offset plan as the management plan for the reserve in conjunction with FFI, listing key tasks as the provision of alternative livelihoods to various communities.

Protected Area Gazettal Process

FFI shared that the typical gazettal process begins with Free and Prior Informed Consent (FPIC) procedures, consultations with local communities and state governments and the formation of settlement committees. Locals will be granted a 90 day period to submit any complaints they have about the proposed PA.

FFI provided 2 offset implementation approaches for consideration: the first would be to engage local communities for patrolling; the second approach would be to involve government staff in patrolling and FFI to lead on the initial capacity building phase. FFI advised that the government may be in favour of decentralized approach towards biodiversity conservation.

Monitoring

FFI said that camera trapping is potentially the easiest mode of monitoring. It can be carried out both in a grid setting or at selected locations where chances of encountered animals are deemed to be the highest. A primate survey can be conducted every 5 years with the adoption of listening posts for gibbon monitoring.

Transect surveys are relevant to flora monitoring but the surveys need not proceed on permanent transects. FFI also suggested conducting surveys to track attitudes and behaviours.

Forest cover should be monitored and can be achieved through the use of drones to obtain higher resolution imagery. Drone based mapping can also be carried out to monitor for illegal logging roads and conversion of grassland to agriculture. In the absence of the drone option, satellite imagery can also be used.

FFI advised that a monitoring budget will need to be set aside under the offset plan.

Capital expenditure

FFI suggested that 2-3 motorbikes will be required.

Funding Model

FFI suggested an FFI-led 5 year establishment and capacity building phase followed by a 20 year implementation phase by the forest department.

Consultation Details	
Date	13 June 2017, Tuesday, 10:00 am
Location	Ministry of Natural Resources and Environmental Conservation (MONREC) Nature and Wildlife Conservation Division, Nay Pyi Taw
Consultation	Win Naing Thaw, Director, Nature and Wildlife Conservation Division
Personnel Present	
STC	U Ze Lum; Kyaw Naing Soe; Zaw Win Htut
ERM	David Nicholson; Cheong Shu Min

Proposed Offset Location for the Cement Plant

The Director was in agreement about the addition of a portion of the limestone range to Panlaung-Pyadalin Cave Wildlife Sanctuary as part of the offset plan.

Proposed Offset Location for the Coal Mine

The Director expressed his preference for the offset for the coal mine to occur at Mahamyaing (Sagaing Region) instead of Pauk Sa (Magway Region). He commented that Pauk Sa was too far from the project area and also administratively in a different state from the coal mine. He shared that the Sagaing Region chief minister has indicated full support for the offset in his region and advised STC to consult with the chief ministry of Sagaing.

The Director said it would take another 6 months before Mahamyaing is gazetted as a PA. He shared that Mahamyaing faced uncontrolled logging, hunting and was understaffed and underfunded.

Biodiversity Offset Plan Structure and Implementation

The Director shared that the biodiversity offset funds will be important in covering gaps in existing MONREC funding and welcomed the partnership between his division and STC. He stated his preference for the biodiversity offset document to contain 2 plans – a management plan and a habitat/ecological restoration plan. ERM highlighted that the offset plan and management plan are unlikely to have the same types of content as the purpose of each plan is different.

He shared that for such offsets, what they are envisioning is the setting up of a project committee for the funds, and a biodiversity trust fund. Shared that there are laws guiding private sector fund use: environmental law states that any polluter pays for pollution and must reinvest in the environment. FD also said that will require a monitoring and inspection team for the Annual Report.

Amendments to Existing Law

The Director said that MONREC is in the process of amending the environmental/conservation law and will be updated end 2017. The offset should consider these laws as well.

Consultation Details	
Date	14 June 2017, Wednesday, 11:30 am
Location	Township Forest Office, Ywangan
Consultation	Kyaw Naing Oo, Forest Department Officer
Personnel Present	
STC	U Ze Lum; Win Htein
ERM	David Nicholson; Cheong Shu Min

Introduction

ERM provided an introduction and background of project and biodiversity offset plan objectives. It was shared that the plan would span a total of 25 years supporting capacity building in the first 5 years. Over the subsequent 20 years, STC will provide an annual fund to the FD to continue managing this site. It was also communicated to the FD officers that there will be monitoring requirements tied to the funds and the IFC will audit the sites to check for progress and based on this disburse committed funds to STC. The FD staff must prepare an annual report must be submitted to STC and the IFC.

The wildlife department officers said that they have no objection to the extension of Panlaung-Pyadalin Cave Sanctuary to include the limestone range to the south and they are supportive of all activities tied to the funds. The officers shared an existing plan to extend Panlaung-Pyadalin sanctuary on northern extent. They also expressed willingness to provide input on the offset plan if required.

Existing Threats to Panlaung-Pyadalin Cave Sanctuary

The officers shared that the key threats faced by the Sanctuary were from overharvesting of materials by the local people. There is also illegal logging around Kyubin village where activities run along the border of the conservation and forest areas. Random inspections and seizures in cooperation with the police department and village leaders have been conducted previously.

The department carries out community engagement and conservation talks, and is proposing community forests for people to harvest from instead. A Japanese organization (Makino Botanical Garden) has assisted the FD before in technology in getting food from bamboo shoots (project ended in 2007).

ERM enquired about the local Forest Department has experienced any conflict with the community. The officers said that they have been verbally threatened after the seizure of illegally harvested wood. Shots have also been fired in the air before but no injuries were sustained. Majority of offenders are locals from vicinity townships. Two cases have been taken to court and offenders jailed under the Wildlife Act before – these cases involved illegal logging using a chainsaw and approaching the logging sites from the lake via boat. No wildlife traffickers have been encountered so far.

Existing Capabilities of Park Management Office

ERM asked the existing resources the FD uses for the wildlife sanctuary. The officers shared that there are currently 40 staff looking after the sanctuary. In terms of equipment, the team has no official motorbikes and instead uses their personal vehicles. There is only 1 tuk tuk vehicle available for use. Patrols are conducted on foot in the forest. The team is already equipped with uniforms, boots and jungle hats.

The FD team conducts patrols 10-15 times a month; a larger team involving the township administrators, police department and FD team conducts its patrols randomly. Currently no monitoring (e.g. population, habitat monitoring) is conducted.

ERM asked if the FD has a GIS system/mapping resource. The officer shared that they use software called Smart patrol where maps can be downloaded from the GPS and processed within the system. The FD has worked with the Korea-based research organization, the National Institute of Biodiversity Research, to conduct surveys on small mammals, amphibians, reptiles and invertebrates. A Memorandum of Understanding (MoU) was signed in 2013 and since then, 3 teams from the NIBR have visited the wildlife sanctuary biannually. The data collected was reported to the head office at Nay Pyi Taw. The FD team possesses no wildlife cameras of their own for monitoring purposes but relies on the data from the NIBR team.

The officers said the PPC management plan is available at the Director's office at Nay Pyi Taw.

Consultation Details	
Date	16 June 2017, Friday, 09:30 am
Location	Township Forest Office, Kalaywa
Consultation	Myo Aung
Personnel Present	
STC	U Ze Lum
ERM	David Nicholson; Cheong Shu Min

Introduction

ERM provided an introduction and background to the project and biodiversity offset plan objectives. It was shared that the plan would span a total of 25 years with an NGO partner supporting capacity building in the first 5 years. Over the subsequent 20 years, STC will provide an annual fund to the FD to continue managing this site. It was also communicated to the FD officers that there will be monitoring requirements tied to the funds and the IFC will audit the sites to check for progress and based on this disburse committed funds to STC. The FD staff must prepare an annual report must be submitted to STC and the IFC.

The FD officer shared their proposal to make Mahamyaing a wildlife sanctuary and said it was due to be approved by the end of the year. He added that there is no management plan for Mahamyaing at the moment.

Existing Conditions at Mahamyaing

Vegetation

The officer shared that there are 3 forest types in Mahamyaing, in a gradient of dry deciduous, mixed deciduous to moist deciduous in a south to north direction. There were no remaining areas of primary forest in the reserve, only mature secondary forest toward the northern extent of the reserve. This area appears to still harbor good quality forest.

Wildlife

Based on the officer's description, the gibbon population in Mahamyaing appears to be distributed throughout the reserve. Elephants were still present albeit seemingly restricted to the northern extent of the reserve where the forest is still in relatively good condition. These areas would be priority areas for conservation. Human-elephant wildlife conflicts have occurred before in Mahamyaing.

Socio-economic Conditions

There are currently an estimated 48 households within the reserve. Illegal logging is undertaken by local people; hunting and poaching occur for subsistence and not for wildlife trafficking purposes. Two hunting methods used – guns and traps. Pangolins are hunted but rarely. The officers identified the major threat to Mahamyaing as illegal logging. It is

understood that officers typically prosecute 2 to 3 cases a month for small fines; patrols are conducted irregularly. Water is fairly scarce at the lower extent of the reserve.

No community engagement has been conducted at Mahamyaing as the people are very scattered and hence hard to engage. Officers are trying to establish community forests and irrigation systems within the reserve in collaboration with Friends of Wildlife. These projects are typically small scale.

Management Details

The FD officer had prepared a list of equipment required to run the Mahamyaing wildlife reserve office. He will be able to generate costing for each set of equipment and the salaries of the park wardens.

A2 Consultation Results Summary (November 2017)

Consultation details	
Date	15 November 2017, Wednesday 10am
Location	STC office, Yangon
Consultation	Ngwe Lwin and Ana Komericki (Flora and Fauna international), WCS – Absent due to illness, IUCN – Absent, WWF – Absent
Personnel Present	
STC	U Zee Lum, Mayzun aungthu, Aung Khaing Nyi
ERM	David Nicholson, Adam Stickler

ERM provided an introduction and background to the project and the Biodiversity Action Plan (BAP) and sought input from NGO representatives on the content, and implementation of the BAP.

FFI asked: Is the entire limestone ridge subject to mining concessions? Are the potential site endemics at risk from non IFC funded projects? ERM responded that IFC PS6 requires the ESIA to assess cumulative impacts; other companies will be required to assess their impacts on fauna and flora values and the Myanmar Government will assess these projects under the EIA Regulation. STC is responsible for managing species that they potentially impact due to their operations.

FFI asked if caves were identified. ERM responded that surveys were conducted and concluded that there were no caves onsite.

FFI asked if there are cave/subsurface watercourses where the rivers cross the roads. ERM responded that the assessment found that there was no water loss from rivers flowing throughout the site. STC provided additional information that this issue was not detected during site assessments.

FFI asked if the monitoring be carried out by educated staff. ERM responded that the NGO service provider will educate staff to undertake monitoring, STC will provide equipment.

FFI asked if there will be a management committee set up. ERM responded that the biodiversity offset management committee will include the NGO service provider, STC, the government, and a technical representative.

FFI asked if there will be an increase in capacity of extraction for the existing site? ERM and STC responded that the rate of extraction will remain constant for 25 years during the concession period. After which the project may move to subsurface mining.

Consultation details	
Date	17 November 2017, Friday 10am
Location	Park Royal Hotel, Nay Pyi Taw
Consultation	Nature and Wildlife Conservation Division of MONREC (NWCD), Ministry of Mines, NDC
Personnel Present	
STC	U Zee Lum, Kyaw Naing Soe, Aung Khaing Nyi
ERM	David Nicholson, Adam Stickler

STC provided an introduction from to the plant project manager Kyaw Naing Soe; in Myanmar language followed by an introduction to the BAP by ERM which included details of STC's commitments to the BAP.

Survey Methodology

The Nature and Wildlife Conservation Division of MONREC (NWCD) asked what the survey methodology by specialists is. ERM responded in further detail the survey techniques and referred NWCD to the ESIA and sub consultant reports.

NWCD asked how are secondary impacts by project being avoided? ERM provided further explanation from the impact summary focusing on secondary effects, including air and noise emissions on wildlife. NWCD was referred to the assessment within the ESIA.

NWCD asked how was the offset area identified. ERM explained that the process took into account a number of considerations such as how well the offset site be managed in the future, how well the offset site matched the biodiversity of the project site and the existing institutional frameworks available for conservation. The habitat area was devised using an internationally recognized metric (Habitat Hectares). The obligation for funding is currently being determined and is based on literature prepared by Flora and Fauna international on protected area management in Myanmar.

NWCD asked if the project could share the species data from the Paunlaung Pyaladin Cave Wildlife Sanctuary and also all reports of flora and fauna from the project site. ERM responded that this information was provided in the ESIA and is also disclosed on the IFC website.

NWCD asked if any social survey been carried out. ERM responded that social surveys had been, including stakeholder engagement and an ecosystem services survey. During the implementation of the BAP the first surveys will also be focused on community engagement.

NWCD asked if there is data on the local dependency on the forest by local people. ERM responded that there is a process to determine livelihood dependence from survey upon implementation. The project will restrict access around the project site but the offset site

will have unrestricted access for the local community. The purpose of the offset is to change attitudes and behaviors to favor wildlife protection whilst sustaining livelihoods.

NWCD recommend more consultation process in the plan for social engagement. This was noted by ERM.

NWCD asked for detail on who will conduct monitoring. ERM responded that monitoring will be conducted by STC, some species will need specialist advice from the NGO service provider and STC employees will be trained to do this in the medium to long term. The methodology is detailed in the BAP.

NCWD recommended that there is no overlap with the actions in the BAP with other conservation project in the vicinity. ERM responded that other conservation projects are known and NCWD are invited to provide other comments if NCWD know of other programs/projects.

NCWD asked if there any plan for the replanting of the lost forest that has been removed from the site within the 25year period. STC responded to this question and are in the process of replanting areas of forest and there are already forest offset areas as required under the Forestry Act.

NWCD asked what the next steps in the process are. ERM responded that the STC will be working on how the procurement process for the NGO service provider will work. ERM will assist with the production of the Terms of Reference (ToR) and it will be reviewed by the IFC. It is expected that the procurement process will occur in 3 to 6 months. ERM requested comments to be provided within 3 weeks on the draft BAP.

Consultation details	
Date	29 November 2017, Wednesday 3pm
Location	MCRB office, Yangon
Consultation	Vicky Bowman (Director MCRB), Aung Kyaw Soe (Extractives Program Director) On Phone: Conrad Savy (IFC)
Personnel Present	
STC	U Zee Lum
ERM	David Nicholson, Adam Stickler

Introduction of MCRB, ERM and STC person attending the meeting occurred.
The following points were made during the presentation:

Offset plan implementation

How will the funding of the protected area work? MCRB is concerned and recommends that the Project must be careful not to inflate government salaries.

ERM commented that this can be funded through an NGO service provider but the details are still being worked out and STC will develop a MoU with the government. ERM/STC will take on your recommendations and will be looking into this but it is noted that there will be a need to comply with the law of the country.

A robust and detailed ecological accounting system is being used to determine the sum of money to be spent on the offset. ERM are still going through this assessment so there currently are not any details. Efforts will be made to ensure the existing financing from the government is not replaced.

Note that the candidate offset areas are much larger than the expected offset. It is not expected that the company is responsible for the entire area so there is a division of responsibility with STC and the Myanmar government. If the protected area was already fully funded then STC or other company would not be able to use it as an offset.

Who are the users of the offset area defined at the Panlaung-Pyadalin Cave Wildlife Sanctuary?

ERM/STC responded that the peoples are Burma and Karen; the villages were formally camps but have recently expanded into villages. The offset is not fixed as yet, the Government will engage with local community and indigenous people to further define the area.

MCRB recommend that there could be tensions about creating the extension of the wildlife sanctuary from experience in other parts of the country and further stresses the importance of consultation in the design of the offset area. ERM/STC may however find that there is less tension in this area as the communities are not long term settled.

Concern over local loss of species
IFC commented that they take a population level view, may lose individuals of the species at the project side but the aim is to protect a species at the habitat level.

Concern over Tiger habitat identified
ERM have discussed about this with FFI – it is a landscape level designation (tiger conservation landscape) which signifies historic range. No data has been found for presence of tiger, community interviews are a tool to determine presence for this species, and this and camera trapping are part of the monitoring plan.

Is there an opportunity to promote tourism to the sanctuary?
This is possible but the access is very difficult to do well. Co-financing any offset by this means is very valuable but tourism can have its own impacts and this will have to be balanced. This will be looked at more through further research and community engagement.

Local community access, land use and livelihoods restoration
Have we looked at community impact at local business?
STC have a community relations committee, local land producers are gradually changing their business around the site away from the use of artisanal lime kilns and illegal logging in the vicinity of the site.

Do you have buy in from neighboring business?
The neighboring companies have been informed and it is up to them to implement the policy. STC have only the control of their concession.

MCRB recommended that if STC work with them to help influence the projects to implement policies.

MCRB recommended that UN REDD should be used to harness company engagement.

Community engagement
Recommendation for the social engagement - do not become disengaged over time.
STC have a public information center and run clinics at the location to give information to the community. The relationship with the local community is active in surrounding villages. A further community engagement plan will be developed and local training will be undertaken. Survey training, controls and enforcement mechanisms come later. Market monitoring surveys will also be undertaken.

Next steps
The Project is still going through the process of finalising the documentation and undertaking consultation. The intent is now to start filling in gaps through consultation. The Project will continue to update the BAP, as part of an ongoing process.

The Project is very keen to have lessons learned sessions with all players when the project is more up and running.

There is a recommendation to talk other parties, other more socially focused groups; there may be further concerns from these groups around the use of coal mining.
MCRB recommends that the IFC takes this on board on the social side. IFC commented that there is a need to get the BAP right with conservation Stakeholders first for the BAP to make it robust before STC/ERM go out into a more public arena.

ANNEX B – Procedure for Establishment of a Natural Area under the Myanmar Forestry Law (Unofficial Translation)

Ministry of Natural Resource and Environment Conservation

Forest Department

The Procedure of Establishment of Natural Area

Natural Area and Forest Land

"Natural Area" means the area determined under the Law for the purpose of Protection and Conservation of wildlife, ecosystem or significant landscape for their sustainment. (The Protection of Wildlife and Conservation of Natural Areas Law, 1994)
"Forest Land" means reserved forest formed under the Forest Law and protected public forest notified under the Law.

Object of Establishment of Nature Reserve

(c) to implement the policies of environment conservation and biodiversity conservation of the State;
(d) to protect ecosystem and its wild plants, wild animals, living and non-living organism, seasonally migratory animals, natural plants and animals found in Myanmar; and
(e) to develop the natural science activities.

Categories of Natural Area of Myanmar

Categories of Natural Area under The Protection of Wildlife and Conservation of Natural Areas Law (1994) and The Protection of Wildlife and Conservation of Natural Areas Rules (2002) are as follows;

(a) Science Reserve Forest
(b) National Park
(c) Marine National Park
(d) Nature Reserve Forest
(e) Wildlife Sanctuary
(f) Geological Park/ Reserve Forest
(g) Other Nature Reserves identified by Ministry

Duties and Functions according to Categories of Natural Areas

The following duties and functions must be carried out according to categories of natural areas;

- **Within Science Reserve Forest**;
    1. Conducting the scientific research within area of land or water where the presence of unique living and non-living organism, geo-physical characteristics and species
    2. Assessing constantly the change of natural process

- **Within Natural Park**;
    1. Protecting and conserving to sustain the living and non-living organism; and conducting the harmless scientific research to the living and non-living organism and conducting the awareness raising activities;
    2. Allowing the public to the recreation zone determined;
    3. Effectively prohibiting the squatting and extraction which can damage the living and non-living organism and nature;
- **Within Marine National Park**;
    1. Protecting and conserving to sustain the marine living and non-living organism;
    2. Conducting the harmless scientific research to the marine living and non-living organism and conducting the awareness raising activities;
    3. Allowing the public to the recreation zone determined;
    4. Effectively prohibiting the squatting and extraction which can damage the marine living and non-living organism and nature;
- **Within Nature Reserve Forest**;
    1. Conserving the unharmed living and non-living organism and natural process for sustainability;
    2. Managing that local community can sustainably use without impacting natural resources;
    3. **Within Wildlife Sanctuary**; Protecting and conserving the wildlife animals including critically protected animals without disturbance, managing for the habitat sustainability, and protecting and conserving the seasonally migratory birds in sanctuary;
    4. **Within Geological Park/ Reserve Forest**; Protecting and conserving the unique nature and well-known heritage of culture; and providing the recreation areas for the public in the area; and
    5. Planning to develop the ecotourism according to the types of the Natural Areas, and spending part of the income for the Natural Area development.

Formation of Natural Area

Establishment of Natural Area – In respect of establishment of the Natural Area, the minister of the Ministry of Natural Resources and Environment Conservation may, with the approval of the Government, identify and establish any categories of Natural Area in any areas by issuing the notification. Zoological garden and botanical garden can be established under sub-section (a), (b) of Section 8 of the Law. In order to determine and establish the Natural Area, the announcement of intention in advance must be made. The followings must be covered -

- Location, boundary, size of area;

- Types of Natural Area and Objective;
- Zoological garden or botanical garden;
- Prohibitions; and
- Formation and functions of Initial Examination Body.

Prohibitions - From the date of announcement of the intention to establish the Natural Area, the following prohibitions must be mentioned in the order of the Union Minister of Ministry of Natural Resource and Environment Conservation.

- Building a new building;
- Catching, killing, wounding, possessing, selling, transporting or transferring of wildlife animals or part of those; destroying, cutting, extracting and collecting of natural plants and forest resource;
- Digging in the land and doing clearance of the land;
- Planting crops;
- Using as a pasture;
- Setting up fire;
- Fishing;
- Hunting; and
- Water and air pollution, damaging the water flow or poisoning the water, possessing or discharging hazardous materials or waste.

Initial Examination Body – the Union Minister of Ministry of Natural Resource and Environment Conservation must form the Body with the township administrator of General Administration Department as Settlement Officer and township forest officer and township land record officer as members and other required representatives. The Body must carry out the following steps;

- **Settlement Form (1) –** disclosure on the Establishment of Natural Area and application of entitlement to the all stakeholders by Settlement Officer/relevant township administrator assigned by Ministry of Natural Resource and Environment Conservation.
- **Settlement Form (2)** –Submitting the recommendation letter to establish the Natural Area and the completeness of settlement activities by Forest Settlement Officer
- **Settlement Form (3) –** coordinating with relevant township, village, ward administration departments to avoid the impact on the entitlement of the people and the applications of individual entitlement within 90 days from the announcing date of Initial Examination Body
- **Settlement Form (4) –** when there is submission (from the community) for matters included in Settlement Form (3), to investigate the required witnesses and relevant documents under the civil law, and prepare and present the list of compensation the government would allow

- **Settlement Form (5) –** when there is submission for the land use, to investigate whether affect the biodiversity or not in the whole submission or a portion of submission; and to submit the notification (draft) with comment - included accurate location, size of area, potential boundary - to Director General of Forest Department.

Issuing of Notification of Determination and Establishment of Natural Area – After reviewing the Report (prepared in accord with law) submitted from Initial Examination Body, Director General must submit (the report) to the Union Minister of Natural Resource and Environment Conservation with (his/her) comment in order to determine and establish the Natural Area under the Section 8 of the Law. After reviewing (the report), the Union Minister must submit (it) to the Union Government with (his/her) comment. With the approval of the Government in exercise of power conferred under the law, the order/notification of the Establishment of Natural Area must be issued. The notification must be disclosed and kept in the Gazette in order to inform the relevant departments, organizations and all stakeholders.

Reformation, Alteration and Cancellation the Category of the Natural Area – In Respect of the entitlement of reforming, altering and cancelling the category of the whole or a portion of the Natural Area, the Union Minister of Ministry of Natural Resource and Environment Conservation with the approval of the Government must carry out. The case file must be established through scrutinizing the following steps in order to present to the Union Government.

In respect of the application for handing over or cancel the whole or a portion of the Natural Area, Region/State Forest Department must be assigned to do field work on the settlement within the Natural Area and land use.
Region/State Forest Department presenting to the Region/State Government must form the Field Visit Survey Body which includes relevant departments.

The report attached with lists of land use and land own, record, map, photo of Field Visit Survey Body must be submitted to Director General of Forest Department via State/Region Forest Department.
In respect of converting the Natural Area into other land use, Director of Forest Department must report to the Union Minister with (his/her) comment.
In respect of converting the Natural Area into other land use, the Union Minister must report to the President Office attached with the meeting's decision of the Union Minister Office Management Committee.

If the President Office approves to convert the Natural Area into other land use, the case file must be submitted to the Union Government and the approval of the Government is required.

The Union Minister with the approval of the Union Government's meeting decision may publish a notification to reform, alter and cancel the category of the whole or a portion of the Natural Area.

Reformation of Natural Area – After issuing the notification of cancelling the whole or a portion of the Natural Area in accord with the procedures above under the law and rules, Director General of Forest Department must submit the case file established with attachments of the required map and boundary of the Natural Area to the Union Minister Office for reforming the Natural Area.
Forest Department

References

The Protection of Wildlife and Conservation of Natural Areas Law, 1994
The Protection of Wildlife and Conservation of Natural Areas Rules, 2002
Wild Animals to be Protected from Extinction in Union of Myanmar, 1994

ANNEX C: No Hunting – No Poaching Posters

NO

HUNTING & POACHING

Illegal hunting and poaching are serious threats to the future of many animals and plants. Many species are important in the normal functioning of the natural ecosystem. Their decrease could lead to habitat degradation. Many local communities rely on natural resources in their daily lives– illegal poaching leads to the unsustainable removal of these resources and threatens livelihoods. Poaching also fuels the illegal wildlife trade which has ties to criminal networks and impacts the security of a region.

Our Commitment

Shwe Taung Group is committed to sustainability and protecting the environment in which we operate. Illegal poaching practices are strongly prohibited on our premises. Offenders will be reported to the Forest Department and local police. Any employee caught engaging in illegal poaching or hunting will be suspended and their employment terminated if necessary.

PROTECTING OUR WILDLIFE

Apache Cement Plant

The forests around you are home to several beautiful and interesting animals. Sadly, they unsustainably hunted or are targets of illegal poachers. Shwe Taung Group seeks your cooperation in protecting these animals. If you see any of the animals below, please notify us at <INSERT MOBILE> with the location, date and number of individuals seen. We will use this information to improve our operations to be more sustainable and wildlife-friendly.

Manis pentadactyla
Chinese Pangolin

The shy **Pangolin** lives in forests and feeds on termites. It is heavily hunted for the illegal wildlife trade, and is critically endangered. There are heavy penalties for hunting and selling this animal.

Macaca assamensis
Assamese Macaque

The **Assamese Macaque** can be found on limestone forests. The primary loss is habitat loss but hunting also occurs. It is legally protected in Myanmar under the 1994 Wildlife Protection Law.

Trachypithecus phayrei spp. *Shanicus*
Shan State Langur

The **Shan State langur** is the eastern subspecies of the endangered Phayre's langur. It is only known from a few protected areas in Myanmar. The survival of the species is threatened by habitat loss and hunting for meat and traditional medicine.

Nycticebus bengalensis
Bengal Slow Loris

The presence of the **Bengal Slow Loris** signals a healthy ecosystem. It is a seed disperser and pollinator, and prefers forests with dense canopies. Unfortunately, it is severely threatened by habitat loss and the wildlife trade.

Ratufa bicolor
Black Giant Squirrel

The **Black Giant Squirrel** is one of the largest squirrels in the world. It is very shy and rarely comes to the ground. Human-driven forest clearance and hunting has led to a decline in the population of this species.

Arctonyx collaris
Hog Badger

The **Hog Badger** is a curious species with a pig-like snout. It is not very wary of people. The decline in numbers of Hog Badger is driven strongly by hunting for the wildlife trade and traditional medicine.

PROTECTING OUR WILDLIFE

Paluzawa Coal Mine

The forests around you are home to several beautiful and interesting animals. Sadly, they unsustainably hunted or are targets of illegal poachers. Shwe Taung Group seeks your cooperation in protecting these animals. If you see any of the animals below, please notify us at <INSERT MOBILE> with the location, date and number of individuals seen. We will use this information to improve our operations to be more sustainable and wildlife-friendly.

Manis pentadactyla
Chinese Pangolin

The shy **Pangolin** lives in forests and feeds on termites. It is heavily hunted for the illegal wildlife trade, and is critically endangered. There are heavy penalties for hunting and selling this animal.

Bos gaurus
Gaur

The **Gaur** is a stunning animal with its massive size and impressive horns. It is highly adaptable and can live in disturbed habitats. It has been heavily targeted for the illegal wildlife trade. It is legally protected in Myanmar.

Trachypithecus phayrei spp. *phayrei*
Phayre's Langur

Phayre's Langur has a preference for good quality forests and consumes mainly leaves, fruits and bark. Hunting and habitat loss are main causes for its decline. It is illegal to hunt this species in Myanmar.

Ursus thibentanus
Asiatic Black Bear

The **Asiatic Black Bear** is an important seed disperser in forests., helping to maintain the healthy life cycle of important plants. The illegal wildlife trade and habitat loss are key threats to the bear.

Hoolock hoolock
Western Hoolock Gibbon

The **Western Hoolock Gibbon** is found west of the Chindwin River in Myanmar. It lives in forests and enjoys a diet of fruits. Habitat loss and hunting are the main threats to these charismatic animals.

Prionailurus viverrinus
Fishing Cat

The **Fishing Cat** is a secretive feline well adapted to catching fish. It is typically found in densely vegetated areas along streams and rivers. Wetland destruction has reduced the habitat for this beautiful animal.

ANNEX D: Anti-Illegal Logging Poster

APACHE
PORTLAND CEMENT
THE STRENGTH TO BUILD

NO

ILLEGAL LOGGING

Illegal logging causes many environmental, economic and social problems. It destroys important forest environments, reducing wildlife populations and increases soil erosion into rivers. This has a negative impact on the livelihoods of many people who depend on a healthy forest environment and clean rivers for water.

Our Commitment

Shwe Taung Group is committed to sustainability and protecting the environment in which we operate. Illegal logging practices are strongly prohibited on our premises. Offenders will be reported to the Forest Department and local police. Any employee caught engaging in illegal logging will be suspended and their employment terminated if necessary.

ANNEX E: Injured Wildlife Management Protocol

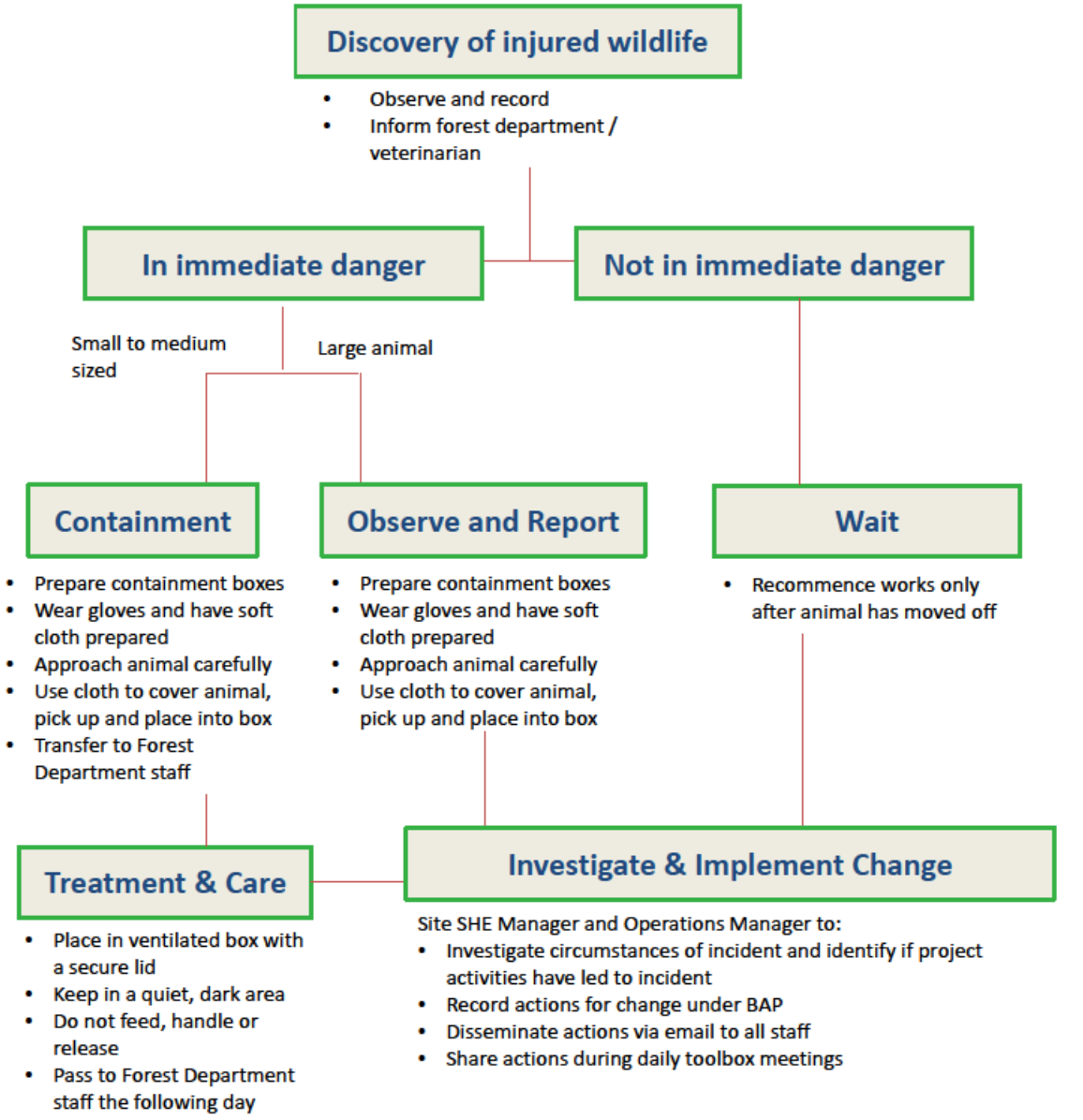
Title	Injured Wildlife Management Protocol
Document Reference	BAP_Plan IWNP V1
BAP Action Item	3 - *Develop protocols for the management of injured wildlife and identifying management of change measures.*
Last Updated	4 December 2018
Objective	A document outlining the appropriate procedures to undertake when injured wildlife is encountered within the project area

Event	Action
Upon discovery of injured animal	• Record the date, time, location, condition of animal and circumstances concerning the incident, including photographic evidence wherever possible. • Stop work in affected area. • Observe from a distance what the animal is doing. • If NOT in immediate danger, wait for animal to move off before carrying on with work. • If animal is in immediate danger or clear distress, assess feasibility of capture depending on its size, location and safety of capture to both animal and staff. • Alert forest department staff on incident and arrange a same-day appointment for transfer of animal to them.
Preparation for containment	• All staff involved in the containment exercise should be equipped with a pair of gloves and towel/gunny sack that is appropriately sized to cover the animal. • A vehicle should be immediately ready to transport the animal back to site without delay.
Management of small to medium sized injured animals, egg. Birds Bats Rodents Pangolins Slow loris Gibbons and langurs	• An adequately sized covered box or cage should be prepared to contain the animal immediately. The bottom of the box/cage should have towels or rags placed at the bottom to protect feet of animals. Use separate boxes for individuals, never place two animals in the same container. • Approach the animal from behind slowly and carefully, pausing when needed to let the animal calm down and habituate to human presence • When picking the animal up, use a towel to gently wrap around its back (and wings, if bird or bat) and cover the head. Keep voices down to avoid further stress to the animal.
Management of large injured animals, egg. Gaur Dhole Asiatic black bear	• Inform the forest department or veterinarian as soon as possible. • If the animal stays in place, cordon off the area and stop all work. Allow the forest department staff/ veterinarian to assess the feasibility of treatment. • If the animal moves off, record which direction it is moving towards and consult the forest department staff on next steps.

Event	Action
Treatment of small to medium sized injured animals	• Pass the animal to the forest department staff. • If the animal must be kept overnight, place it in a ventilated box with a secure lid. Keep it in a quiet, dark area and do not attempt to feed, handle or release it. Transfer the animal to the forest department staff the following day. • Discard all boxes used for transporting injured wildlife to avoid transfer of disease. For cages, clean out thoroughly before re-use. • All staff involved in the capture to wash and sterilize their hands immediately upon return from site. • All clothes worn during the capture should be washed the same day and not re-worn.
Post-incident	• Follow up with forest department/ veterinarian on condition of animal and date of release. • Environment Process Senior Executive to investigate further circumstances of incident • Interview workers on site that day and record their observations • Identify potential activities that could have led to animal injury • If injury attributed to project activities, identify corrective actions to avoid future incidents with Process Senior Executive • Record actions formally under BAP Management-of-Change and Incident Reporting System • Process Senior Executive to disseminate actions via email to all staff and share during daily toolbox meetings

INCIDENT REPORTING FORM			
Submission Details	Name:	Designation:	Date:
Type of Incident	Wildlife Sighting Injury/Roadkill Others	Health & Safety	Illegal Activity
Incident Details	Date:	Time:	Location/GPS:
Description of Incident *Include photographs if available*			
Eyewitnesses			
Condition of Animal and Suspected Cause of Injury *Include photographs if available*			
Actions Taken	Action & Date Taken:		Involved Personnel:
Forest Department Staff Contact Details			
Additional Comments			
Title	Communication Protocol		
Document Reference	BAP_Plan 1.2		
BAP Action Item	3, 4, 22		
Last Updated	4 December 2018		
Objective	A document outlining the appropriate chain of communication for incident reporting during project operations		

INJURED WILDLIFE PROTOCOL



Post-Incident

- Wash hands with soap thoroughly
- Wash all clothes worn on the day of animal handling
- Discard all boxes used for transport or clean cages thoroughly
- Follow up with Forest Department on condition of animal and estimated date of release

INCIDENT REPORTING COMMUNICATION CHAIN CONTACT DETAILS		
Designation	**Name & Address (where relevant)**	**Contact Number**
Senior Manager		
SHE Site Manager		
Process Senior Executive		
Security Supervisor		
Forest Department Warden 1		
Forest Department Warden 2		
Veterinarian		
Police Department Officer 1		
Police Department Officer 2		
Hospital		

Key Steps of Communication

Upon incident occurrence, the SHE Site manager should be notified immediately. The nature of the incident (wildlife sighting/injury, health and safety, illegal activity) and location of the incident should be provided.

Depending on the nature of the incident, the SHE Site manager will escalate the response to the **first responder**:

- Wildlife Incidents: The Process Senior Executive will be informed so that he/she can make decisions to halt work or cordon off the affected area.
- Health and Safety Incidents: The Process Senior Executive will be informed so that he/she can make decisions to halt work or cordon off the affected area.
- For Illegal Activity Incidents: The Security Supervisor will be informed so that he/she can make decisions to secure the site or detain suspects.

Depending on the severity of the incident, the first tier responders together with the SHE Site manager will decide whether there is a need to alert the **second tier of responders**:

- Wildlife Incidents: Forest Department staff and/or a veterinarian should be contacted next.
- Health and Safety Incidents: The hospital will be contacted in the event of a serious injury to make preparations to receive individual.
- For Illegal Activity Incidents: Forest Department staff may be pulled in if illegal poaching or logging activities are suspected. As a final resort, the police department (**third tier responder**) may be notified if suspects are aggressive or activity is a prosecutable offence.

The SHE Site Manager will direct the incident reporting process.

The incident report will be reviewed by the senior manager and approve any corrective actions that do not have a serious impact on project productivity.

The change will be implemented on site.

ANNEX F – Wildlife Shepherding Protocol

Title	Wildlife Shepherding Protocol
Document Reference	BAP_Plan WSP V1
BAP Action Item	9,10,11
Last Updated	4 December 2018
Objective	A document outlining the steps to be undertaken as part of a responsible wildlife shepherding protocol to be applied at the Coal Mine and Mudstone Quarry

Wildlife Shepherding Team Requirements

All personnel involved will be briefed on the details of this plan and their respective roles before field activities begin. Personnel will also be equipped with mobile communication devices on the field to ensure that lines of communication are maintained during field activities and that the appropriate persons (e.g. veterinarians, wildlife handlers) are able to respond to exigencies in a timely manner.

Wildlife Shepherding Protocol

Step	Activity Description
General approach to wildlife shepherding (scheduled during daylight hours only i.e. 8am to 6pm)	
1	Installation of barriers (if required), which will function as a drift fence to guide target terrestrial fauna in the intended direction of movement and as a barrier to prevent wildlife displacement onto adjacent roads.
2	Systematic pattern of walking through the site, starting from the area furthest from and then gradually moving towards the identified refuge area, in order to shepherd wildlife in an intended direction of movement towards adjacent refuge habitats.
3	In conjunction with (2), the site will be carefully surveyed to check for the presence of target fauna species and any active dens.
4	Site inspection by an ecologist to ensure that no target fauna and active dens remain.
5	Closing of gaps in the barriers (if required) as soon as practicable to prevent target terrestrial fauna from returning to the site.
*To note	Steps (2) and (3) to be carried out repeatedly over a course of up to three weeks for a site no larger than twenty hectares.
General approach for target fauna encounters *Highly mobile fauna for which a passive shepherding approach is expected to be effective.*	
6a	Personnel to remain in place to allow fauna to move on their own accord. Generation of mild human noise disturbance (e.g. talking loudly) may be used to encourage fauna movement. However, no attempt should be made to capture or handle these species, unless the animal is visibly injured in which case experienced wildlife handlers will carefully capture the animal for immediate veterinary attention. If any individual fauna does not move on its own after sufficient time (i.e. up to one hour) has passed, the area where the individual is located should be GPS-marked and left overnight to provide additional opportunity for the individual to move on its own accord. Personnel shall return to the GPS-marked location on the following day to inspect the area. This process will be repeated until the individual has moved.

Step	Activity Description
Fauna for which a passive shepherding approach is expected to be unsafe and/or ineffective in guiding the individual fauna to move in an intended direction.	
6b	A capture-and-release approach will be needed to ensure safe relocation of these fauna from the site prior to construction. Experienced wildlife handlers will carefully capture the animal for subsequent assessment and microchipping (where safe and possible) by a veterinarian. Where sensitive fauna (i.e. Chinese Pangolin) and venomous snakes from are concerned, their capture shall only be carried out by designated wildlife handlers who have been trained in the appropriate handling techniques.
Arboreal and aerial species	
Able to continue utilizing remnant habitats on the site during construction, and will not be excluded by the installed hoarding.	
7	An ecologist shall inspect the tree for the presence of fauna, inhabited tree hollows, and nests.
8	In the event that the presence of arboreal mammals and herpetofauna, birds and/or bats are detected on the tree, tree felling or transplanting must be postponed until the animal has left the tree on its own accord.
9	In the event that an inhabited tree hollow is identified, tree felling or transplanting must be postponed until the animal has left the hollow on its own accord and the entrance to the hollow has been sealed to prevent re-entry.
10	Tree felling or transplanting shall not occur during the prime breeding season for local avifauna. In any case, if active nests are detected on the tree, nests shall be left undisturbed until nesting activities have been completed (i.e. the young have left the nest). In addition, inactive nests shall be removed to minimize the possibility of a new nesting attempt. Tree felling or transplanting shall occur only when no active nests are present on the tree.
11	Notwithstanding the aforementioned steps, after tree felling has occurred, an ecologist shall thoroughly search the fallen tree for any injured or trapped fauna that may have gone undetected. In the event that injured or trapped fauna are found, immediate veterinary attention shall be administered.

ANNEX G: Community Engagement Protocol

Title	Community Engagement Guidance
Document Reference	BAP_Plan CEG V1
BAP Action Item	13
Last Updated	4 December 2018
Objective	A document outlining the key topics for discussion with key community members to maintain engagement throughout project operation.

Objectives for Continued Engagement

- Continue raising awareness of the conservation value of the habitats within the Project and surrounding areas;
- Encourage local people not to conduct illegal logging activities and poaching and discuss alternatives;
- Provide a forum for the communities to ask questions, express their concerns and provide comments. Ensure monitoring of grievances and participation of all the groups of the population, including the most vulnerable ones, to the engagements. and
- Update local communities on developments within the Project that might be relevant to them.

Community Survey and Stakeholder Engagement Activities

(a) Local Community Engagement (Focus Groups and Key Stakeholder Interviews)

A detailed socio-economic survey of primary community stakeholders is to be undertaken. This is to understand who the local community are composed of; income; education; health; natural resource use; access patterns; dependencies; demographics; and socio-cultural makeup.

The location of the villages is shown in *Figure G.1* and *Figure G.2*. The names of the villages are shown in *Table G2* below.

Note that not all of these villages will require engagement. Villages should be chosen that are in close proximity or are within the protected areas and/or along major transport routes. Intelligence should be gathered on villages that pose a risk to conservation due to illegal activities.

(b) Outsider Consultation (Key Stakeholder Interviews)

Engagement with outsiders e.g. poachers (where possible); timber traders; law enforcement officers; forestry officials; truckers and other service providers is to occur.

(c) Market Surveys

Visit the local markets where forest products and wild animals are traded. Understand how the any illegal wildlife trade and/or logging value chain works and who the key players to engage or target are. The surveys are to be conducted discretely by Myanmar locals so as to avoid suspicion.

(d) Stakeholder mapping

Map out the information identified from (a) through (c) to identify the key stakeholders, where are they located, how they access/use the protected areas, and how they interact with one another. The level of importance in terms of implementation of the conservation activities related to this BAP requires to be ranked.

(e) Action Plan

Identifying Champions

Identify people from each such community to become "paid volunteers" i.e. people who genuinely want to protect the sanctuaries, who will get paid a reasonable stipend by this budget to act as sanctuary patrols for a number of years. Also identify/assign ambassadors in each community, who will organize events in local language to educate community members and their kids about the need to protect the forests. Use localized communication methods such as community theatre etc. to make it fun and accessible.

Benefits Sharing

Highlight those stakeholders who derive income or similar benefits from the sanctuaries/protected areas; and formulate actions to help the identified local people develop viable alternative income sources. Provide transition strategies where the Project can support the change of livelihood (for e.g. providing chickens and henhouse; facilitating sustainable farming/forestry, etc.)

Managing illegal activities

To manage illegal activities, work with law enforcement to strategically enforce the law, monitor and curb animal/timber/NTFP trade at key market locations, etc. undertake enforcement action against repeat offenders. All legal action must follow due legal process.

Communications Program

As part of local communications, include a broader publicity campaign to let people know about the offset program. Post local language and/or pictorial flyers at market locations, shops, etc. near the offset areas/protected areas. Local radio broadcasts and community workshops can be held.

Past Consultations

A log of stakeholders consulted by ERM during the Supplementary ESIA phase is presented below in *Table G1*. This forms a baseline group of stakeholders to be engaged for future consultations.

Table G1 List of previous consultation undertaken by ERM

Date	Village	Village Tract	Township	Activities Carried Out
17 Jan 2017	Kubyin & Pyi Nyaung	Pyi Nyaung	Tharzi, Mandalay	Meeting with village leaders 2 socio-economic surveys
18 Jan 2017	Kubyin	Pyi Nyaung		25 households surveyed
19 Jan 2017	Pyi Nyaung	Pyi Nyaung		25 households surveyed
20 Jan 2017	Kubyin & Pyi Nyaung	Pyi Nyaung		2 townhall meetings, 6 group discussions
22 Jan 2017	Paluzawa	Ywatha	Kalaywa, Sagaing	Townhall meeting, 11 households surveyed, socio-economic survey, 3 group discussions
23 Jan 2017	Nanmawke	Ma Sein		Townhall meeting, 19 households surveyed, socio-economic survey
24 Jan 2017	Chaungzon	Ma Sein		Townhall meeting, 20 households surveyed, socio-economic survey
25 Jan 2017	Nanmawke & Chaungzon	Ma Sein		6 group discussions

Table G2 List of Villages within 20km of the Biodiversity Offset Sites (Limestone Concession)

No	Name	Lat	Long
1	Kyi Taing	21° 11' 39.336" N	96° 18' 58.248" E
2	Kan Swei	21° 11' 32.208" N	96° 18' 44.748" E
3	In Taing Thar	20° 55' 20.964" N	96° 12' 24.192" E
4	Yae Twin Gyi	20° 55' 22.620" N	96° 11' 31.488" E
5	Myet Ni Kyin	20° 54' 29.268" N	96° 16' 57.288" E
6	Hpoe Than Daing	20° 56' 48.444" N	96° 16' 15.168" E
7	Yin Mar Pin	20° 45' 18.576" N	96° 18' 46.728" E
8	Yae Boke Son	20° 48' 7.560" N	96° 20' 43.800" E
9	Pyi Nyaung (Kar)	20° 49' 14.988" N	96° 23' 49.416" E
10	Pyi Nyaung (Ya Htar)	20° 49' 19.668" N	96° 23' 54.420" E
11	Ku Pyin	20° 53' 27.168" N	96° 23' 30.084" E
12	Oke Kyin	20° 48' 17.460" N	96° 22' 20.316" E
13	Kyat Sa Khan	20° 48' 56.628" N	96° 26' 43.008" E
14	War Ywet	20° 53' 54.672" N	96° 29' 42.792" E
15	Kyauk Taw (North)	20° 59' 7.044" N	96° 18' 27.504" E
16	Nwar Ban Gyi	21° 11' 50.748" N	96° 24' 49.824" E
17	Pway Na Hpar	21° 12' 5.220" N	96° 25' 37.128" E
18	Kyauk Hmyaung	21° 12' 47.952" N	96° 28' 42.852" E
19	Ka Zei	21° 12' 1.764" N	96° 28' 50.772" E
20	Ka Pyin	21° 11' 22.092" N	96° 30' 13.860" E
21	Kyauk Gu Pyin	21° 13' 55.308" N	96° 26' 50.964" E
22	Sin Net Chaung	21° 14' 0.384" N	96° 26' 34.800" E
23	Inn Kone	21° 8' 56.832" N	96° 26' 29.076" E
24	Thein Kone	21° 13' 51.564" N	96° 30' 7.308" E
25	Kyan Taw	21° 8' 24.648" N	96° 30' 55.836" E
26	Yae Chan	21° 6' 39.924" N	96° 30' 57.960" E
27	Tat Kone	21° 5' 53.808" N	96° 30' 35.352" E
28	Oke Twin	21° 10' 43.644" N	96° 30' 52.308" E
29	Kyauk Pon	21° 9' 6.804" N	96° 29' 16.656" E
30	Thit Seint Pin	21° 8' 9.708" N	96° 29' 1.932" E
31	Inn Hla	21° 7' 12.648" N	96° 30' 2.376" E
32	Hta Min Paung	21° 8' 57.264" N	96° 30' 58.032" E
33	Nyaung Aing	21° 5' 51.216" N	96° 28' 8.760" E
34	Let Pan Pin	21° 7' 31.980" N	96° 27' 20.124" E
35	Pein Hne Kone	21° 4' 51.240" N	96° 27' 30.636" E
36	Nyaung Hpyu Yoe	21° 4' 12.972" N	96° 28' 59.952" E

No	Name	Lat	Long
37	See Ne Yoke	21° 4' 21.216" N	96° 27' 55.656" E
38	Inn Gyi	21° 4' 40.260" N	96° 28' 25.680" E
39	Lel Kaing	21° 5' 43.008" N	96° 26' 11.868" E
40	Hmyar Ka Lay	21° 8' 29.040" N	96° 24' 57.780" E
41	In Taw	21° 6' 16.380" N	96° 25' 18.660" E
42	Hsat Chan	21° 2' 4.992" N	96° 26' 59.100" E
43	Taung Poet Khaung	21° 3' 47.664" N	96° 26' 16.188" E
44	Te Lu	20° 59' 58.200" N	96° 28' 3.612" E
45	Taung U	21° 1' 14.664" N	96° 26' 23.856" E
46	Gway Pin	21° 2' 51.180" N	96° 26' 47.040" E
47	Ya Ne	21° 2' 7.224" N	96° 24' 3.564" E
48	Min Pa Laung	20° 55' 47.964" N	96° 27' 20.232" E
49	Nyaung Pin Thar	20° 58' 20.028" N	96° 19' 19.308" E
50	Myaing	21° 2' 59.964" N	96° 30' 49.212" E
51	Inn Khaung	21° 3' 37.188" N	96° 31' 18.084" E
52	Thit Say Kone	21° 3' 21.276" N	96° 28' 21.720" E
53	Nyaung Kone	21° 5' 11.400" N	96° 29' 46.284" E
54	Myauk Lut Kone	21° 1' 35.688" N	96° 31' 52.680" E
55	Lay	20° 59' 54.024" N	96° 31' 41.700" E
56	Kaing Su	21° 1' 17.976" N	96° 31' 9.984" E
57	Pyi Thar	21° 1' 51.348" N	96° 31' 3.864" E
58	Myin Wun	20° 53' 44.268" N	96° 32' 1.032" E
59	Taw Kyei	20° 58' 36.300" N	96° 31' 11.712" E

Table G3 List of Villages within 20km of the Biodiversity Offset Sites (Coal Mine Concession)

No	Name	Lat	Long
1	Paw	22° 55' 4.764" N	94° 51' 32.544" E
2	Ton	22° 57' 33.876" N	94° 43' 42.996" E
3	Pa Lu Za Wa	22° 52' 27.948" N	94° 51' 1.512" E
4	Thit Hpa	22° 53' 0.924" N	94° 50' 56.688" E
5	Auk Yae Twin	22° 52' 13.980" N	94° 49' 49.944" E
6	Gwayt Ngu	22° 52' 37.128" N	94° 50' 38.472" E
7	Aung Thu Kha	22° 51' 45.288" N	94° 50' 5.784" E
8	Taung Pyin Nge	22° 50' 25.008" N	94° 49' 8.256" E
9	Aik	22° 48' 38.844" N	94° 52' 44.976" E
10	Yin	22° 47' 10.752" N	94° 41' 50.424" E
11	Kone Thar	22° 47' 33.900" N	94° 42' 20.484" E
12	Kyauk Hlay Kar	22° 48' 53.244" N	94° 42' 59.364" E
13	Mi Chaung Twin	22° 48' 32.040" N	94° 40' 50.556" E
14	Kyaw Zin	23° 11' 24.180" N	94° 18' 22.752" E
15	Kya Khat Taw	23° 24' 50.184" N	94° 23' 2.112" E
16	Se Gyi	23° 23' 25.116" N	94° 22' 58.548" E
17	Kaing Shwe Taung	23° 13' 27.552" N	94° 19' 16.788" E
18	Thit Chauk	23° 11' 37.752" N	94° 15' 11.556" E
19	Thet Kei Kyin	23° 12' 4.968" N	94° 36' 35.928" E
20	Ka Toe	23° 9' 44.388" N	94° 33' 42.984" E
21	Sin Aing Ma	23° 10' 26.940" N	94° 34' 9.516" E
22	Aung Chan Thar	23° 12' 3.348" N	94° 35' 12.984" E
23	Khaung Tee	23° 7' 44.256" N	94° 20' 23.676" E
24	Sin Gaung	23° 17' 27.888" N	94° 22' 23.556" E
25	Kywe Nan	23° 15' 43.992" N	94° 21' 11.160" E
26	Kywe Ku	23° 18' 9.216" N	94° 22' 1.164" E
27	Thin Gan	23° 15' 33.228" N	94° 23' 26.628" E
28	Ga Zet	23° 19' 18.660" N	94° 22' 6.672" E
29	Naung Hpa Nan	23° 20' 6.468" N	94° 23' 29.724" E
30	He Daung	23° 25' 47.604" N	94° 23' 28.032" E
31	Shan Su	23° 26' 15.648" N	94° 23' 42.576" E
32	Man Hpar Lay	23° 30' 55.800" N	94° 24' 14.652" E
33	Kywe Tat	23° 18' 32.724" N	94° 24' 58.284" E
34	Khan Ni	23° 17' 35.988" N	94° 28' 2.676" E
35	Myo Ma	23° 18' 2.988" N	94° 24' 8.064" E
36	Tha Yet Taw	23° 21' 1.584" N	94° 25' 30.936" E

No	Name	Lat	Long
37	In Daing	23° 20' 22.956" N	94° 24' 27.900" E
38	Maung Khar	23° 21' 49.248" N	94° 24' 5.940" E
39	In Doke	23° 23' 4.596" N	94° 24' 46.080" E
40	Moe Kaung	22° 57' 44.640" N	94° 49' 29.892" E
41	Sin Pe	22° 58' 35.652" N	94° 50' 9.276" E
42	Nan Pin	23° 25' 36.156" N	94° 27' 6.840" E
43	Hin Tin	23° 24' 40.068" N	94° 28' 20.280" E
44	Ywar Thar	23° 27' 34.056" N	94° 21' 0.144" E
45	Ta Bu Chaung	23° 25' 7.428" N	94° 19' 54.732" E
46	Nan Za Lein	23° 29' 6.252" N	94° 22' 19.488" E
47	Myay Thar	23° 18' 15.840" N	94° 19' 2.820" E
48	Yaw Su	23° 18' 52.056" N	94° 18' 37.332" E
49	Ma Sein	23° 22' 15.924" N	94° 20' 38.940" E
50	Ba Let Thar	23° 23' 11.436" N	94° 21' 8.496" E
51	Taung Ywar Ma	23° 22' 49.476" N	94° 21' 50.148" E
52	Ton Nan	23° 13' 58.044" N	94° 19' 6.672" E
53	Man Lon	23° 14' 43.224" N	94° 20' 11.472" E
54	Khon Gyi	23° 10' 9.912" N	94° 20' 48.264" E
55	Thar Si	23° 10' 8.400" N	94° 22' 43.392" E
56	Chaung Wa	22° 59' 13.668" N	94° 21' 23.076" E
57	Pa Thay (North)	22° 47' 13.524" N	94° 30' 3.168" E
58	Inn Daung	22° 47' 45.420" N	94° 30' 20.808" E
59	Sa Thar (Upper)	22° 48' 25.092" N	94° 30' 11.196" E
60	Laung Tei	22° 49' 34.176" N	94° 32' 7.980" E
61	Laung Kyin	22° 49' 11.856" N	94° 32' 31.272" E
62	Pauk Aing	22° 51' 10.872" N	94° 32' 24.936" E
63	Kywe Kya	22° 50' 53.016" N	94° 32' 45.744" E
64	Taung Kone	22° 50' 40.488" N	94° 32' 19.896" E
65	Pwint Hlet	22° 49' 45.912" N	94° 30' 4.104" E
66	Myay See Taung	22° 51' 12.672" N	94° 29' 43.584" E
67	Kyun Taw	23° 0' 52.956" N	94° 25' 57.864" E
68	Kyay Taung U	22° 53' 39.444" N	94° 31' 41.160" E
69	Kan	22° 54' 52.344" N	94° 29' 23.136" E
70	Taung Yar Taw (North)	22° 54' 25.128" N	94° 29' 42.576" E
71	Se Chaung	22° 53' 48.624" N	94° 29' 35.556" E
72	Ba Yon Kar	22° 58' 22.908" N	94° 22' 18.264" E
73	Khon Thar	22° 59' 29.832" N	94° 21' 53.424" E

No	Name	Lat	Long
74	Ku Seik	22° 59' 7.008" N	94° 23' 20.256" E
75	Nga Yaung	22° 58' 48.792" N	94° 24' 20.304" E
76	Ma Taw	22° 53' 14.748" N	94° 31' 45.696" E
77	Let Pan Seik	22° 52' 56.100" N	94° 32' 35.268" E
78	Yon Thar	22° 53' 59.532" N	94° 30' 47.736" E
79	Nga Ohn	22° 52' 36.552" N	94° 34' 2.028" E
80	Na Nwin Chaung	22° 52' 1.956" N	94° 33' 35.100" E
81	Pu Htoe Lone	22° 52' 27.552" N	94° 32' 17.268" E
82	Pin Tin (Notth)	22° 54' 0.252" N	94° 37' 22.872" E
83	Hpet Khat	22° 53' 22.236" N	94° 38' 42.828" E
84	In Pin Hla	22° 57' 35.136" N	94° 37' 33.564" E
85	Ah Nyar Lel	22° 56' 26.628" N	94° 34' 35.688" E
86	Pyin Taw	22° 57' 8.460" N	94° 36' 58.896" E
87	Yar	22° 56' 40.884" N	94° 39' 18.288" E
88	Mauk Ka Taw	22° 58' 19.344" N	94° 40' 0.372" E
89	Za Na Hpyin	22° 59' 45.492" N	94° 39' 9.648" E
90	Thay Ma Thauk	22° 59' 45.492" N	94° 39' 9.648" E
91	Mu Thar	23° 1' 13.296" N	94° 39' 7.128" E
92	Mauk Tet	23° 0' 36.972" N	94° 39' 5.436" E
93	Peik Chin Taw	23° 4' 22.440" N	94° 41' 59.316" E
94	Kyun Taw	23° 2' 22.380" N	94° 40' 17.652" E
95	Sa Myin	23° 5' 53.628" N	94° 46' 7.032" E
96	Ywar Taw	23° 6' 29.700" N	94° 45' 23.652" E
97	Pyin Kaing	23° 8' 56.544" N	94° 49' 56.064" E
98	Te Gyi	23° 11' 10.392" N	94° 50' 37.608" E
99	Shan Chaung	23° 9' 49.752" N	94° 49' 18.084" E
100	Than Pauk	22° 57' 14.976" N	94° 44' 40.704" E
101	Laung Pyayt	22° 54' 18.396" N	94° 44' 56.796" E
102	Kyauk Khei Tet	22° 57' 13.680" N	94° 43' 12.720" E
103	Zin Ka Le	22° 51' 32.688" N	94° 45' 48.420" E
104	Khet Lon	22° 50' 3.984" N	94° 45' 17.136" E
105	Thin Taw	22° 51' 27.828" N	94° 44' 24.504" E
106	Nyaung Pin Thar	22° 50' 41.388" N	94° 43' 50.988" E
107	Bin	22° 50' 2.904" N	94° 42' 58.500" E
108	Oke Hnan Boke	22° 50' 23.820" N	94° 43' 29.172" E
109	Ah Nauk Taw	22° 50' 3.012" N	94° 42' 3.132" E
110	Kyway	23° 3' 53.352" N	94° 25' 24.996" E

No	Name	Lat	Long
111	Ywar Thit Kone	23° 3' 0.288" N	94° 26' 32.820" E
112	Myauk Chun	23° 4' 53.220" N	94° 23' 56.328" E
113	Than Pu Yar	23° 7' 26.688" N	94° 25' 36.984" E
114	Ywar Ba	23° 3' 54.756" N	94° 24' 6.372" E
115	Inn Kone Gyi	23° 2' 34.836" N	94° 25' 44.688" E
116	Kyauk Tan	23° 6' 15.480" N	94° 21' 33.516" E
117	Yaw Su	23° 5' 27.348" N	94° 22' 50.268" E
118	Nar Pin	23° 42' 55.008" N	94° 27' 3.240" E
119	Htin Shu Chaung	23° 43' 43.320" N	94° 28' 4.980" E
120	Kin Tat	23° 43' 28.776" N	94° 25' 42.600" E
121	Shar Pin	23° 44' 37.032" N	94° 26' 45.780" E
122	Tun Pin	23° 41' 37.068" N	94° 24' 33.768" E
123	Aw Zee Khon	23° 41' 24.936" N	94° 28' 15.492" E
124	Nwe Kho	23° 40' 54.120" N	94° 26' 43.476" E
125	Laung Kaung	23° 39' 10.692" N	94° 25' 55.272" E
126	Nyaung Tha Pyay	23° 37' 12.036" N	94° 26' 14.532" E
127	Kyar Inn	23° 34' 40.332" N	94° 26' 2.076" E
128	Zee Khon	23° 33' 50.040" N	94° 26' 47.976" E
129	Inn Ta Paung	23° 32' 34.008" N	94° 26' 27.132" E
130	Hman Pin	23° 34' 54.948" N	94° 28' 20.208" E
131	Taung Twin	23° 35' 47.040" N	94° 28' 19.020" E
132	Kan Htu	23° 34' 17.220" N	94° 28' 43.464" E
133	Yae U Kone	23° 30' 30.384" N	94° 25' 20.028" E
134	Hpar Tin	23° 29' 21.048" N	94° 23' 32.496" E
135	Oke Hpo	23° 29' 49.884" N	94° 27' 11.016" E
136	Taung Kone	23° 33' 12.276" N	94° 30' 7.020" E
137	Khon Thar	23° 34' 28.380" N	94° 29' 57.516" E
138	Taung In	23° 35' 57.696" N	94° 29' 42.036" E
139	Kaung Kway	23° 36' 3.564" N	94° 34' 32.448" E
140	Man New	23° 35' 16.800" N	94° 35' 17.052" E
141	Kyoke Thar	23° 37' 12.684" N	94° 38' 32.640" E
142	Taing Thar	23° 38' 11.148" N	94° 40' 14.700" E
143	Law Thar	23° 42' 12.888" N	94° 41' 39.516" E
144	Inn Taw	23° 39' 42.876" N	94° 46' 3.144" E

Figure G1 Location of Villages (Limestone Concession)

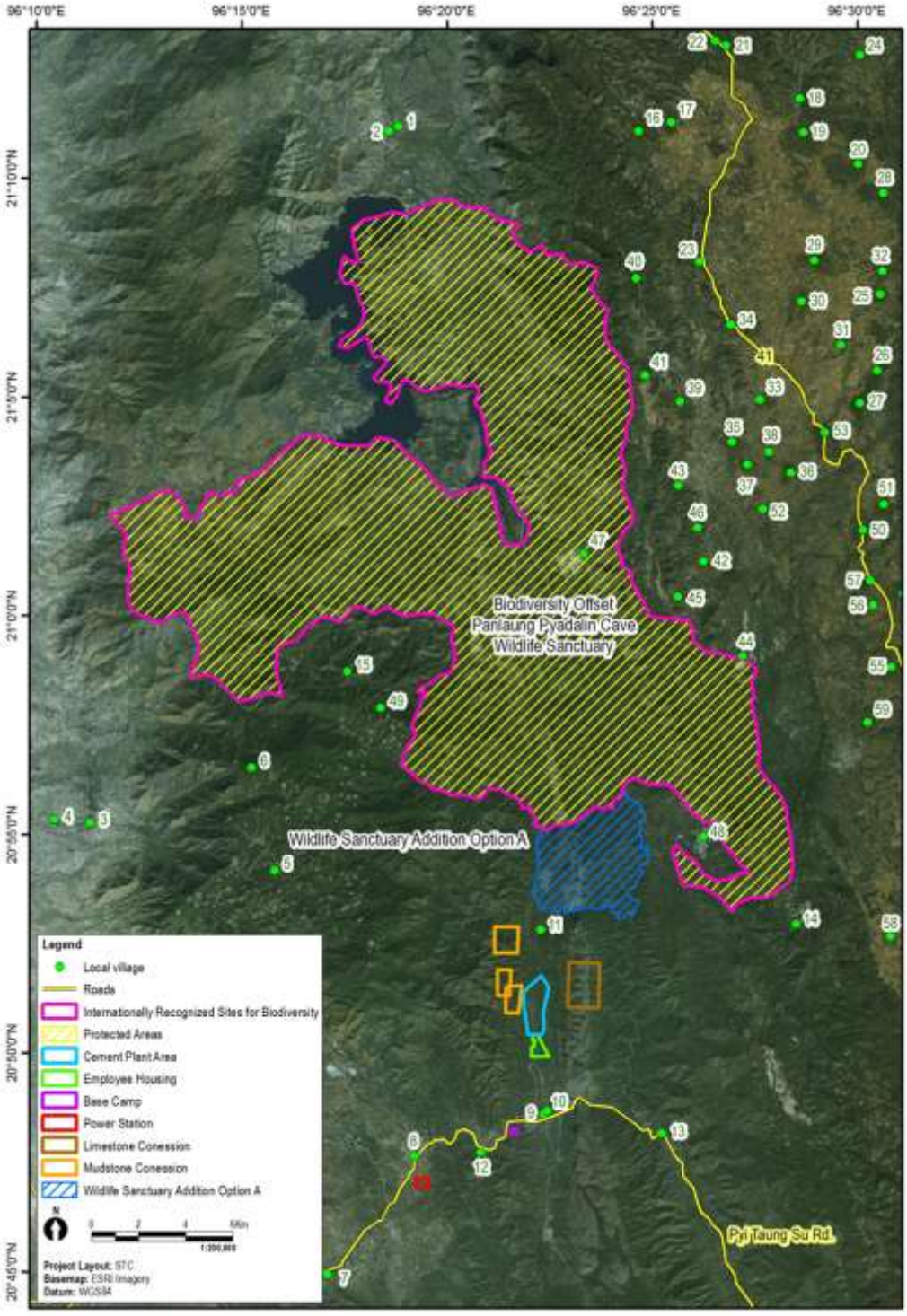
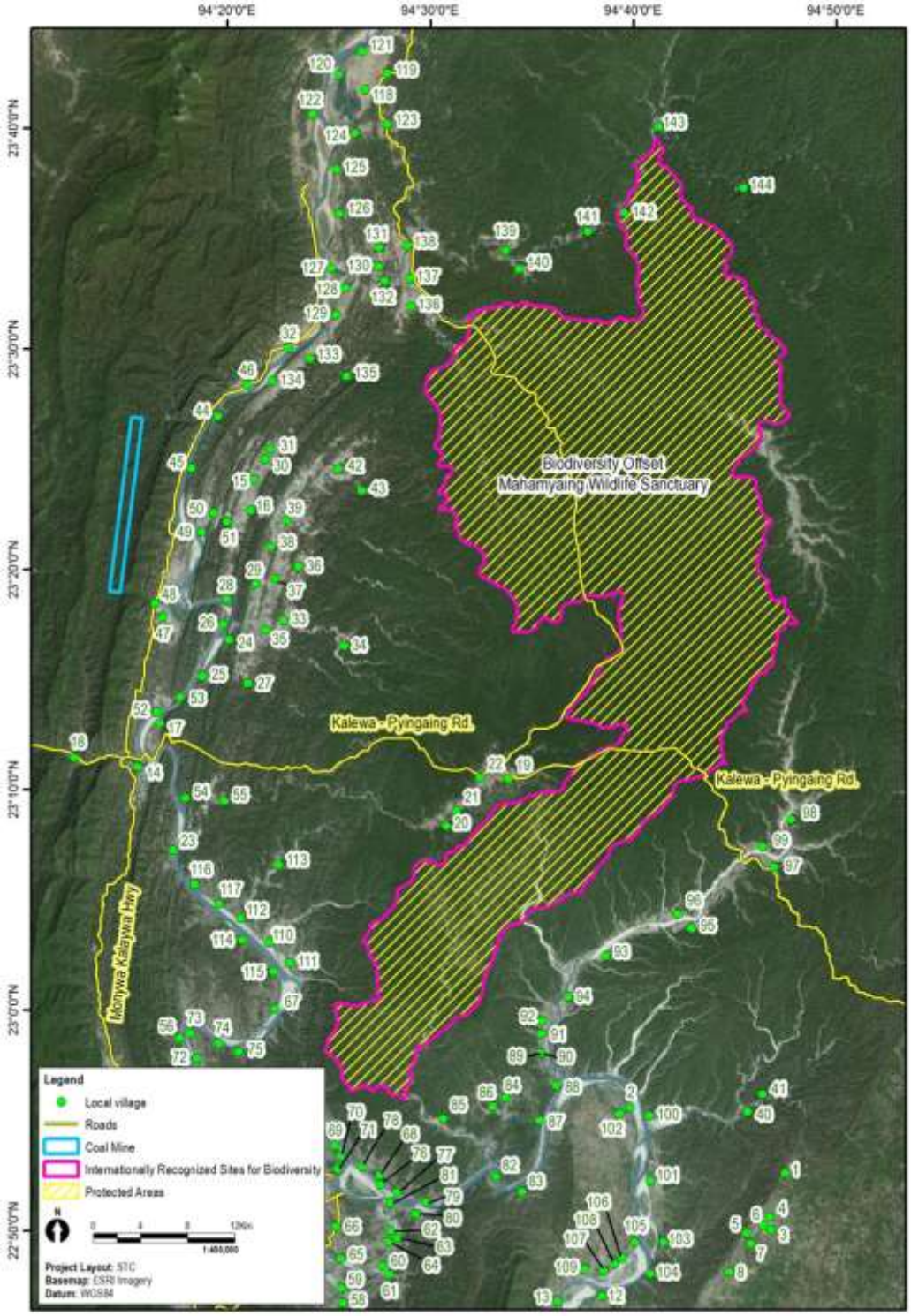


Figure G2 Location of Villages (Coal Mine Concession)



ANNEX H: Wildlife Survey Protocol

Title	Wildlife Survey Protocol
Document Reference	BAP_Plan 1.3
BAP Action Item	9,10,11
Last Updated	4 December 2018
Objective	A document outlining the methodology and locations for wildlife surveys in the project area. Brief descriptions of target species are also provided.

Wildlife Survey Protocol: STC Cement Plant

Objectives: The key habitat of interest identified within the project area is the karst formation within the project's limestone concession (part of the Sai Taung limestone range). Therefore, monitoring activities would be focused on limestone flora and fauna to further characterize the biodiversity of the area, understand potential project impacts on wildlife, and inform future operational/expansion decisions.

Target Species

Species identified to be Critical Habitat (CH) triggers in the Supplementary ESIA report, and suspected to still persist at the project area, will be targeted for future monitoring. These are namely:

- Chinese Pangolin (*Manis pentadactyla*)
- Shan State Langur *Trachypithecus phayrei ssp. shanicus*
- Karst snails
- Karst reptiles
- Karst flora

Fauna Monitoring Protocol

Limestone surveys	<u>Requirements</u> The limestone surveys are not recommended to be undertaken by STC staff given the potential for highly cryptic species to be present within the limestone range, a high level of expertise is required for identification of species. <u>Frequency</u> Conduct these surveys annually for the first 5 years of the loan term. Subsequent surveys may be conducted every 2 years. <u>Procedure – Karst Reptile Surveys</u> Select 5 survey sites throughout the limestone concession, prioritizing habitats rich in karst rocks, boulders and cliff faces. The GPS coordinates of all sites surveyed for that particular round are to be recorded. Given the nature of the landscape and survey, it is unlikely that the same sites can be visited repeated every year. Therefore, the aim of the survey is to continue building on a representative picture of the project area and assess year-on-year changes in species abundance and richness. The diurnal survey will proceed from 8:30 am to 12:00 pm and the nocturnal component from 7:30 pm – 10:30 pm. Conduct a visual search for reptilian species and document species, abundance, location/site and timing of observation. <u>Procedure – Karst Snail Surveys</u> Throughout the project concession, select a total of <u>5 sites</u> where suitable microhabitats and thanatocoenoses are present for the snail survey. The GPS coordinates of all sites surveyed for

Wildlife Survey Protocol: STC Cement Plant	
	that particular round are to be recorded. Given the nature of the landscape and survey, it is unlikely that the same sites can be visited repeated every year. Therefore, the aim of the survey is to continue building on a representative picture of the project area and assess year-on-year changes in species abundance and richness. At each survey site, collect 15 – 20 litres (two buckets) of soil and handpick any shells that are over 6 mm long. Process soil samples through flotation of soil in water and filtering through a cascade of increasingly fine sieves to sort shells according to size. Shells are to be identified down to the lowest possible taxonomic level.
Transect Surveys	<u>Requirements</u> STC staff are to conduct the survey under the guidance of external experts every 1-2 years for the first 5 years to build capacity. Once the STC staff have established reliable skills of detection and identification, surveys can be handed over to STC with external experts joining every 5 years to ensure quality maintenance. Locations for survey: Limestone quarry Mudstone quarry <u>Frequency</u> Conduct these surveys quarterly for the first 5 years of the loan term. Subsequent surveys can be done on an annual basis. <u>Procedure</u> All surveys will be conducted at night starting from 7:30 pm. Conduct visual and auditory detection of mammals, using torchlights for spotlighting. Walk up the limestone quarry via the access road to spot for mammals, including the Chinese Pangolin. Walk up the mudstone quarry via the access road to spot for mammals, including the Chinese Pangolin and Shan State Langur.
Interviews	The Chinese Pangolin and Shan State Langur was detected in the ESIA stage through interviews with local communities. Field monitoring can be supported by indirect observations. As part of STC's continued community engagement, local people should be asked every session on whether they have had any recent sightings of target species. These sightings should be officially minuted in meeting minutes and added to STC's species database.

Wildlife Survey Protocol: Paluzawa Coal Mine	
Objectives: The key habitat of interest identified within the project area is the deciduous forest within and surrounding the project area. The ESIA biodiversity surveys have also uncovered several species of global conservation concern from the site, including the Western Hoolock Gibbon (*Hoolock hoolock*). Therefore, monitoring activities would be focused on camera trapping surveys and targeted gibbon surveys to obtain a better understanding of the population utilizing the project area. The data from these surveys will serve to further characterize the biodiversity of the project area, understand potential project impacts on wildlife, and inform future operational/expansion decisions.	
Target Species	
Species identified to be Critical Habitat (CH) triggers in the Supplementary ESIA report, and suspected to still persist at the project area, will be targeted for future monitoring. These are namely: Chinese Pangolin (*Manis pentadactyla*) Western Hoolock Gibbon (*Hoolock hoolock*)	
Fauna Monitoring Protocol	
Camera Trapping	<u>Requirements</u> STC staff are to conduct the camera trapping survey under the guidance of external experts every 1-2 years for the first 5 years to build capacity. Once the STC staff have established reliable skills of camera deployment and maintenance, surveys can be handed over to STC with external experts joining every 5 years to ensure quality maintenance. Locations for survey: Limestone quarry Mudstone quarry <u>Frequency</u> For the first 5 years of the loan term, conduct 1 camera trapping survey per year, with each survey spanning a total of 60 camera trapping days. For the subsequent years of the loan term, conduct 1 camera trapping survey every 5 years, with each survey spanning a total of 60 camera trapping days per year. <u>Procedure</u> Lay 17 camera traps throughout the project concession at the locations indicated in *Table 1 Camera Trap Locations* and according to the settings in *Table 2 Camera Trap Settings*. Any changes to the camera trap locations should be recorded in the survey report for that particular round of camera trapping. Analyse camera trap findings and derive a species list and relative abundance. Compare species richness and abundance with previously collected data.
Western Hoolock Gibbon Surveys	Each gibbon triangulation survey shall commence at 4:30 am. Three teams are required per survey. Select three points within the concession in a triangle formation. Log the GPS coordinates and elevation of each point. Upon detection of a gibbon call, record compass bearings of the call and the estimated distance. Record if there is more than one individual and if it belongs to a male or female. After the survey, analyse triangulation data to estimate abundance and location of gibbon group. Record this location for follow-up.

Wildlife Survey Protocol: Paluzawa Coal Mine	
	Assess if it is feasible to hike to the location identified from the triangulation survey and investigate. Further reference to be made to: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3605491/

Table H1 Camera Trap Locations

Camera trap location no.	Camera Trap Label	Coordinates	Remarks	ESIA Recorded Species
Phase 1/Phase 2				
C1	ERM UV C27	N23° 26.865' E94° 16.707'	Fruiting tree	Yellow-throated marten, Porcupine, Domestic cattle, Humans
C2	ERM UV C29	N23° 26.430' E94° 16.464'	Mountain ridge	-
C3	ERM SG C25	N23° 26.369' E94° 16.480'	Ridge, near fruiting tree	-
C4	ERM SG C07	N23° 22.875' E94° 16.405'	Ridgeline, bamboo	Red muntjac, Leopard cat, Kalij pheasant
C5	ERM UV 15	N23° 22.794' E94° 16.366'	Bamboo	Porcupine, Red muntjac, Pallas` squirrel
C6	ERM UV C28	N23° 22.702' E94° 16.501'	Bamboo	Red jungle fowl
C7	ERM UO C05	N23° 22.709' E94° 16.533'	Fruiting tree	Porcupine, Red muntjac, Rhesus macaque, Rat, Kalij pheasant
Phase 3				
C8	-	N23° 24.662' E94° 16.668'	Dry bed of a small rocky stream, degraded bamboo forest, close to mining site	Yellow-throated marten, Leopard cat, Squirrel
C9	ERM UV 20	N23° 24.739' E94° 16.659'	bamboo	Red muntjac
Phase 2/Phase 3				
C10	ERM SG C08	N23° 24.776' E94° 16.665'	Fruiting tree, dense bamboo	Red muntjac
C11	ERM SG C23	N23° 24.941' E94° 16.643'	Dense bamboo forest	Wild boar, Northern tree-shrew
C12	ERM UO C01	N23° 24.959' E94° 16.672'	Dense bamboo forest, carnivore tracks	Wild boar, Squirrel
C13	ERM SG C06	N23° 25.057' E94° 16.734'	Ridge, degraded bamboo forest	Large indian civet, Domestic water buffalo, Scaly trush, Red jungle fowl

Camera trap location no.	Camera Trap Label	Coordinates	Remarks	ESIA Recorded Species
C14	ERM SG C22	N23° 24.920' E94° 16.723'	Ridge, dry stream, bamboo	Red muntjac, Greater necklaced laughingthrush
Phase 3/Phase 4				
C15	ERM SG C10	N23° 23.771' E94° 16.675'	Next to small stream, muntjac and carnivore tracks, secondary growth	Red muntjac, Red jungle fowl
C16	ERM UO C04	N23° 23.767' E94° 16.618'	Small stream, close to mining area, degraded forest, tracks of wild boar and muntjac	Fishing cat, Yellow-throated marten, red muntjac, Humans
C17	ERM UV 30	N23° 23.781' E94° 16.545'	Upstream small rocky stream, banana palm, small cat track, muntjac track	Red muntjac,Red-billed blue magpie

Table H2 ***Camera Trap Settings***

Set Mode	Image Size	Image Format	Set Mode Interval	Sensor Level	Night Vision Shutter	Time Stamp	Set Date	Coordinate Input
Camera	8 MP	Widescreen	1 Minute	Normal	Medium	On	Ind. Date	Off

ANNEX I: Invasive Species Management Plan

Title	Invasive Species Management Plan
Document Reference	BAP_Plan ISMP V1
BAP Action Item	9,10,11
Last Updated	4 December 2018
Objective	A plan presenting key actions to prevent the proliferation of invasive species within the project area. A list of invasive flora species currently present within the project area and their key identifying characteristics is also provided.

Procedures for the Eradication of Invasive Species

Use herbicides where appropriate to control invasive species within the Project Area in accordance with the safe use and label directions of the herbicides.

At areas where herbicides are not recommended for use (e.g. Near drinking waterbodies), manual weeding or removal should be considered.

Where required, reforestation experts or ecologists from NGOs can be engaged to provide advice on eradication activities.

Procedures to Prevent the Transmission of Invasive Species

Wheel wash bays to be installed at the guardhouse at the cement plant and Access Road to the Coal Mine to remove dirt and plant material from vehicle wheels prior to entering and leaving the Project Area.

Conduct monitoring of invasive species on an annual basis. Data for the following monitoring parameters should be collected:

- Locations of patches of high density/concentration of invasive species
- Rough extent of patch size for the abovementioned areas
- Number of invasive species recorded from surveys
- Ecological interactions: utilization of invasive species by native fauna
- Geo-referenced photographic evidence

Spatial data should be maintained on the biodiversity database as per *Biodiversity Action Plan Item 19 – Database for storage of biodiversity monitoring data.*

Conduct a comparison of year-on-year invasive species monitoring findings to assess if invasive species are proliferating within the project area.

If species are found to be proliferating, control using herbicides or manual weeding. Investigate to understand paths of transmission, including assessment by external experts, and if it is feasible for the Project to adopt further control measures.

Areas where invasive species have been removed must be rehabilitated to prevent the re-establishment of these species as many of them are weedy species that re-colonize bare ground quickly. Actions that can be undertaken include:

- Removal of soil layer where seed bank or rhizomes is mostly contained, to remove all presence of invasive species propagative parts;
- Replace soil with soil that has been excavated from another part of the project area OR treat soil with herbicide or do manual weeding;
- During the wet season, plant native seedlings (obtained from site nursery) into soil, adopting an intensive and high density planting pattern;
- Fertilize the planted saplings with generic fertilizer;
- Lay mulching (dead plant matter) around the saplings to reduce desiccation and weed growth
- Continue weeding regularly;
- Monitoring regeneration of patch;

Indigenous or naturalized species to be used where ever possible for landscaping, rehabilitation or other on-site needs.

Where required, reforestation experts or ecologists from NGOs can be engaged to provide advice on reforestation activities.

Further information on identification and eradication of invasive native species can be found at:

Global Invasive Species Database: www.iucngisd.org/

Invasive Species Compendium: http://www.cabi.org/isc/

Table I1 Invasive Species Identification Guide (Limestone Quarry)

S/N	Scientific Name	Photograph	Key Features
1	*Ageratum conyzoides*	   Further information: http://www.iucngisd.org/gisd/speciesname/Ageratum+conyzoides	Stems and leaves covered in fine hairs Egg-shaped leaves Purple, blue, pinkish or white small flowers Fruits are small and brown in colour
2	*Bidens pilosa*	  Further information: http://www.iucngisd.org/gisd/speciesname/Bidens+pilosa	Black, slender, rigid seeds with bristle-like barbs Flowers have white petals with tightly clustered orange-yellow florets

S/N	Scientific Name	Photograph	Key Features
3	*Caesalpinia decapetala*	   Further information: http://www.iucngisd.org/gisd/speciesname/Caesalpinia+decapetala	Can be in the form of a shrub or tree Numerous straight to hooked thorns on its stems Pale yellow flowers Fruits are flattened, woody pods
4	*Chromolaena odorata*	   Further information: http://www.iucngisd.org/gisd/speciesname/Chromolaena+odorata	Stems are yellowish green and hairy Leaves are hairy and egg-shaped with a pointed tip at the end Flowers are pale pink Seeds black or dark brown with a tuft of hairs attached
5	*Hiptage benghalensis*	  	Flowers white with a pink or yellow base Fruit is pink with 3 papery, spreading elliptic wings. Brown when mature.

S/N	Scientific Name	Photograph	Key Features
		Further information: http://www.iucngisd.org/gisd/speciesname/Hiptage+benghalensis	
6	*Leucaena leucocephala*	    Further information: http://www.iucngisd.org/gisd/speciesname/Leucaena+leucocephala	Small scrubby tree Bark is greyish Leaves are small and pungent when crushed Flowers are white and filamentous Fruits are hard, flat and thin capsules that ripen from green to brown. Each capsule contains 15-25 shiny brown seeds
7	*Mimosa pudica*	  Further information: http://www.iucngisd.org/gisd/speciesname/Mimosa+pudica	Leaves fold and bend at night and upon being touched Pompom-shaped flowers

S/N	Scientific Name	Photograph	Key Features
8	*Oroxylum indicum*	   Further information: http://www.cabi.org/isc/datasheet/37913	Seed pods are large up to 1.5 m long and 10 cm in width that hang from bare branches Seeds are papery thin Large leaf stalks wither and fall off tree, collecting near base of trunk
9	*Paederia foetida*	  Further information: http://www.iucngisd.org/gisd/species.php?sc=632	Flowers white with violet centre and petals are very hairy

S/N	Scientific Name	Photograph	Key Features
10	*Ricinus communis*	   Further information: http://www.iucngisd.org/gisd/speciesname/Ricinus+communis	Leaves are glossy and palmate Young leaves may mature from red to green Fruit is spiny, greenish capsule Flowers are either red or yellow depending on their sex
11	*Ziziphus jujuba*	  Further information: http://www.iucngisd.org/gisd/speciesname/Ziziphus+mauritiana	Leaves are oval shaped with toothed margins Branches droopy and spiny Flowers white to yellowish-green Fruit is a singular, round to oval shaped fruit; turns green to reddish-brown when ripe

Table I2 Invasive Species Identification Guide (Coal Mine)

S/N	Scientific Name	Photograph	Key Features
1	*Ageratum conyzoides*	 Further information: http://www.cabi.org/isc/datasheet/3572	Erect, branching, annual herb with shallow, fibrous roots. Stems, which may root where the bases touch the ground, are cylindrical, and become strong and woody with age
2	*Amaranthus spinosus*	 Further information: http://www.cabi.org/isc/datasheet/4653	Stem is reddish with spines Fruit opens in a line around the centre

S/N	Scientific Name	Photograph	Key Features
3	*Bidens pilosa*	  Further information: http://www.iucngisd.org/gisd/speciesname/Bidens+pilosa	Black, slender, rigid seeds with bristle-like barbs Flowers have white petals with tightly clustered orange-yellow florets
4	*Caesalpinia decapetala*	   Further information: http://www.cabi.org/isc/datasheet/10733	Can be in the form of a shrub or tree Numerous straight to hooked thorns on its stems Pale yellow flowers Fruits are flattened, woody pods

S/N	Scientific Name	Photograph	Key Features
5	*Chromolaena odorata*	   Further information: http://www.cabi.org/isc/datasheet/23248	Stems are yellowish green and hairy Leaves are hairy and egg-shaped with a pointed tip at the end Flowers are pale pink Seeds black or dark brown with a tuft of hairs attached
6	*Hiptage benghalensis*	   Further information: http://www.cabi.org/isc/datasheet/27228	Flowers white with a pink or yellow base Fruit is pink with 3 papery, spreading elliptic wings. Brown when mature.
7	*Imperata cylindrica*	 	Flowers form a plume like structure which is white and hairy Leaves are long and straight, up to 1.8 m long and 2.5 cm wide Leaves are tough enough to scratch skin

S/N	Scientific Name	Photograph	Key Features
		Further information: http://www.cabi.org/isc/datasheet/28580	
8	*Mikania micrantha*	  Further information: http://www.cabi.org/isc/datasheet/34095	Grows as a climber or creeper Seeds are featherlike Flowers are white and grow in clusters
9	*Mimosa pudica*	  Further information: http://www.cabi.org/isc/datasheet/34202	Leaves fold and bend at night and upon being touched Pompom-shaped flowers

S/N	Scientific Name	Photograph	Key Features
10	*Oroxylum indicum*	   Further information: http://www.cabi.org/isc/datasheet/37913	Seed pods are large up to 1.5 m long and 10 cm in width that hang from bare branches Seeds are papery thin Large leaf stalks wither and fall off tree, collecting near base of trunk
11	*Paederia foetida*	  Further information: http://www.cabi.org/isc/datasheet/38458	Flowers white with violet centre and petals are very hairy

S/N	Scientific Name	Photograph	Key Features
12	*Ziziphus jujuba*	  Further information: http://www.iucngisd.org/gisd/speciesname/Ziziphus+mauritiana	Leaves are oval shaped with toothed margins Branches droopy and spiny Flowers white to yellowish-green Fruit is a singular, round to oval shaped fruit; turns green to reddish-brown when ripe

Table I3 Invasive species within Myanmar

S/N	Scientific Name	Common Name
Bacteria and Viruses		
1	Banana bunchy top virus (BBTV)	-
2	*Yersinia pestis*	-
Coral		
3	*Tubastraea coccinea*	Orange Cup Coral
Plants & Algae		
4	*Acacia auriculiformis* [+]	Acacia
5	*Acacia longifolia*	-
6	*Acacia mangium*	-
7	*Adenanthera pavonina*	-
8	*Ageratum conyzoides*[+]	Goat Weed
9	*Alternanthera philoxeroides*	-
10	*Cardamine flexuosa*	Wavy Bittercress
11	*Chromolaena odorata*	Siam Weed, Bitter Bush
12	*Eichhornia crassipes*	Water Hyacinth
13	*Eichhornia crus-galli* [+]	Barnyard Grass
14	*Hyptis suaveolens* [+]	Bush Tea
15	*Imperata cylindrica*	Blady Grass
16	*Lantana camara* [+]	Lantana
17	*Leucaena leucocephala*	-
18	*Limnocharis flava*	-
19	*Loranthus pulverulentus* [+]	Mistletoe
20	*Mikania micrantha* [+]	Mile-a-Minute
21	*Mimosa diplotricha* [+]	Giant Sensitive Plant
22	*Mimosa pigra* [+]	Giant Sensitive Plant
23	*Paspalum conjugatum* [+]	Buffalo Grass
24	*Pennisetum* spp. [+]	Mission Grass
25	*Prosopis juliflora* [+]	Mesquite
26	*Sorgum halepense* [+]	Johnson Grass
27	*Ziziphus mauritiana*	Chinese Date
28	*Acanthophora spicifera*	-
Insects		
29	*Aedes aegypti*	Yellow Fever Mosquito
30	*Brontispa longissima*	Coconut Leaf Beetle
31	*Matanastria grisea* [+]	Gypsy Moth
32	*Paratrechina longicornis*	Longhorn Crazy Ant
33	*Solenopsis geminata*	Tropical fire Ant
34	*Tapinoma melanocephalum*	Ghost Ant
35	*Trogoderma granarium*	Khapra Beetle
Invertebrates		
36	*Achatina fulica* [+]	Giant African Snail
37	*Pomacea canaliculata* [+]	Golden Apple Snail
38	*Teredo* spp. [+]	Shipworm
39	*Varroa jacobsoii* [+]	Parasitic Bee Mite
Fish		
40	*Clarias gariepinus*	African Sharptooth Catfish
41	*Ctenopharyngodon idella*	Grass Carp

S/N	Scientific Name	Common Name
42	*Cyprinus carpio*	European Carp
43	*Gambusia affinis*	Mosquito Fish
44	*Hypophthalmichthys nobilis*	Bighead Carp
45	*Oreochromis aureus*	Tilapia
46	*Poecilia reticulata*	Guppy
47	*Labeo rohita*	Rohu
Reptile		
48	*Hemidactylus frenatus*	Common House Gecko
Mammal		
49	*Rattus exulans*	Polynesian Rat/Pacific Rat
Notes: + Additionally sourced from Myanmar NBSAP 2015-2020		

ANNEX J: Rehabilitation Plan

Title	Mining Rehabilitation Plan
Document Reference	BAP_Plan 1.3
BAP Action Item	24
Last Updated	4 December 2018
Objective	A plan presenting actions that will support the rehabilitation of the land impacted by mining activity, restoring as far as possible back to a sustainable and usable condition.

Rehabilitation Plan

Rehabilitation Plan
Prior to Mining Activity
Prior to mining activities, the following actions are required to prepare for site rehabilitation following the completion of mining activities: • A site nursery is to be established to grow native seedstock propogated from collected native indigenous seed from the coal mining site. • A flora survey is to occur to identify the existing flora values of the proposed site. Lists of threatened flora and a general list of flora identified during surveys in 2017 are shown below. • A seed collection activity is to occur during late spring in order to gather seed for propogation in the site nursery. • Propogation activities are to occur on collected seed stock in the site nursery. Propogation and nursery care are to continue for the life of the mine. • A full time nursery attendant is to be charged with matinaning flora within the nursery. • No invasive or introduced species are to be cultivated for replanting or landscaping.
Stakeholder Consultation
Prior to site rehabilitation activities, the following consultation will occur: • Undertake one round of consultations with the local community to understand needs and expectations of rehabilitated land use. The planting composition can be adjusted where appropriate (eg. Creation of community forests) and the community can be engaged in the rehabilitation process. • Undertake consutlation with the Forest Department to understand their expectations of rehabilitated land use and if these are aligned to those of the local community. Based on Forest Department feedback, undertake a second round of consultations with the local community, if required. All rehabilitation will be of native indigenous species, in areas that were previously natural habitats. Non-native tree plantations may be established on areas cleared prior to development. A supporting map of such areas will be developed/maintained to inform what type of rehabilitation is required and at which locations.
Landform Reshaping
The following activities will be undertaken during land shaping: • Land reshaping is to occur to return landform to disturbed sites using heavy earth moving equipment. • All land surfaces are to be reshaped with a maximum gradient of 40o, with a preferable gradient of 30o in side slope • All drainage features are to be reshaped occording to natural flow regimes. • Sediment basins are to be retained below reshaped areas during rehabilitation. • Best practice sediment and erosion control measures are to be utilized to reduce overland flow and concentration of waterflow.

Rehabilitation Plan

Erosion and Sediment Control Best Practices

Further references in relation to sediment and erosion control best practices can be found at the following:

- Best practices for erosion and sediment control (IECA): https://www.austieca.com.au/publications/books-1-3
- NSW Office of Environment and Heritage (2012) Erosion and sediment control: http://www.environment.nsw.gov.au/Stormwater/ESCtrlUnsealedRds.htm
- LandCom NSW (2004) Managing Urban Stormwater: Soils and Construction: http://www.environment.nsw.gov.au/resources/water/BlueBookVol1.pdf
- West Virginia Department of Environmental Protection (2006) Erosion & Sediment Control BMP Manual http://www.dep.wv.gov/WWE/Programs/stormwater/csw/Pages/ESC_BMP.aspx

Required Sediment and Erosion Control Measures

Topic	Recommended Measures
Road maintenance	Undertake regular maintenance of roads and road drainage structures. Roads should be inspected regularly, particularly during or after periods of heavy rain to identify issues such as build-up of sediment, deposition of road base sediment in watercourse, riling and scouring of the road surface, flattening out or crossfall. Where these signs are observed, assess severity of erosion and undertake light or heavy road grading to maintain the road profile. In instances where ineffective road drainage was identified to be the issue, design and implement suitable drainage along the affected road
Material stockpiles	All stockpiled materials on site must be covered with a tarpaulin and/or stock piled beneath a sheltered area with provisions to ensure it will not be washed away
Erosion control blankets	For laying of erosion blankets, first ensure that the ground surface is free of grass and objects (rocks and sticks etc). The upslope mat should be placed such that it overlaps the top of the next downslope mat. Secure the mat with staples
Reducing sedimentation into natural watercourses	Accord a level of protection to streams and rivers within the project area, erecting sediment fences where appropriate at vulnerable areas to filter sediments from rainwater flowing into streams and rivers. A series of sedimentation pools may be established in a step wise manner at drainage from the project area that discharges into natural streams and rivers.
Reducing erosion at rehabilitated areas	Drainage systems around rehabilitated areas should be designed to channel bulk of water flow away and through the placement of rock-lined waterways to reduce the velocity of flow. In certain cases the rehabilitated area lies in the path of a natural drainage line within the landscape or at the base of a natural channel/ road where large quantities of water will be flushed towards during heavy rain events.

Topsoiling/ Soil Replacement and Protection

The following activities are required during soil replacement:

- Obtain compost or fertilizer for application to the soil matrix to provide organic material, if available.
- The compost/fertilizer mixture should be screened and treated with herbicide/fungicide to eliminate the viability of invasive species within the mixture to as low as possible
- Based on the Rehabilitation Plan and expertise from the land rehabilitation expert, lay the compost material at the selected location and cover with erosion control blanket as soon as possible
- Soil laying is best done during the dry season where loss of soil due to large downpours can be avoided. However, given planting should be best timed during the wet season when water is plentiful, the plan may accommodate this by laying soil the end and start of the dry and wet seasons respectively and implement erosion control immediately

Vegetation Planting

The following activities are required during vegetation planting:

Rehabilitation Plan
• Engage the community to undertake the planting and maintenance work (weeding, fertilizer) and include remuneration where appropriate • Select plant species native to the project area, preferably sourcing most individuals from the on-site nursery. A variety of fruiting species, nutrient cycling / fixation species should be selected based on the natural vegetation characteristics of the area • During the wet season, plant native seedlings (obtained from site nursery) into soil, adopting an intensive and high density planting pattern • Fertilise the planted saplings with generic fertilizer • Lay mulching (dead plant matter) around the saplings to reduce desiccation and weed growth • Water daily in the absence of heavy rainfall for 6-8 weeks after planting to allow the plant to establish itself • Continue weeding regularly • Where required, reforestation experts or ecologists from NGOs can be engaged to provide advice on reforestation/rehabilitation activities • Fence freshly planted areas to prevent animal intrusion and grazing
Management and Monitoring
The following activities are required for the management and monitoting of rehabilitated areas: • Permanent vegetation monitoring plots: Establishment of at ten 20 m by 20 m monitoring plots throughout the project area and undertake annual surveys of flora species within these plots to track recovery. Number of species and abundance should be recorded and then compared on a year-on-year basis. • As the plots will require walking off-trail to access, this could impede plant regeneration. Therefore, monitoring involving vegetation plots should be undertaken only after 5 years after the start of rehabilitation. • Canopy denseness tracking using satellite imagery: Review of satellite /drone imagery to assess canopy denseness on an annual basis. Identify spots that appear to be regenerating slowly and investigate on the ground. Specific Monitoring Requirements – Paluzawa Coal Mine: • The following activities are required for the management and monitoting of rehabilitated areas for the coal mine concession: • Using transect surveys on accessible trails and along roads, count number of species and abundance of birds and diurnal mammals. • The surveys are to be complemented with annual local community interviews on their perception of the rate of recovery and wildlife that has been sighted utilising the rehabilitated areas. Specific Monitoring Requirements – Apache Cement Plant: • The following activities are required for the management and monitoting of rehabilitated areas at the limestone concession: • For the Apache cement plant, it is unlikely that the original karst condition and substrate composition can be restored. Therefore, monitoring based on karst fauna would not be advised. • Transect surveys on accessible trails and along roads to count for species and abundance of birds and diurnal mammals are recommended. • The surveys are to be complemented with annual local community interviews on their perception of the rate of recovery and wildlife that has been sighted utilising the rehabilitated areas.

Table J1 Flora Species of concern identified in the Coal Mine Concession

S/N	Scientific Name	Common Name	Family	IUCN Class
1	*Acacia intsia* Willd.	Su-pok-gyi	Mimosaceae	LC ver 3.1
2	*Acacia pennata* (L.) Willd.	Su-yit	Mimosaceae	LC ver 3.1
3	*Alstonia scholaris*(L.) R. Br.	Taung-ma-yoe/Say-kha-gyi	Apocynaceae	LR/lc ver 2.3
4	*Bauhinia forficata* Link	Min-ka-daw-kyet-kyay-kite	Caesalpiniaceae	LC ver 3.1
5	*Crotalaria albida* Heyne ex Roth	Not known	Fabaceae	LC ver 3.1
6	*Dalbergia cultrata* Grah.	Yin-daik	Fabaceae	NT ver 3.1
7	*Dalbergia rimosa* Roxb.	Daung-ta-laung	Fabaceae	LC ver 3.1
8	*Dendrocalamus membranaceus* Munro	Hmyin-wa	Poaceae	LC ver 3.1
9	*Desmodium triflorum* (L.)DC.	Than-ma-naing-kyauk-ma-naing	Fabaceae	LC ver 3.1
10	*Dioscorea wallichii* Hook.f.	Ka-det-nwee	Dioscoreaceae	LC ver 3.1
11	*Eclipta alba* (L.) Hassk.	Kyeik-hman	Asteraceae	DD ver 3.1
12	*Equisetum hyemale*	Equisetum	Equisetaceae	LC ver 3.1
13	*Holarrhena pubescens* Wall. ex G. Don	Let-htok-gyi	Apocynaceae	LC ver 3.1
14	*Homonoia riparia* Lour.	Ye-mo-ma-kha	Euphorbiaceae	LC ver 3.1
15	*Juglans regia L.*	Thit-khwe/Thit-kya	Juglandaceae	NT ver 3.1
16	*Lathyrus latifolius*	Not known	Fabaceae	LC ver 3.1
17	*Mangifera sylvatica* Roxb.	Taw-tha-yet	Anacardiaceae	LR/lc ver 2.3
18	*Millettia ovalifolia* Kurz	Thin-win	Fabaceae	DD ver 3.1
19	*Mimosa pudica L.*	Hti-ka-yone	Mimosaceae	LC ver 3.1
20	*Polygonum barbatum L.*	Kywe-hna-khaung-gyate	Polygonaceae	LC ver 3.1
21	*Pterocarpus indicus*Willd.	Taw-pa-dauk	Fabaceae	VU A1d ver 2.3
22	*Shorea obtusa* Wall.	Thit-ya	Dipterocarpaceae	LR/lc ver 2.3
23	*Shorea siamensis* (Kurz) Miq.	In-gyin	Dipterocarpaceae	LR/lc ver 2.3
24	*Tadehagi triquetrum* (L.)H. Ohashi	Lauk-thay	Fabaceae	LC ver 3.1
25	*Tetrameles nudiflora* R.Br.	Baing	Datiscaceae	LR/lc ver 2.3
26	*Woodfordia fruticosa* (L.)Kurz	Pan-swe	Lythraceae	LR/lc ver 2.3
27	*Zingiber fragile*	Not known	Zingiberaceae	NT ver 3.1
28	*Ziziphus jujuba* Lam.	Zi	Rhamnaceae	LC ver 3.1

DD=Data Deficient, LC=Least Concern, LR/lc=Lower Risk/least concern, NT=Near Threatened, VU=Vulnearble

Table J2 Flora Species Identified in the Coal Mine Concession

S/N	Scientific Name	Common Name	Family Name	Habitats
1	*Abelmoschus crinitus Wall.*	Taw-wa	Malvaceae	S
2	*Abelmoschus moschatus*	Taw-yon-pa-de	Malvaceae	S
3	*Abutilon indicum (L.) Sweet*	Bauk-khway	Malvaceae	S
4	*Acacia intsia Willd.*	Su-pok-gyi	Mimosaceae	CL
5	*Acacia pennata (L.) Willd.*	Su-yit	Mimosaceae	S
6	*Achyranthes aspera L.*	Kyet-mauk-su-pyan	Amaranthaceae	H
7	*Adina cordifolia Hook. f.*	Hnaw	Rubiaceae	T
8	*Aegle marmelos L.*	Ok-shit	Rutaceae	T
9	*Ageratum conyzoides L.*	Khwe-thay-pan	Asteraceae	H
10	*Albizia lebbek (L.)Benth.*	Taung-ko-kko	Mimosaceae	T
11	*Albizia lebbekoides (DC.) Benth.*	Taung-ma-gyi	Mimosaceae	T
12	*Albizia odoratissima (L.f.)Benth.*	Gote-kye	Mimosaceae	T
13	*Alstonia scholaris(L.) R. Br.*	Taung-ma-yoe/Say-kha-gyi	Apocynaceae	T
14	*Amaranthus spinosus L.*	Hnin-nu-new-su-bauk	Amaranthaceae	H
15	*Ampelocissus barbata Planch.*	Not known	Vitaceae	CL
16	*Anogeissus acuminata Wall.*	Yone	Combretaceae	T
17	*Anthocephalus morindaefolius Korth.*	Ma-u-let-lan	Rubiaceae	T
18	*Antidesma velutinumTul.*	Kin-pa-lin	Euphorbiaceae	ST
19	*Ardisia polycephala Roxb.*	Kyet-ma-ok	Myrsinaceae	S
20	*Argemone mexicana L.Sp.*	Kon-kha-ya	Papaveraceae	S
21	*Argyreia nervosa*	Not known	Convolvulaceae	Cl/Cr
22	*Armillaria mellea (VahlFr.) Kummer.*	Not known	Physalacriaceae	M
23	*Artocarpus chaplasha Roxb.*	Taung-pein-ne	Moraceae	T
24	*Artocarpus lakoocha Roxb.*	Myauk-la-khauk	Moraceae	T
25	*Arundinella hispida (Humb.& Bonpl. ex Willd.)Kuntze*	Pyaung-sa-myet	Poaceae	G
26	*Asparagus densiflorus*	Shint-ma-tet	Asparagaceae	CL
27	*Auricularia auricula-judae*	Kywet-na-ywet-hmo	Auriculariaceae	M
28	*Bambusa tulda Roxb.*	Thaik-wa	Poaceae	B
29	*Bauhinia forficata Link*	Min-ka-daw-kyet-kyay-kite	Caesalpiniaceae	Cl
30	*Bauhinia malabarica Roxb.*	Pha-lan/Chin-byit	Caesalpiniaceae	T
31	*Bauhinia sp.*	Swe-daw-nwee	Caesalpiniaceae	Cl/Cr
32	*Beilschmiedia roxburghiana Nees*	Myauk-ok-shit	Lauraceae	T
33	*Bidens pilosa*	Hmwe-sok	Asteraceae	H
34	*Bliospermum axillare Blume*	Hnat-cho	Euphorbiaceae	H
35	*Blume balsamifera DC..*	Phon-ma-thein	Asteraceae	S
36	*Bombax ceiba L.*	Let-pan	Bombacaceae	T
37	*Bombax insigne Wall.*	Taung-let-pan	Bombacaceae	T
38	*Bridelia retusa L.*	Seik-chee	Euphorbiaceae	ST
39	*Buchanania latifolia Roxb.*	Lun-pho	Anacardiaceae	T
40	*Buddleja asiatica*	Pon-ma-gyi	Buddlejaceae	S
41	*Butea monosperma (Lam.)Kuntze*	Pauk-pin	Fabaceae	T
42	*Butea superba Roxb.*	Pauk-nwee	Fabaceae	CL
43	*Caesalpinia decapetala (Roth.)Alston*	Suk-yan-bo /Kyant-sa-su-pin	Caesalpiniaceae	Cl/Cr
44	*Calamus erectus Roxb.*	Taung-kyein	Arecaceae	Cl/Cr
45	*Callicarpa nudiflora*	Kyun-na-lin	Verbenaceae	T

S/N	Scientific Name	Common Name	Family Name	Habitats
46	*Calotropis gigantea*	Ma-yoe	Apocynaceae	S
47	*Canscora diffusa (Vahl) R.Br.*	Kyauk-pan	Gentianaceae	H
48	*Cardiospermum halicacabum L.*	Ka-la-myet-si	Sapindaceae	Cl/Cr
49	*Careya arborea Roxb.*	Ban-bwe	Lecythidaceae	T
50	*Caryota mitis Lour.*	Min-baw	Arecaceae	T
51	*Cassia fistula L.*	Ngu	Caesalpiniaceae	T
52	*Cayratia trifolia*	Not known	Vitaceae	CL
53	*Cedrela febrifuga Blume*	Ye-ta-ma	Meliaceae	T
54	*Celosia argentea*	Kyet-mauk	Amaranthaceae	S
55	*Cephalostachyum pergracile Munro*	Tin-wa	Poaceae	B
56	*Chassalia curviflora*	Phet-ya	Rubiaceae	S
57	*Chromolaena odorata (L.) R.M. King & H Robinson*	Bi-zet	Asteraceae	S
58	*Chukrasia velutina Roem.*	Yin-ma	Meliaceae	T
59	*Clausena excavata Burm.f.*	Seik-nan	Rutaceae	S
60	*Clausena heptaphylla (Roxb.) Wight & Arn.*	Taw-pyin-daw-thein	Rutaceae	S
61	*Clematic fasiculiflora L.*	Khwa-nyo	Ranunculaceae	CL
62	*Cleome viscosa L.*	Hin-ga-la-yaing	Capparaceae	H
63	*Clerodendrum infortunatum Gaertn.*	Phet-kha	Verbenaceae	S
64	*Clerodendrum villosum Blume*	Thin-gyan-pan	Verbenaceae	S
65	*Colona floribunda*	Pet-shat	Tiliaceae	T
66	*Congea tomentosa Roxb.*	Tha-ma-ga-nwee	Verbenaceae	Cl/Cr
67	*Corchorus capsularis L.*	Gon-shaw/Khwe-la-but	Tiliaceae	S
68	*Cordia myxa L.*	Tha-net	Boraginaceae	T
69	*Costus specious Sm.*	Pha-lan-taung-hmwe	Costaceae	H
70	*Crassandra sp.*	Not known	Acanthaceae	H
71	*Cratoxylum cochinchinense*	Pe-ma-kyit	Hypericaceae	ST
72	*Cratoxylum polyanthum Korth*	Pe-ma-kyit	Hypericaceae	ST
73	*Crotalaria albida Heyne ex Roth*	Not known	Fabaceae	S
74	*Croton oblongifolius Roxb.*	Tha-yin-gyi	Euphorbiaceae	ST
75	*Cryptolepis buchanani Rome.& Schult.*	Na-sha-gyi	Asclepiadaceae	Cl/Cr
76	*Curculigo recurvata Dryand.*	Kywet-ma-lut-ohn	Hypoxidaceae	H
77	*Cymbidium aloifolium (L.) Sw.*	Thit-tet-lin-nae	Orchidaceae	E
78	*Dalbergia cultrata Grah.*	Yin-daik	Fabaceae	T
79	*Dalbergia paniculata Roxb.*	Ta-pauk	Fabaceae	T
80	*Dalbergia rimosa Roxb.*	Daung-ta-laung	Fabaceae	ST
81	*Dalbergia stipulacea Roxb.*	Ta-ma-lan-nwee	Fabaceae	Cl/Cr
82	*Dalbergia volubilis Roxb.*	Daung-ta-laung	Fabaceae	ST
83	*Dendrocalamus calostachyus (Kurz)Kurz*	Wa-bo-wa	Poaceae	B
84	*Dendrocalamus membranaceus Munro*	Hmyin-wa	Poaceae	B
85	*Derris sp.*	Leik-yoe	Fabaceae	ST
86	*Desmodium polycarpum (Poir)DC.*	Myay-pe-htwe	Fabaceae	S
87	*Desmodium triflorum (L.)DC.*	Than-ma-naing-kyauk-ma-naing	Fabaceae	H
88	*Dillenia parviflora Griff*	Kyet-zin-byun	Dilleniaceae	T
89	*Dillenia pentagyna Roxb.*	Zin-byun	Dilleniaceae	T
90	*Dioscorea cylindrica Burm.*	Kywe-thon-ywet	Dioscoreaceae	Cl/Cr
91	*Dioscorea pentaphylla L.*	Kywe-ngar-ywet	Dioscoreaceae	Cl/Cr
92	*Dioscorea sativa L.*	Kauk-yin-nwee	Dioscoreaceae	Cl/Cr

S/N	Scientific Name	Common Name	Family Name	Habitats
93	*Dioscorea wallichii Hook.f.*	Ka-det-nwee	Dioscoreaceae	Cl/Cr
94	*Diospyros kika L.f.*	Te/Te-net	Ebenaceae	T
95	*Diospyros ehretioides Wall.*	Auk-chin-sa	Ebenaceae	T
96	*Dipterocarpus sp.*	Ka-nyin-pho	Dipterocarpaceae	T
97	*Drynaria quercifolia*	Oak-leaf Fern	Polyporaceae	F
98	*Duabanga grandiflora*	Myauk-ngo	Lythraceae	T
99	*Eclipta alba (L.) Hassk.*	Kyeik-hman	Asteraceae	H
100	*Equisetum hyemale*	Equisetum	Equisetaceae	H
101	*Equisetum hyemale*	Not known	Equisetaceae	H
102	*Eranthemum roseum*	Not known	Acanthaceae	H
103	*Erythrina stricta Roxb.*	Taung-ka-thit	Fabaceae	T
104	*Euphorbia hypericifolia L.*	Kywe-kaung-hmin-sae	Euphorbiaceae	H
105	*Evolvulus nummularius L.*	Kyauk-kwe	Convolvulaceae	H
106	*Ficus hispida L.*	Kha-aung	Moraceae	T
107	*Ficus lacor Buch.-Ham.*	Nyaung-gyin	Moraceae	T
108	*Ficus obtusifolia Roxb.*	Nyaung-gyat	Moraceae	T
109	*Ficus racemosa L.*	Ye-tha-phan	Moraceae	T
110	*Firmiana colorata (Roxb.)R.Br.*	Wet-shaw	Sterculiaceae	T
111	*Flacourtia cataphracta Roxb.*	Na-ywe	Flacourtiaceae	T
112	*Flemingia congesta Roxb.*	Kye-hmi	Fabaceae	S
113	*Flueggea leucopyrus Willd*	Ye-chin-ya	Euphorbiaceae	S
114	*Gardenia coronaria Buch.-Ham.*	Yin-gat-gyi	Rubiaceae	T
115	*Garuga pinnata Roxb.*	Chin-yok/Gyi-yok	Burseraceae	T
116	*Getonia floribunda Roxb.*	Kywet-nwee	Combretaceae	S
117	*Glochidion sp.*	Hta-ma-sok	Euphorbiaceae	ST
118	*Gmelina arborea Roxb.*	Ya-ma-nae	Verbenaceae	T
119	*Grewia eriocarpa Juss.*	Ta-yaw	Tiliaceae	ST
120	*Grewia laevigata Vahl*	Kyet-tha-yaw	Tiliaceae	T
121	*Heliotropium indicum L.*	Sin-hna-maung	Boraginaceae	H
122	*Heterophragma adenophyllum Seem.*	Phet-than	Bignoniaceae	ST
123	*Hibiscus macrophyllus*	Taung-phet-wun	Malvaceae	T
124	*Holarrhena pubescens Wall. ex G. Don*	Let-htok-gyi	Apocynaceae	T
125	*Homalium tomentosum Benth*	Myauk-chaw	Flacourtiaceae	T
126	*Homonoia riparia Lour.*	Ye-mo-ma-kha	Euphorbiaceae	S
127	*Hoya sp.*	Not known	Asclepiadaceae	CL
128	*Hymenodictyon flaccidum Wall.*	Khu-san	Rubiaceae	ST
129	*Imperata cylindrica (L.)P. Beauv.*	Thet-ke	Poaceae	G
130	*Jasminum laurifolium Roxb.*	Taw-sabe	Oleaceae	Cl/Cr
131	*Juglans regia L.*	Thit-khwe/Thit-kya	Juglandaceae	T
132	*Justicia procumbens*	Not known	Acanthaceae	H
133	*Lagerstroemia macrocarpa Kurz*	Pyin-ma-gyi/Eik-hmwe	Lythraceae	T
134	*Lagerstroemia parviflora Roxb.*	Zaung-ba-lae	Lythraceae	T
135	*Lagerstroemia speciosa (L.)Pers.*	Pyin-ma/Eik-hmwe	Lythraceae	T
136	*Lagerstroemia tomentosa Presl.*	Lae-sa	Lythraceae	T
137	*Lagerstroemia villosa Wall. ex Kurz*	Kyet-ka-law	Lythraceae	T
138	*Lannea coromandelica (Houtt.) Merrr.*	Na-bae	Anacardiaceae	T
139	*Lathyrus latifolius*	Not known	Fabaceae	S
140	*Leea hirta Banks*	Na-ga-mauk-phyu	Leeaceae	S
141	*Leea rubra Blume.*	Na-ga-mauk-ni	Leeaceae	S

S/N	Scientific Name	Common Name	Family Name	Habitats
142	*Lepidagathis semiherbacea (Clarke) Nees*	Not known	Acanthaceae	H
143	*Leptadenia reticulata Wight & Arn.*	Gone-cho	Asclepiadaceae	Cl
144	*Leucas cephalotes Spreng.*	Pin-gu-hteik-peik	Lamiaceae	S
145	*Lindenbergia philippensis Benth.*	Not known	Scrophulariaceae	H
146	*Lophopetalum wallichii Kurz*	Mon-daing	Celastraceae	T
147	*Luffa aegyptiaca Mill.*	Tha-but-kha	Cucurbitaceae	CL
148	*Malaxis sp.*	Not known	Orchidaceae	H
149	*Mangifera sylvatica Roxb.*	Taw-tha-yet	Anacardiaceae	T
150	*Markhamia stipulata (Wall.) Seem.ex K.Schum.*	Ma-hlwa	Bignoniaceae	T
151	*Mazus pumilus (Burm.f.)Steenis*	Not known	Scrophulariaceae	H
152	*Merremia vitifolia (Burm.f.) Hallier. f.*	Kyet-hinga-lae-new	Convolvulaceae	Cl/Cr
153	*Mikania micrantha H.B.K.*	Bi-zet-nwee	Asteraceae	CL
154	*Miliusa roxburghiana Hook.f.& Thomson*	Tha-but-thein	Annonaceae	ST
155	*Miliusa velutina Hook.f.& Thomson*	Tha-but-gyi	Annonaceae	T
156	*Millettia extensa Benth.*	Win-u	Fabaceae	CL
157	*Millettia ovalifolia Kurz*	Thin-win	Fabaceae	T
158	*Millingtonia hortensis L.f.*	Ega-yit	Bignoniaceae	T
159	*Mimosa pudica L.*	Hti-ka-yone	Mimosaceae	H
160	*Miscanthus sinensis*	Not known	Poaceae	G
161	*Mitragyna parvifolia (Roxb.)Korth.*	Htein	Rubiaceae	T
162	*Mitragyna rotundifolia (Roxb.) Kuntze*	Bin-ga	Rubiaceae	T
163	*Moghania strobilifera (L.) Aiton f.*	Not known	Fabaceae	S
164	*Morus laevigata Wall.*	Po-sa-gyi	Moraceae	T
165	*Musa balbisiana*	Sin-chee-taing-nget-pyaw	Musaceae	H
166	*Musa sp.*	Taw-nget-pyaw	Musaceae	H
167	*Nauclea orientalis L.*	Ma-u	Rubiaceae	T
168	*Ocimum gratissimum L.*	Not known	Lamiaceae	H
169	*Oroxylum indicum (L.) Kurz.*	Kyaung-sha	Bignoniaceae	ST
170	*Paederia foetida L.*	Pe-bok-nwee	Rubiaceae	CL
171	*Pajanelia longifolia (Willd.) K. Schum.*	Kyaung-sha-pho	Bignoniaceae	ST
172	*Pandanus foetidusRoxb.*	Tha-baw	Pandanaceae	S
173	*Parthenocissus quinquefolia (L.) Planch.*	Not known	Vitaceae	Cl/Cr
174	*Pentasachme caudatum Wall. Ex Wight*	Not known	Asclepiadaceae	H
175	*Phaseolus velutina Grah.*	Pauk-net	Fabaceae	Cl/Cr
176	*Phyllanthus albizzioides (Kurz)Hook.f.*	Taun-zi-phyu	Euphorbiaceae	T
177	*Phyllanthus columnaris Muell. Arg.*	Kalon-letthe	Euphorbiaceae	ST
178	*Phyllanthus emblica L.*	Zi-phyu	Euphorbiaceae	ST
179	*Physalis minima L.*	Mi-pon/Bauk-thi	Solanaceae	S
180	*Picnoporus cinnabarina*	Not known	Polyporaceae	M
181	*Pilea scripta Langtang*	Kyet-chay-pin	Urticaceae	ST
182	*Polygonum barbatum L.*	Kywe-hna-khaung-gyate	Polygonaceae	H
183	*Prema pyramidata Wall.*	Kyun-na-lin/Kyun-pho	Verbenaceae	T
184	*Protium serratum Engl.*	Tha-di	Burseraceae	T
185	*Pterocarpus indicusWilld.*	Taw-pa-dauk	Fabaceae	T
186	*Pterospermum grandiflorum*	Not known	Sterculiaceae	ST

S/N	Scientific Name	Common Name	Family Name	Habitats
187	*Pterospermum semisagittatum Buch.-Ham.*	Na-gyi	Sterculiaceae	T
188	*Quercus lineata Blume*	Sa-gat	Fagaceae	ST
189	*Salvia sp.*	Not known	Lamiaceae	S
190	*Schima wallichii (DC.)Korth.*	Lauk-ya	Theaceae	T
191	*Schleichera oleosa (Lour.) Oken*	Gyo	Sapindaceae	T
192	*Senna hirsuta (L.) Irwin & Barneby*	Ka-thaw-hmwe-htu	Caesalpiniaceae	S
193	*Senna timoriensis (DC.) Irwin & Barneby*	Taw-ma-ze-li	Caesalpiniaceae	T
194	*Shorea obtusa Wall.*	Thit-ya	Dipterocarpaceae	T
195	*Shorea siamensis (Kurz) Miq.*	In-gyin	Dipterocarpaceae	T
196	*Smilax aspericaulis Wall ex A. D.C.*	Sein-na-baw-thay	Smilaceae	CL
197	*Smilax macrophylla Roxb.*	Sein-na-baw-gyi	Smilaceae	CL
198	*Solanum indicum L.*	Kha-yan-ka-zaw	Solanaceae	S
199	*Sonchus asper*	Not known	Asteraceae	H
200	*Spondias pinnata (L. f.) Kurz.*	Taw-gwe	Anacardiaceae	T
201	*Sterculia foetida L.*	Shaw-wa	Sterculiaceae	T
202	*Sterculia versicolor Wall.*	Shaw-phyu	Sterculiaceae	T
203	*Sterculia villosa Roxb.*	Shaw-ni	Sterculiaceae	T
204	*Stereospermum fimbriatum(Wall. ex G.Don.) A.DC.*	Than-thet	Bignoniaceae	T
205	*Stereospermum suaveolens (Roxb.) DC.*	Kywe-ma-gyo-lein	Bignoniaceae	T
206	*Streblus asper Lour.*	Ok-hne	Moraceae	T
207	*Streptocaulon tomentosum Wight & Arn.*	Myin-sa-gon-ni	Asclepiadaceae	CL
208	*Strychnos nux-blanda A.W.Hill*	Kha-baung	Loganiaceae	ST
209	*Tadehagi triquetrum (L.)H. Ohashi*	Lauk-thay	Fabaceae	S
210	*Tectona grandis L. f.*	Kyun	Verbenaceae	T
211	*Terminalia alata (Heyne) Roth*	Htauk-kyant	Combretaceae	T
212	*Terminalia bellirica (Gaertn) Roxb.*	Thit-seik	Combretaceae	T
213	*Terminalia chebula Retz.*	Phan-kha	Combretaceae	T
214	*Tetrameles nudiflora R.Br.*	Baing	Datiscaceae	T
215	*Tetrastigma planicaule*	Not known	Vitaceae	Cl/Cr
216	*Thladiantha cordifolia (Blume)Cogn.*	Ka-yin-ma-tin-pa	Cucurbitaceae	Cl/Cr
217	*Thunbergia laurifolia Lindl.*	Kyi-hnok-thi	Acanthaceae	CL
218	*Tinospora nudiflora Kurz*	Sin-don-ma-nwee	Menispermaceae	CL
219	*Trema orientalis (L.) Blume*	Kyet-chee-pho	Ulmaceae	ST
220	*Tristaniopsis burmanica (Griff.)P.G. Wilson & J.T. Waterh.*	Taung-tha-bye	Myrtaceae	T
221	*Triumfetta bartramia L.*	Kat-se-nae-thay	Tiliaceae	S
222	*Urea lobata L.*	Kat-se-nae	Malvaceae	S
223	*Vangueria spinosa Roxb.*	Magyi-bauk	Rubiaceae	S
224	*Vitex peduncularis Wall.*	Phet-le-zin/Thit-kyut	Verbenaceae	T
225	*Vitex pubescens Vahl*	Kyet-yoe/Thit-kyut	Verbenaceae	T
226	*Woodfordia fruticosa (L.)Kurz*	Pan-swe	Lythraceae	S
227	*Wrightia arborea (Dennst.) Mabb.*	Let-htok-thay	Apocynaceae	T
228	*Xylia xylocarpa (Roxb.)Taub.*	Pyin-ka-doe	Mimosaceae	T
229	*Zanthoxylum budrunga Wall.*	Ma-yanin-kyet-su	Rutaceae	T
230	*Zanthoxylum rhetsa*	Hmae-khaung	Rutaceae	T
231	*Zingiber fragile*	Not known	Zingiberaceae	H
232	*Zingiber squarrosum Roxb.*	Tauk-ta	Zingiberaceae	H

S/N	Scientific Name	Common Name	Family Name	Habitats
233	*Zingiber zerumbet (L.)Roscoe ex J.E.Sm.*	Lin-nay	Zingiberaceae	H
234	*Ziziphus glabra Roxb.*	Taw-zi-nwee/Paung-bet	Rhamnaceae	Cl/Cr
235	*Ziziphus jujuba Lam.*	Zi	Rhamnaceae	ST

B=Bamboo, CL=Climber, Cl/Cr=Climber/Creeper, E=Epiphyte, F=Fern, G=Grass, H=Herbs, M=Mushroom, S=Shrubs, ST=Small Tree, T=Tree

Table J3 Threatened Flora Species Identified at the Limestone Concession

No.	Scientific Name	Common Name	Family Name	IUCN criteria
1	Bauhinia ornata Kurz	Myauk-hle-kha	Caesalpiniaceae	LC ver 3.1
2	Dalbergia cultrata Grah.	Yin-daik	Fabaceae	NT ver 3.1
3	Dalbergia oliveri Gamble	Ta-ma-lan	Fabaceae	EN A1cd ver 2.3
4	Dalbergia rimosa Roxb.	Daung-ta-laung	Fabaceae	LC ver 3.1
5	Dendrocalamus membranaceus Munro	Hmyin-wa	Poaceae	LCver 3.1
6	Dipterocarpus tuberculatus Roxb.	In	Dipterocarpaceae	LR/lc ver 2.3
7	Holarrhena pubescens Wall. ex G. Don	Let-htok-gyi	Apocynaceae	LC ver 3.1
8	Homonoia riparia	Ye-mo-ma-kha	Euphorbiaceae	LC ver 3.1
9	Ludwigia hyssopifolia	Lay-nyin-thay	Onagraceae	LC ver 3.1
10	Ludwigia octovalvis	Lay-nyin-gyi	Onagraceae	LC ver 3.1
11	Lathyrus latifolius	Not known	Fabaceae	LC ver 3.1
12	Mangifera sylvatica Roxb.	Taung-tha-yet	Anacardiaceae	LR/lc ver 2.3
13	Millettia ovalifolia Kurz	Thin-win	Fabaceae	DD ver 3.1
14	Mimosa pudica L.	Hti-ka-yone	Mimosaceae	LC ver 3.1
15	Pennisetum purpureum Schum.	Yon-sa-myet	Poaceae	LC ver 3.1
16	Potamogeton natans L.	Floating-leaf Pondweed	Potamogetonacea e	LC ver 3.1
17	Pteris vittata	Brake Fern	Pteridaceae	LC ver 3.1
18	Pterocarpus indicusWilld.	Taw-pa-dauk	Fabaceae	VU A1d ver 2.3
19	Shorea obtusa Wall.	Thit-ya	Dipterocarpaceae	LR/lc ver 2.3
20	Shorea siamensis (Kurz) Miq.	In-gyin	Dipterocarpaceae	LR/lc ver 2.3
21	Tadehagi triquetrum (L.)H. Ohashi	Lauk-thay	Fabaceae	LC ver 3.1
22	Tetrameles nudiflora R. Br.	Baing	Datiscaceae	LR/lc ver 2.3
23	Ziziphus jujuba Lam.	Zi	Rhamnaceae	LC ver 3.1

DD=Data Deficient, EN=Endangered, LC=Least Concern, LR/lc=Lower Risk/least concern, NT=Near Threatened, VU=Vulnerable

Table J4 Flora Species identified at the Limestone Concession

S/N	*Scientific Name*	Common Name	Family Name	Habitats
1	*Abelmoschus moschatus*	Taw-yon-pa-de	Malvaceae	S
2	*Acacia catechu Willd.*	Sha	Mimosaceae	T
3	*Acacia pennata (L.) Willd.*	Su-yit	Mimosaceae	Cl/Cr
4	*Achyranthes aspera L.*	Kyet-mauk-su-pyan	Amaranthaceae	H
5	*Acmella calva (DC.) R.K. Jansen*	Pe-le-nyin	Asteraceae	H
6	*Adenostemma viscosum*	Not known	Asteraceae	H
7	*Adina cordifolia Hook. f.*	Hnaw	Rubiaceae	T
8	*Aeginetia pedunculata Wall.*	Kauk-hlaing-di-yaing	Orobanchaceae	H
9	*Aegle marmelos L.*	Ok-shit	Rutaceae	T
10	*Ageratum conyzoides L.*	Khwe-thay-pan	Asteraceae	H
11	*Ajuga lupulina*	Not known	Lamiaceae	H
12	*Alangium chinense (Lour.)Harms.*	Hmaik	Alangiaceae	T
13	*Albizia lebbek (L.)Benth.*	Taung-ko-kko	Mimosaceae	T
14	*Albizia lebbekoides (DC.) Benth.*	Taung-ma-gyi	Mimosaceae	T
15	*Alternanthera sessilis (L.) R.Br.*	Pa-zun-sa-yaing	Amaranthaceae	H
16	*Amaranthus aspera*	Not known	Amaranthaceae	H
17	*Amaranthus gracilis Desf.*	Hin-nu-nwe-yaing	Amaranthaceae	H
18	*Anisomeles indica*	Not known	Lamiaceae	H
19	*Anogeissus acuminata Wall.*	Yon	Combretaceae	T
20	*Anthocephalus morindaefolius Korth.*	Ma-u-let-tan-shae	Rubiaceae	T
21	*Antidesma velutinumTul.*	Kin-pa-lin	Euphorbiaceae	ST
22	*Aporusa dioica (Roxb.) Mull.Arg.*	Thit-khauk	Euphorbiaceae	T
23	*Argyreia nervosa*	Not known	Convolvulaceae	Cl/Cr
24	*Argyreia roxburghii Choisy*	Not known	Convolvulaceae	Cl/Cr
25	*Armillaria mellea (VahlFr.) Kummer.*	Not known	Physalacriaceae	M
26	*Bambusa bambos (L.)Voss*	Kya-khat-wa	Poaceae	B
27	*Bambusa polymorpha Munro*	Kya-thaung-wa	Poaceae	B
28	*Bauhinia malabarica Roxb.*	Pha-lan/Chin-byit	Caesalpiniaceae	T
29	*Bauhinia ornata Kurz*	Myauk-hle-kha	Caesalpiniaceae	Cl/Cr
30	*Bauhinia sp.*	Swe-daw-nwee	Caesalpiniaceae	Cl/Cr
31	*Bidens pilosa*	Hmwe-sok	Asteraceae	H
32	*Blechnum orientale*	Not known	Blechnaceae	F
33	*Bliospermum axillare Blume*	Hnat-cho	Euphorbiaceae	H
34	*Blume balsamifera DC..*	Phon-ma-thein	Asteraceae	S
35	*Blumea balsamifera*	Not known	Asteraceae	H
36	*Boehmeria sp.*	Not known	Urticaceae	S
37	*Bombax anceps Pierre*	Ko-khe	Bombacaceae	T
38	*Bombax ceiba L.*	Let-pan	Bombacaceae	T
39	*Bombax insigne Wall.*	De-du	Bombacaceae	T
40	*Bridelia retusa L.*	Seik-chee	Euphorbiaceae	ST
41	*Buchanania lazan Spreng.*	Lun-pho	Anacardiaceae	T
42	*Buddleja asiatica*	Pon-ma-gyi	Buddlejaceae	S
43	*Butea superba Roxb.*	Pauk-nwee	Fabaceae	Cl/Cr
44	*Caesalpinia decapetala (Roth.)Alston*	Suk-yan-bo /Kyant-sa-su-pin	Caesalpiniaceae	Cl/Cr
45	*Cajanus cajan*	Pe-sin-ngone	Fabaceae	S
46	*Callicarpa arborea Roxb.*	Kyun-na-lin	Verbenaceae	ST
47	*Callicarpa longifolia*	Kun-na-lin-thay	Verbenaceae	ST
48	*Callicarpa nudiflora*	Kyun-na-lin	Verbenaceae	T
49	*Calotropis gigantea*	Ma-yoe	Apocynaceae	S

S/N	*Scientific Name*	Common Name	Family Name	Habitats
50	*Calycopteris floribunda Lam.*	Gyut-nwe	Combretaceae	Cl/Cr
51	*Canscora diffusa (Vahl) R.Br.*	Kyauk-pan	Gentianaceae	H
52	*Careya arborea Roxb.*	Ban-bwe	Lecythidaceae	T
53	*Cassia fistula L.*	Ngu	Caesalpiniaceae	T
54	*Cassia timoriensis DC.*	Not known	Caesalpiniaceae	ST
55	*Cayratia trifolia*	Not known	Vitaceae	CL
56	*Celosia argentea L.*	Taw-kyet-mauk	Amaranthaceae	S
57	*Centratherum punctatum*	Not known	Asteraceae	H
58	*Cephalostachyum pergracile Munro*	Tin-wa	Poaceae	B
59	*Chloris barbata*	Not known	Poaceae	G
60	*Chromolaena odorata (L.) R.M. King & H Robinson*	Bi-zet	Asteraceae	S
61	*Chukrasia velutina Roem.*	Yin-ma	Meliaceae	T
62	*Cissampelos pareira L.*	Not known	Menispermaceae	Cl/Cr
63	*Clematic fasiculiflora L.*	Khwa-nyo	Ranunculaceae	CL
64	*Congea tomentosa Roxb.*	Tha-ma-ga-nwee	Verbenaceae	Cl/Cr
65	*Corchorus aestuans L.*	Byauk-o	Tiliaceae	S
66	*Corchorus capsularis L.*	Gon-shaw/Khwe-la-but	Tiliaceae	S
67	*Crassocephalum crepidioides (Benth.) S. Moor.*	Pan-zauk-htoe	Asteraceae	H
68	*Cratoxylum neriifolium Kurz.*	Be-bya	Hypericaceae	ST
69	*Cratoxylum polyanthumKorth.*	Be-bya	Hypericaceae	ST
70	*Crotalaria mucronata L.*	Taw-paik-san	Fabaceae	S
71	*Crotalaria multiflora L.*	Not known	Fabaceae	H
72	*Croton oblongifolius Roxb.*	Tha-yin-gyi	Euphorbiaceae	ST
73	*Crypteronia pubescens Blume*	A-nan-pho	Crypteroniaceae	T
74	*Cryptolepis buchanani Rome.& Schult*	Na-sha-gyi	Asclepiadaceae	Cl/Cr
75	*Curcuma aurantiaca*	Ma-la	Zingiberaceae	H
76	*Cymbidium aloifolium (L.)Sw.*	Thit-tet-lin-nae	Orchidaceae	E
77	*Dactyloctenium aegyptium*	Lay-gwa-myet	Poaceae	G
78	*Dalbergia cultrata Grah.*	Yin-daik	Fabaceae	T
79	*Dalbergia oliveri Gamble*	Ta-ma-lan	Fabaceae	T
80	*Dalbergia rimosa Roxb.*	Daung-ta-laung	Fabaceae	ST
81	*Dalbergia volubilis Roxb.*	Daung-ta-laung	Fabaceae	ST
82	*Dendrocalamus longispathus (Kurz) Kurz*	Wa-net	Poaceae	B
83	*Dendrocalamus membranaceus Munro*	Hmyin-wa	Poaceae	B
84	*Derris sp.*	Not known	Fabaceae	Cl/Cr
85	*Desmodium heterophyllum (Willd.)DC.*	Not known	Fabaceae	S
86	*Desmodium pulchellum Benth.*	Taung-da-min	Fabaceae	S
87	*Dillenia parviflora Griff*	Kyet-zin-byun	Dilleniaceae	T
88	*Dillenia pentagyna Roxb.*	Zin-byun	Dilleniaceae	T
89	*Dinochloa maclellandii Kurz*	Ba-du-ma-wa/Wa-nwee	Poaceae	B
90	*Dioscorea bulbifera*	Myauk-u	Dioscoreaceae	Cl/Cr
91	*Dioscorea cylindrica Burm.*	Kywe-thon-ywet	Dioscoreaceae	Cl/Cr
92	*Dioscorea pentaphylla L.*	Kywe-ngar-ywet	Dioscoreaceae	Cl/Cr
93	*Dioscorea sativa L.*	Kauk-yin-nwee	Dioscoreaceae	Cl/Cr
94	*Diospyros kika L.f.*	Te	Ebenaceae	T
95	*Dipterocarpus tuberculatus Roxb.*	In	Dipterocarpaceae	T
96	*Duabanga grandiflora*	Myauk-ngo	Lythraceae	T

S/N	*Scientific Name*	Common Name	Family Name	Habitats
97	*Ehretia acuminata R.Br*	Taung-poe-lu-lin	Boraginaceae	T
98	*Elephantopus scaber L.*	Not known	Asteraceae	H
99	*Entada scandens Benth.*	Doe-nwee	Mimosaceae	Cl/Cr
100	*Erythrina stricta Roxb.*	Ka-thit	Fabaceae	T
101	*Euphorbia antiquorum L.*	Tazaung-gyi	Euphorbiaceae	ST
102	*Euphorbia hypericifolia L.*	Kywe-kyaung-hmin-se	Euphorbiaceae	H
103	*Evolvulus nummularius L.*	Kyauk-kwe	Convolvulaceae	Cl/Cr
104	*Ficus hispida L.*	Kha-aung	Moraceae	ST
105	*Ficus lacor Buch.-Ham.*	Nyaung-gyin	Moraceae	T
106	*Ficus microcarpa*	Not known	Moraceae	S
107	*Ficus obtusifolia Roxb.*	Nyaung-gyat	Moraceae	T
108	*Flacourtia cataphracta Roxb.*	Na-ywe	Flacourtiaceae	T
109	*Flemingia congesta Roxb.*	Kye-hmi	Fabaceae	S
110	*Gardenia coronaria Buch.-Ham.*	Yin-gat-gyi	Rubiaceae	T
111	*Getonia floribunda Roxb.*	Kywet-nwee	Combretaceae	Cl/Cr
112	*Glochidion sp.*	Hta-min-sok	Euphorbiaceae	ST
113	*Goniothalamus laoticus*	Not known	Annonaceae	ST
114	*Grewia laevigata Vahl*	Kyet-ta-yaw	Tiliaceae	ST
115	*Harrisonia perforata Merr.*	Su-gyin	Simaroubaceae	S
116	*Hemigraphis brunelloides (Lam.) Bremek.*	Not known	Acanthaceae	S
117	*Hibiscus macrophyllus*	Taung-phet-wun	Malvaceae	T
118	*Hiptage benghalensis (L.) Kurz*	Bein-new	Malpighiaceae	ST
119	*Holarrhena pubescens Wall. ex G. Don*	Let-htok-gyi	Apocynaceae	ST
120	*Homalium tomentosum Benth*	Myauk-chaw	Flacourtiaceae	T
121	*Homonoia riparia*	Ye-mo-ma-kha	Euphorbiaceae	S
122	*Ipomoea quamoclit L.*	Myet-lay-ni	Convolvulaceae	Cl/Cr
123	*Justicia procumbensL.*	Not known	Acanthaceae	S
124	*Justicia sp.(1)*	Not known	Acanthaceae	H
125	*Justicia sp.(2)*	Not known	Acanthaceae	S
126	*Kleinhovia hospita L.*	O-tein/Pashu-phet-wun	Sterculiaceae	T
127	*Lagerstroemia parviflora Roxb.*	Zaung-pa-lae	Lythraceae	T
128	*Lagerstroemia speciosa (L.) Pers.*	Pyin-ma	Lythraceae	T
129	*Lagerstroemia tomentosa Presl.*	Le-sa	Lythraceae	T
130	*Lannea coromandelica (Houtt.) Merrr.*	Na-be	Anacardiaceae	T
131	*Lathyrus latifolius*	Not known	Fabaceae	S
132	*Leea hirta Banks*	Naga-mauk-phyu	Leeaceae	S
133	*Leea rubra Blume.*	Naga-mauk-ni	Leeaceae	S
134	*Lepidagathis semiherbacea (Clarke) Nees*	Not known	Acanthaceae	H
135	*Leptadenia reticulata Wight & Arn.*	Gon-kha	Asclepiadaceae	Cl/Cr
136	*Leucaena leucocephala (Lam.) De.Wit*	Baw-za-gaing	Mimosaceae	ST
137	*Lindenbergia philippensis Benth.*	Not known	Scrophulariaceae	H
138	*Lindenbergia urticaefolia Lehm.*	Not known	Scrophulariaceae	H
139	*Loranthus pulverulentus Wall.*	Kyi-paung	Loranthaceae	E
140	*Ludwigia hyssopifolia*	Lay-nyin-thay	Onagraceae	H
141	*Ludwigia octovalvis*	Lay-nyin-gyi	Onagraceae	H
142	*Luffa aegyptiaca Mill.*	Tha-but-kha	Cucurbitaceae	Cl/Cr
143	*Mangifera sylvatica Roxb.*	Taung-tha-yet	Anacardiaceae	T
144	*Markhamia stipulata (Wall.) Seem.ex K.Schum.*	Ma-hlwa	Bignoniaceae	ST

S/N	*Scientific Name*	Common Name	Family Name	Habitats
145	*Melanorrhoea usitata Wall.*	Sit-se	Anacardiaceae	T
146	*Merremia hederacea Hallier f.*	Nwe-shoke	Convolvulaceae	Cl/Cr
147	*Merremia vitifolia (Burm.f.) Hallier. f.*	Kyet-hinga-lae-new	Convolvulaceae	Cl/Cr
148	*Microcos paniculata L.*	Mya-ya	Meliaceae	ST
149	*Millettia extensa Benth.*	Win-u	Fabaceae	Cl/Cr
150	*Millettia ovalifolia Kurz*	Thin-win	Fabaceae	T
151	*Mimosa pudica L.*	Hti-ka-yone	Mimosaceae	H
152	*Mitragyna rotundifolia (Roxb.) Kuntze*	Bin-ga	Rubiaceae	T
153	*Moghania macrophylla Runtze*	Not known	Fabaceae	S
154	*Morinda tinctoria Roxb.*	Ni-ba-sae	Rubiaceae	S
155	*Mucuna pruriens (L.)DC.*	Khwe-lae-ya	Fabaceae	Cl/Cr
156	*Musa sp.*	Taw-nga-pyaw	Musaceae	H
157	*Nauclea orientalis L.*	Ma-u	Rubiaceae	T
158	*Operculina turpethum (L.) Silva Mansa*	Kyar-hin-nwe	Convolvulaceae	Cl/Cr
159	*Oroxylum indicum (L.) Kurz.*	Kyaung-sha	Bignoniaceae	ST
160	*Oxalis corniculata L.*	Hmo-chin	Oxalidaceae	H
161	*Paederia foetida L.*	Pe-bok-nwee	Rubiaceae	CL
162	*Pennisetum purpureum Schum.*	Yon-sa-myet	Poaceae	G
163	*Phyllanthus albizzioides (Kurz)Hook.f.*	Shit-sha	Euphorbiaceae	T
164	*Phyllanthus emblica L.*	Zi-phyu	Euphorbiaceae	ST
165	*Polygonum chinense L.*	Maha-gar-kyan-sit	Polygonaceae	H
166	*Potamogeton natans L.*	Floating-leaf Pondweed	Potamogetonaceae	Aq
167	*Prema pyramidata Wall.*	Kyun-na-lin/Kyun-pho	Verbenaceae	T
168	*Pteris vittata*	Brake Fern	Pteridaceae	F
169	*Pterocarpus indicusWilld.*	Taw-pa-dauk	Fabaceae	T
170	*Pterospermum semisagittatum Buch.-Ham.*	Na-gye	Sterculiaceae	T
171	*Pueraria lobata var. montana*	Not known	Fabaceae	CL
172	*Salvia regla*	Not known	Lamiaceae	S
173	*Salvia sp.*	Not known	Lamiaceae	S
174	*Salvia splendensKer Gawl.*	Not known	Lamiaceae	H
175	*Samadera indica Gaertn.*	Ka-di	Simaroubaceae	ST
176	*Schleichera oleosa (Lour.) Oken*	Gyo	Sapindaceae	T
177	*Scoparia dulcis L.*	Dana-thu-kha	Scrophulariaceae	H
178	*Senna hirsuta (L.) Irwin & Barneby*	Ka-thaw-hmwe-htu	Caesalpiniaceae	S
179	*Senna timoriensis (DC.)(DC.) H. S. Irwin & Barneby*	Taw-ma-zeli	Caesalpiniaceae	T
180	*Senna tora (L.) Roxb*	Dan-gwe	Caesalpiniaceae	S
181	*Sesbania paludosa Roxb.*	Nyan	Fabaceae	S
182	*Setaria lutescens Hubb.*	Yon-sa	Poaceae	G
183	*Shorea obtusa Wall.*	Thit-ya	Dipterocarpaceae	T
184	*Shorea siamensis (Kurz) Miq.*	In-gyin	Dipterocarpaceae	T
185	*Sida acuta Burm f.*	Ta-byet-si	Malvaceae	S
186	*Smilax aspericaulis Wall ex A. D.C.*	Sein-na-baw-thay	Smilaceae	CL
187	*Smilax macrophylla Roxb.*	Sein-na-baw-gyi	Smilaceae	CL
188	*Spermacoce mauritiana*	Not known	Rubiaceae	H
189	*Spondias pinnata (L. f.) Kurz.*	Taw-gwe	Anacardiaceae	T
190	*Sterculia foetida L.*	Let-khok	Sterculiaceae	T
191	*Sterculia ornata Wall. ex Kurz*	Don-shaw	Sterculiaceae	T
192	*Sterculia versicolor Wall.*	Shaw-phyu	Sterculiaceae	T

S/N	*Scientific Name*	Common Name	Family Name	Habitats
193	*Stereospermum colais (Buch.-Ham. ex Dillwyn) Mabb.*	Than-thay	Bignoniaceae	T
194	*Stereospermum suaveolens (Roxb.) DC.*	Kywe-ma-gyo-lein	Bignoniaceae	T
195	*Strobilanthes auriculata*	Not known	Acanthaceae	S
196	*Strobilanthes rufescens T. Anders.*	Not known	Acanthaceae	H
197	*Strychnos nux-blanda A.W. Hill*	Ka-baung	Loganiaceae	ST
198	*Tadehagi triquetrum (L.)H. Ohashi*	Lauk-thay	Fabaceae	S
199	*Tectona grandis L. f.*	Kyun	Verbenaceae	T
200	*Terminalia alata (Heyne) Roth*	Htauk-kyant	Combretaceae	T
201	*Terminalia pyrifolia Kurz*	Lein-pin	Combretaceae	T
202	*Tetrameles nudiflora R. Br.*	Baing	Datiscaceae	T

Aq=Aquatic, B=Bamboo, CL=Climber, Cl/Cr=Climber/Creeper, E=Epiphyte, F=Fern, G=Grass, H=Herbs, M=Mushroom, S=Shrubs, ST=Small Tree, T=Tree

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Annex F

Waste Management Plan

SHWE TAUNG CEMENT CO.,LTD.	Waste Management Procedure		EHSS-SOP-XXX
	Revision	Effective Date	**EHSS Department**
	XX-XX-2017	XX-XX-2017	

Change History		
Rev #	**Description of Change**	**Paragraph**
01	Initial Release	All

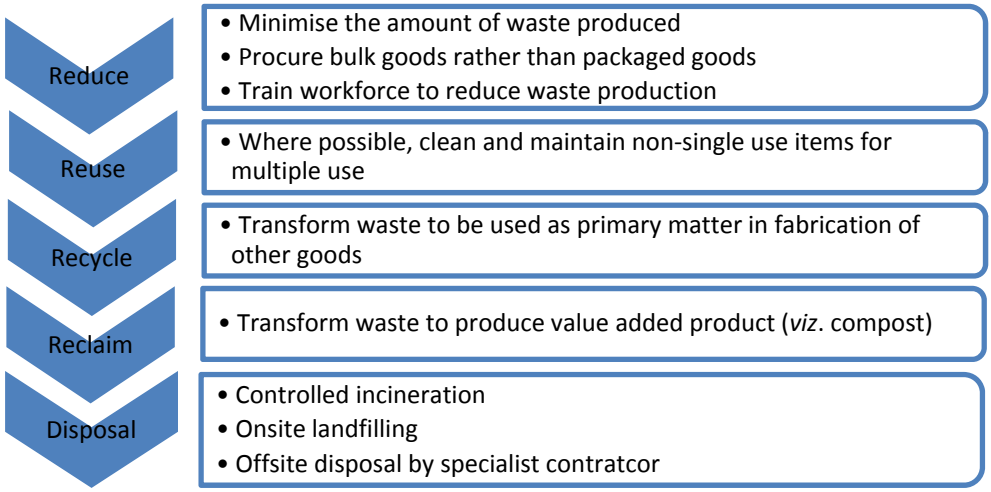
Prepared by		
Name	**Designation**	**Signature**
	EHSS Head	
Verified by		
Name	**Designation**	**Signature**
	Head of Cement / Head of Concrete	
Approved by		
Name	**Designation**	**Signature**
	Shwe Taung Building Materials CEO	

1 Purpose

This document is the Waste Management Procedure of Shwe Taung Building Materials' entities (ST): Shwe Taung Cement Co. Ltd (STC), Shwe Taung Mining Company (STM) and High Tech Concrete Company (HTC). This Waste Management Procedure incorporates the recommendations of the 2017 Supplementary Environmental and Social Impact Assessment process of STC, and in particular of its Environmental and Social Management Plan with respect to waste management good practices.

ST aims to adhere to the principles of the waste hierarchy favouring waste reduction over reuse, recycling over energy recovery and disposal as a last resort (the "4Rs") as follows, from the most preferred option (at the top) to the least preferred option (at the bottom):

Figure.1 The Waste Hierarchy (the "4Rs")



The purpose of this document is to provide workers, employees, contractors and, generally, anyone generating, handling, collecting and managing waste at any of Shwe Taung Building Materials' facilities and/or wastes generated from Shwe Taung Building Materials' activities with general guidance on responsible waste management.

The overall objective of responsible waste management is to avoid or, when avoidance is not feasible, minimise, reuse and recycle waste when it is generated, handled, collected (i.e. sorted) for transfer to collection points where it should be treated, recycled or disposed of in a manner that protects ST's workforce (own and contractors), as well as surrounding communities and natural environment. This objective can be achieved through the following plans:

- ST will comply with the local regulations;
- ST will align with the good practice requirements set out in the International Finance Corporation (IFC) Performance Standards and World Bank Environmental, Health and Safety Guidelines;
- ST will identify and monitor the anticipated waste streams generated from its construction and operational activities on an ongoing basis;

- ST will categorise the waste streams in accordance with the local regulations and international best practices (ref Section 5.1.1 of this procedure) based on the waste characteristics and practicable waste handling, treatment and disposal methods;
- ST will apply to each waste stream the principles of the waste hierarchy in the most responsible manner (reduce, reuse, recycle, reclaim, dispose);
- ST will adopt responsible methods for collection, storage, transportation and treatment/disposal of all waste streams;
- ST will be responsible for implementing this procedure; and
- ST will put in place mechanisms (in terms of procedures, logistics, budget, training, communication) to ensure continuous monitoring, verification and improvement are carried out throughout the lifetime of ST's activities to enable responsible management practices.

The construction, expansion, operation, decommissioning and closure phases of STC will, in particular, result in several waste streams that have the potential to impact on the environment. This procedure provides guidelines on waste reduction, segregation, collection and disposal practices that avoid impacts on the physical, biophysical and social environments and that is in accordance with both international (IFC) and national (Myanmar) requirements and good practices. This procedure aligns with ST's Code of Conduct and policies.

This procedure will be reviewed regularly and revised as ST's activities and the local context on certain waste disposal routes change. This will allow the information contained herein to be improved to the benefit of ST's activities, stakeholders and surrounding environment as a whole. Responsibility for the revision and update of this document is assigned below.

2 Scope

This procedure is applicable for any type of waste entering ST's premises (at the cement plant and the quarries in Pyi Nyaung, at the coal mine in Paluzawa, at the Mandalay and Yangon offices, at HTC's batching plants, etc.) or generated by ST's activities and that will be handled, stored, collected, transported and then disposed of inside and outside ST's premises.

ST employees, contractors and visitors to ST's premises shall comply with the requirements of this Procedure.

3 Definitions and Abbreviations

CEO	The Chief Executive Officer of Shwe Taung Building Materials' entities
FOM	Form
Environmental Manager	Person-in-charge of environmental aspects
EPC Contractor	Engineering, Procurement and Construction company responsible for the design, procurement, construction, commissioning and handover of the expansion project (second clinker and cement line) at STC; the EPC Contractor must appoint a health and safety

	manager (HS EPC Manager) and a manager responsible for the expansion project (Project EPC Manager)
Head of Cement Business	Person-in-charge of STC and STM
Head of Concrete Business	Person-in-charge of HTC
EHSS	Environmental, Health, Safety and Social
EHSS Head	Environmental, Health, Safety and Social Department Head
HS Manager	Health and Safety Manager or person-in-charge of Health and Safety matters
HTC	High Tech Concrete Company
OHS	Occupational, Health and Safety
Social Manager	Person-in-charge of social aspects or social accountability manager
SOP	Standard Operating Procedure
ST	Shwe Taung Building Materials' entities i.e. STC, STM and HTC and their associated facilities and assets
STC	Shwe Tang Cement Co., Ltd.
STC Plant Operation Manager	Person-in-charge of the operations at STC (first clinker and cement line) and of the expansion project at STC (second clinker and cement line) until it is commissioned and incorporated in the operations at STC
STM	Shwe Taung Mining Company
WIS	Working Instruction
Hazardous Waste	Waste that shares the properties of a hazardous material (flammable, corrosive, reactive, toxic or radioactive) and has a high degree of hazard for public health and the environment. Hazardous waste includes materials which are flammable, corrosive, reactive, toxic or radioactive. A substance is defined as hazardous depending on its physical and chemical properties as well as applicable regulations and international good practices. For instance, all recovered spills from industrial hazardous material are hazardous waste and cannot be disposed of directly to landfill.
Inert Waste	Waste that does not undergo significant biological, physical or chemical transformations. It will not dissolve, burn or react physically or chemically with other substances in such a way so as to negatively impact on the environment or human health.
Non-hazardous Waste	Waste which is not hazardous; and which can be recycled, composted, incinerated, disposed or is inert.
ST's premises	ST's premises are defined as ST's premises, sites and facilities including the cement plant (including ancillary facilities, the cement plant expansion, the mudstone and limestone quarries) located in Thazi township of Mandalay region (STC), the coal mine located in the Kalaywa township of the Sagaing region (STM), HTC's premises

	and facilities in Myanmar as well as STC's, STM's and HTC's offices and head offices in Mandalay and Yangon.
Waste	Waste is a solid, liquid or contained gaseous material that is no longer needed for its originally intended purpose within the company; it includes material to be recycled and reclaimed. Waste is typically defined as a material or product that is discarded and no longer used for its original purpose. Solid waste generally includes any garbage, refuse. Examples of such waste include domestic trash and garbage, inert construction / demolition materials, refuse such as metal scraps and empty containers (except those previously used to contain hazardous materials which should be managed as hazardous waste) and residual waste form industrial operations such as boiler slag, clinker and fly ash.
Waste Classification	For the purposes of this procedure, waste will be classified as either hazardous or non-hazardous.
Waste Management	Action of keeping the working environment clear of all waste and unnecessary materials.
Waste Types	Apart from the two main classes of waste, waste may be grouped into different types based on its chemical makeup, composition or constituent parts, e.g. medical, glass, metal, plastics, paper, organic. Different types of waste can be re-used or recycled to varying degrees of efficacy. Typically different hazardous properties have threshold values above which the waste within which they are contained is deemed to be hazardous.

4 Responsibility and Authority

4.1 **CEO**

CEO shall be responsible in overseeing that this Procedure is implemented throughout ST operations. CEO shall endorse this Procedure and have overall accountability for its management.

CEO shall be responsible to ensure that wastes are managed in such a way as to protect the workforce and prevent and control impacts to the communities and the environment.

CEO shall enable and regularly check that this Procedure is implemented and regularly reviewed, including through the ongoing work of ST's audit function unit.

4.2 **Managers and Executives**

Managers and Executives shall be responsible for ensuring good housekeeping practices and regularly checking that wastes are managed in such a way as to protect the workforce as well as prevent and control impacts to the communities and the environment. Managers and Executives should also plan and ensure adequate resources and facilities required are provided for the execution of this procedure, in collaboration with other departments or units as relevant.

Managers and Executives shall be responsible for ensuring waste management is carried out in accordance with this procedure during construction and operations and for promoting a culture of responsible waste management in the operations of site staff.

4.3 **EHSS Head**

EHSS Head is the person-in-charge of the EHSS Department.
EHSS Head shall ensure this Procedure is undertaken as required and coordinate support to the Environmental Manager when needed for this Procedure to be applied.

EHSS Head shall have accountability for the following:

- Handle waste management issues;
- Delegate waste handling responsibilities; and
- Review waste-related reports and statistics.

EHSS Head shall also ensure that this Procedure aligns with the other plans and procedures developed by ST. EHSS Head shall facilitate communication between the various ST employees, ST Divisions and departments, the EHSS Managers and Executives and the Maintenance Team.

4.4 **Environmental Manager**

Environmental Manager shall provide adequate support to workers, employees, contractors working at ST's premises in the implementation of this procedure to enable responsible waste management practices throughout ST.

Environmental Manager shall be responsible for determining appropriate waste management methods for different waste streams from ST activities and liaise with the EHSS Head, EHSS Committee, Managers and Executives, EPC Contractor and other Contractors in implementing this procedure.

Environmental Manager shall be responsible for administering waste management training to staff and contractors including induction and ongoing training as well as ongoing communication to ST workers, employees and contractors, for authoring reports related to waste management, for overseeing waste management annual reporting, for liaising with EPC Contractor and other Contractors on waste management issues, for scheduling and executing inspections related to waste management, for maintaining a waste inventory for ST detailing all waste management movements off site and for undertaking regular 3rd party audits of waste management facilities used by ST to ensure regulatory and good international practices compliance.

Environmental Manager shall be responsible for supporting Maintenance Team to enable there is enough and adequate waste collection points on site and to liaise with the engineering and design teams to design and maintain suitable facilities for hazardous and non-hazardous waste storage and handling.

4.5 **EHSS Committee**

The EHSS Committee gathers the EHSS Head, HS Manager, Environmental Manager, Social Manager, CLO, Head of Cement / Head of Concrete, STC Plant Operation Manager (who is also in charge of the expansion project), representatives from the EPC Contractor (the HS EPC Manager and the Project EPC Manager), is chaired by the Head of Cement / Head of Concrete and is managed by a secretary (the HS Manager).

EHSS Committee shall follow, enable and check every six months during the monthly EHSS Committee Meetings that the Environmental Manager enables this Procedure, advise when needed and for any incident/ accident/ deviation to the Procedure that occurs, corrective actions are taken and lessons shared.

4.6 **Maintenance Team**

Maintenance Team shall be responsible for negotiating appropriate contract terms with suitable waste collectors and waste disposal entities to safeguard ST and ensure regulatory and international good practices compliance.

Maintenance Team shall be responsible for supporting the Procurement Team to negotiate supply contracts for oils, lubricants and any other material that will produce hazardous wastes which include takeback agreements for the disposal of any hazardous residues to the extent possible.

Maintenance Team shall be responsible for liaising with the Environmental Manager, the engineering and design teams to design, construct and maintain suitable facilities for hazardous and non-hazardous waste storage, handling and disposal on site.

Maintenance Team shall be responsible for designing, building and managing in accordance with good international practices a sanitary landfill close to STC's activities. In particular, such landfill should be constructed with environmental protection systems and properly secured. A liner system should be installed at the bottom, as an impenetrable barrier between soil and groundwater and what is disposed of in the landfill, and made of clay and synthetic material. In the absence of such liner, only inert (i.e. non-active) waste should be disposed of in the landfill. Waste disposed of at such landfill should be covered daily with soil so as to isolate it from the surrounding environment (groundwater, air, rain) and keep it dry.

Maintenance Team shall be responsible for providing sufficient and appropriate waste handling receptacles, will supervise the cleaning team which will collect waste on-site and will support the cleaning team and the gardening team in the establishment of composting systems.

Maintenance Team shall be responsible for storing and labelling hazardous waste and non-hazardous waste in accordance with ST's procedures and for providing the appropriate containers, labelling and storage capacities for hazardous waste.

4.7 **EPC Contractor and other Contractors (or Contractors)**

ST's EPC Contractor and ST's other Contractors, and their sub-contractors, are responsible for ensuring this Procedure and its requirements are communicated to their staff and for ensuring their staff follow them as relevant.

For instance, where relevant, ST shall communicate and work with its EPC Contractor or other Contractors to implement corrective actions that are relevant to them. The EPC Contractor or other Contractors must participate.

4.8 **HS Manager**

HS Manager shall support the Environmental Manager in implementing this Procedure and thus shall, in particular, support the Environmental Manager in identifying and purchasing appropriate PPE for uses at site (with the support of the Purchasing Team) and assessing the conditions of the PPEs used and replacing them as needed.

4.9 **All Persons**

All persons employed by ST, directly or indirectly, have a responsibility to be familiar with the requirements of this procedure and to ensure it is carried out in full with regards to their day to day work. All persons are responsible for taking ownership of any waste management issues observed in their day to day work highlighting any non-compliance to the Environmental Manager.

4.10 **Audit Function Unit**

ST's audit function unit, under ST's CEO, is responsible for, on a regular basis, auditing that this document is implemented and for providing post-audit recommendations to be communicated to the EHSS Committee.

5 Procedure

5.1 Waste Generation

5.1.1 Type of Waste

Key waste streams that can be generated at ST's premises are summarised in Table 5.1.1. (non-hazardous wastes) and Table 5.1.2 (hazardous wastes)

Table 5.5.1 Non-Hazardous Waste Streams at ST's Premises

Waste Type	Generation Source
Food Waste, Organic Waste	Canteen
Used Cooking Oil	Canteen
Other Domestic Waste	All
Paper, Cardboard	Office, Canteen, Medical Centre

Metal Tins	Canteen, Process
Scrap Metal	Construction
Plastic Containers, Plastic Bottles	All
Printer and Toner Cartridges	Office, Medical Centre
Glass	Canteen, Process
Air Conditioning Filters	All
Sodium Light Bulbs	All
Fly Ash, Kiln Dust	Cement Clinker
Wood	All
Inert Material	Process, Quarries, Construction
Soil, Spoil Rocks, Topsoil	Construction, Maintenance
Sewage (Grey Water – Domestic)	All

Table 5.5.2 Hazardous Waste Streams at ST's Premises

Waste Type	**Generation Source**
Oil, Oily Rags, Oil Materials, Lubricants, Oil-Contaminated Solids, Oily waters	All
Batteries (Lead Acid, Nickel Cadmium)	All
Aerosol Cans (Empty)	Process
Empty Chemical Drums	Laboratory, Process
Paint Cans/Drums, Brushes, etc	All
Solvents	All
Medical Waste, Expired Medication	Medical Centre
Fluorescent Light Bulbs	All
Filters (Fuel / Diesel Oil) - Instrumentation	Heavy Mechanical Equipment, Fuel Storage, Petrol Station

Waste Type	Generation Source
Tank / Silo / Process Washings	Process
Electrical and Electronic Equipment	All

5.1.2 **Minimising Waste Generation**

Waste should be minimized at source by All Persons with support from ST's procedures, logistics, training, communication:

- Drinkable water sources should be installed throughout the ST premises to minimise the purchase of one way drink plastic bottles (single use), which remains difficult to recycle.
- A composting system should be put in place to treat biodegradable food wastes and gardening wastes by the Maintenance Team (and gardening team) with location of compost heaps / boxes (designed in such a way as to prevent rodents) near canteens and staff housing.
- Implement ongoing promotion campaigns championed by CEO, Head of Cement / Head of Concrete and EHSS Head to encourage workers, employees and contractors to implement responsible waste management practices. The campaigns should be renewed from time to time.
- Organise clean-up days on-site every 6 to 12 months .

5.2 General Waste Management Operations Guidance

5.2.1 Waste Handling

All Persons, Managers and Executives, EPC Contractor and other Contractors are responsible for ongoing responsible housekeeping practices for waste handling. These include avoiding over-ordering, poor storage and maintenance, mishandling or improper operation procedures. This will reduce waste that can be generated at ST's premises.

Waste segregation should be practiced at ST's premises. Waste segregation will help with reducing, reusing and recycling the different waste streams. The Environmental Manager should ensure that all workers, employees and contractors are well trained and provided enough information to recognise the types of waste being generated at ST's premises and to ensure they are being handled and sorted out in accordance with good international practices. The Environmental Manager should also ensure ongoing communication on responsible waste handling practices (e.g. posters in canteens, staff housing, offices, laboratory, etc.).

Once segregated, and when not contaminated, recyclable waste has a higher market value.

5.2.2 **Storage**

Maintenance Team, with the support of the Environmental Manager, is responsible for good housekeeping practices for waste storage. These include separating non-hazardous waste into reusable items and materials to be disposed of or recycled whenever possible. Waste suitable for reuse will be stored on site and reintroduced to the construction or operation processes as and when required. Recyclables such as scrap steel, metals, plastics, and paper items will be collected for recycling wherever possible.

Organic and food waste should be:

- composted (in such a way as to prevent rodents) and used on-site by the Maintenance Team, supported by the cleaning team and gardening team, for the plantation, landscaping and gardening; or
- collected for offsite use as animal feed.

Waste should be stored in clearly labelled containers / skips. Colour coded receptacles labels should clearly state the waste types in languages that are understandable to the workforce and any coding system that is used should also be presented on the labels.

Containers should be allocated depending on the waste type. Light weight waste articles such as light plastics or paper / cardboard should be stored in enclosed skips and should be kept securely closed at all times to prevent such waste from flying around and clogging stormwater and wastewater systems or rivers.

For liquid wastes, all containers should be provided with secondary containments. Each containment capacity should be at least 110% in volume of the largest stored container. Extreme conditions due to climatic factors, such as risks or seasons of heavy rains or strong winds, should be considered.

Waste receptacles should be installed at key areas of ST's premises on higher grounds or poles. Waste receptacles should be placed on impermeable surfaces to prevent the contamination of ground conditions in the case of an accidental release, such as on paved areas not prone to flooding.

Suitable storage for the main waste streams (general waste, wood, cardboard, metals, plastics and oil contaminated solids) should be set up at each of the canteens, staff housing areas and main offices to facilitate waste segregation.

Wastewater, oily waters from waste/oil separators and potentially hazardous waste should be stored in such a way as to avoid contaminating surface and groundwater sources (i.e. in a paved area not prone to flooding) and with cutoff drains diverted to sedimentation basin before discharged. Such type of waste should be collected regularly and either filtered and monitored before on-site or offsite release or treatment at a suitable facility.

5.2.3 **Waste Transport**

Waste should be collected regularly by reputable waste collectors that should be identified and managed in accordance with the Supply Chain Screening Procedure and Contractor Management Procedure.

Disposal routes (transport options and disposal sites) will be pre-identified for all wastes generated at ST's premises.

Waste should be transported from source to waste management facilities and/or final disposal sites (managed in accordance with good international standards), in the most appropriate manner, taking the following into account:

- The nature, composition and integrity of transport packaging and containers will be appropriate to the type and class of waste being transported;
- Transport vehicles will cater for the type, class and quantity of waste being transported in terms of its composition, load capacity, covering etc.;
- Transport will be scheduled according to the weather / weather forecasts to prevent potential accidental releases to the natural environment, for instance in case of heavy rains or winds;
- Loading and unloading procedures that avoid spills and releases will be followed;
- Employees will be trained to address accidental releases of hazardous wastes and related emergencies;
- All transport vehicles will be equipped with suitable materials or equipment to contain, manage and remove accidental spillages;
- Vehicles carrying hazardous wastes shall be labelled appropriately.
- Waste must NOT be scattered in heaps onsite nor burned onsite or offsite (unless in an incinerator run in accordance with international good practices).

5.2.4 **Waste Disposal**

Waste disposal vendors or waste disposal facilities will be identified, with priority given to the closest facilities that are being operated in accordance with referenced standards (including Myanmar regulations and IFC guidelines). Waste disposal vendors or facilities will be regularly audited by the Environmental Manager and their activities related to waste generated at ST's premises will be recorded and monitored. If suitable waste disposal sites are not available in the locale of ST's premises then this waste should be transported back to Mandalay where more suitable recycling, treatment and disposal facilities are available or treated on-site in one or more sanitary landfills to be designed, built and managed in accordance with good international practices and on ST's own areas or close to STC's activities, as agreed with the relevant authorities. In particular, such landfill should be constructed with environmental protection systems and properly secured. A liner system should be installed at the bottom, as an impenetrable barrier between soil and groundwater and what is disposed of in the landfill, and made of clay and synthetic material. In the absence of such liner, only inert (i.e. non-active) waste should be disposed of in the landfill.

Waste disposed of at such landfill should be covered daily with soil so as to isolate it from the surrounding environment (groundwater, air, rain) and keep it dry.

Wastes with monetary values are likely to be collected by the local recycling market and proper segregation, none contamination, containment of sharp objects, will help protect the waste handlers.

Waste suitable for use as fuel can be considered as an alternative to coal. Plastics crushed in pellets and tyres are typical examples of waste that are used in cement production as fuel[1]. Other refuse derived fuels (such as oily rags) are also used in cement production globally providing they meet the required calorific value for the process. Additional air pollution controls may be needed when burning wastes as fuel.

Disposal of construction waste on or off the construction site should be prohibited unless they are to be reused safely. Process residues such as fly ash which are recycled in the process are not considered construction wastes.

5.2.5 Design and Emergency Preparedness

It is recommended that all waste management locations throughout ST's premises have measure in place in case of accidental release of waste in accordance with the Emergency Response Procedure. Each location should have ready access to:

- Spill kits;
- Absorbents;
- Firefighting equipment;
- Cleaning equipment.

5.3 General Hazardous Waste Management Operations Guidance

Hazardous waste should be handled, stored, transported and disposed of as per the non-hazardous waste guidance described under *Section 5.1* as well as in accordance with the Storage and Handling of Hazardous Material Procedure.

Hazardous waste should be stored in such a way as to prevent and control accidental release to the environment (e.g. secondary containment, sealed containers, paved areas, proper drainage systems, oil/water separator), in a dedicated enclosed paved area not prone to flooding.

The reuse of containers by scavengers is a possibility. It is suggested that prior to discarding any hazardous waste container that such containers be pierced to prevent reuse that could cause health impacts and/ or environmental contamination.

[1] http://www.alf-cemind.com/cd/AF_and_ARM_used_tires.htm; http://www.letsrecycle.com/news/latest-news/lafarge-to-increase-waste-tyre-fuel-input-by-over-60/; http://www.cemex.co.uk/fuel-from-tyres.aspx

5.4 Specific Non-Hazardous Waste Management Operations Guidance

5.4.1 Soil/ Spoil Rocks/ Kiln Dust

Soil, spoil rocks and kiln dusts will be stored on site in stockpiles and reuse for reinstatement as per a soil plan to be drawn and kept updated by the Maintenance Team.

5.4.2 Domestic Waste

Organic and food solid waste will be segregated and stored in standard general waste containers, to prevent odours and public health hazards, and composted onsite for organic and food waste or disposed of onsite or offsite in a suitable sanitary landfill or by a suitable waste contractor (food waste can be used as animal feed in the locale of the site).

Domestic waste will be segregated to the extent possible and stored in enclosed containers and / or dedicated enclosed skips for general waste. Containers will be clearly labelled "General Waste".

Domestic waste resulting from general rubbish, industrial (non-hazardous), glass, paper, plastics and related materials will be collected for recycling or disposed of at suitable facilities or landfills that are run in accordance with good international practices.

Domestic waste quantities can be monitored by Maintenance Team / cleaning team supporting Managers and Executives or tracked through waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.4.3 Recyclables

Recyclables include:

- glass;
- aluminum cans;
- plastic bottles, welding rods, paper;
- printer cartridges;
- packaging material;
- cardboard;

Receptacles should be provided throughout ST's premises for main recyclables i.e. plastics, metals, wood, cardboard, other. These should be clearly labelled describing the wastes to be targeted in languages corresponding to the needs of the workforce with photos or images encouraging non-contamination. Recyclables should be prepared for the local recycling markets or for export.

Metals will be stored in open skips. Paper and cardboard will be stored in enclosed skips located at strategic locations throughout ST's premises (near the offices and facilities generating substantial cardboard waste). Plastic bottles will be collected and stored in enclosed skips and dedicated containers throughout ST's premises. Clear signage should be provided at each location describing the wastes that are to be targeted for recycling. These

signs should be multilingual commensurate with the needs of the workforce with photos or images encouraging non-contamination. Baled or suitably aggregated recycling products will be stored in a dedicated storage area prior to collection for recycling in country or for export.

Recyclable quantities can be monitored by Maintenance Team / cleaning team supporting Managers and Executives or tracked through waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.4.4 **Scrap metals**

Scrap metals will be collected separately and stored securely on site. Their value may create a security issue and this should be addressed through security measures such as lockable areas and a robust mechanism for transferring waste off ST's premises.

Scrap metal will be stored in open skips. Scrap metal containers will be clearly labelled describing their contents in languages corresponding to the needs of the workforce with photos or images encouraging non-contamination. Scrap metals should be prepared for the local recycling markets or for export, by cutting or tidying them up.

Scrap metal quantities can be monitored by Maintenance Team / cleaning team supporting Managers and Executives or tracked through waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.4.5 **Wood**

Wood pallets should, wherever possible, be reused on site until such time as they are no longer suitable for reuse (i.e. damaged). The most common application will be for the storage of waste drums and / or recyclables baled at ST's premises prior to onward transportation.

Wood waste can also be used through ST's premises, for landscaping or reinforcing soil areas to prevent erosion and runoff (as sedimentation control mitigating factor). Wood waste that cannot be recycled onsite may be marketable locally as a fuel. If all other avenues for recycling have been exhausted wood waste should be disposed of in onsite or nearby landfills that are run in accordance with good international practices.

Wood will be stored in open skips clearly labelled describing their contents in languages corresponding to the needs of the workforce with photos or images encouraging non-contamination. Pallets will be stockpiled for reuse. Wood should be prepared for onsite reuse or for the local recycling markets, by cutting or tidying it up.

Wood quantities sent to landfill can be monitored by Maintenance Team / cleaning team supporting Managers and Executives or tracked through waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.4.6 Concrete

Waste concrete or concrete overspill should be allowed to dry prior to being transported to a nearby landfill that is run in accordance with good international practices.

Waste concrete or concrete overspill will be stored in open skips with clear signage. These signs should be multilingual commensurate with the needs of the workforce with photos or images encouraging non-contamination.

Waste concrete or concrete overspill quantities sent to landfill can be monitored by Maintenance Team / cleaning team supporting Managers and Executives or tracked through waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.5 Specific Hazardous Waste Management Operations Guidance

5.5.1 Duty of Care

STC has a duty of care to ensure that appropriate disposal of hazardous waste streams takes place. Maintenance Team will retain copies of all records of disposal at ST's premises or off-site for the purpose of audit. The Environmental Manager will periodically spot check the hazardous waste disposal process on site and off site to audit it is implemented in accordance with the Supply Chain Screening Procedure and the Contractor Management Procedure. Accountability for hazardous waste remains with ST.

For all its hazardous wastes, ST should enter into hazardous waste collection and disposal contracts with the hazardous waste management company Dowa in Thilawa and then with the closer hazardous waste management company due to be built and operated in Mandalay.

5.5.2 Waste Oils and Lubricants

Waste lubricants and oils will be stored in appropriate containers prior to disposal. The storage area should be bunded with a capacity 110% of the largest container stored within. Waste lubricants and oils should be kept away from non-compatible waste types to prevent any chemical reaction during storage or transportation.

Such hazardous waste quantities should be sent for recycling either as secondary oil products or for energy recovery. Takeback agreements should be put in place with suppliers to the extent possible. Quantities stored, collected and disposed of should be tracked through hazardous waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.5.3 Oil Contaminated Solids

Oil contaminated solids may include oily rags, filters, absorbents, spill kits, etc.

STC should enter into supply contracts for products that will produce hazardous wastes which include takeback agreements for their disposal to the extent possible.

Oil contaminated solids will be stored in appropriate containers prior to disposal. Ideally the high calorific value of this waste type would be suited to an energy recovery process. Landfill is not advised due to the ability of the oil contaminants to leach out of the waste and into local water courses. Waste oils should be kept away from non-compatible waste types to prevent any chemical reaction during storage or transportation.

Such hazardous waste should be sent back for energy recovery via takeback agreements put in place with suppliers or to a suitable hazardous waste management facility. The quantities can be tracked through hazardous waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.5.4 **Oily Water**

Waste oils will be skimmed routinely from oily wastewater through waste-oil separators to be put in place, in particular, by the canteens, Heavy Mechanical Equipment and fuel storage areas. Filtered waste oils should be stored in onsite waste oil tanks for recycling or disposed of by suitable or licensed waste contractors. Oily water interceptors will be pumped out periodically using vacuum tanker and should be treated via the on-site wastewater treatment systems (WWTS). The resultant sludge from the WWTS should be dewatered and can be disposed to a local landfill that is operating in accordance with good international practices.

5.5.5 **Waste Batteries**

Waste batteries should be aggregated on site and stored in appropriate containers. Smaller batteries should be stored by type and away from non-compatible wastes.

Waste batteries will be collected for recycling / recovery in-country or exported and the quantities leaving ST's premises can be tracked through hazardous waste transfer notes / trip tickets when collected by a suitable waste contractor.

5.5.6 **Medical Waste**

Medical waste should be treated on-site in an autoclave or equivalent decontaminating system to be then handled as non-hazardous general waste. Sharp objects such as syringes should be disposed of in enclosed containers to prevent accidents.

5.5.7 **Instrumentation**

Repatriation will be replaced in an ad-hoc manner as required. ST will enter into repatriation agreement with equipment suppliers, especially in the case of those instruments containing hazardous substances.

Such hazardous waste quantities recovered via repatriation agreements put in place with equipment suppliers will be tracked through export manifest.

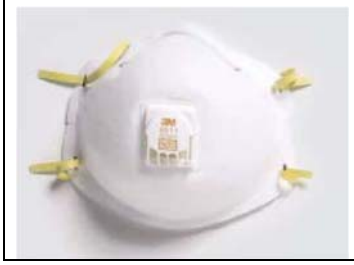
5.6 **Domestic Wastewater Guidance**

Domestic wastewater represents another form of waste to be managed.

Domestic wastewater will be collected through a separate system to the stormwater system and channeled towards onsite wastewater treatment systems before discharge to nearby stream/river once treated as per pre-agreed levels. Wastewater qualities will be monitored periodically (for pre-agreed or required characteristics) at the entrance to the wastewater treatment plant and at the exit by Maintenance Team.

5.7 **Safety Precautions for Staff**

Adequate safety training, information and equipment for workers, employees or any other persons involved in handling waste should be arranged by the Environmental Manager with the support of the Maintenance Team / cleaning team. Refresher courses should also be carried out on a regular basis to ensure all ST staff and waste handlers remain well aware of the safety good practice requirements.
While handling any sort of waste all staff should be wearing appropriate PPE to limit contact with the waste, such as:

Eye protection	Hand Protection	Foot Protection
Safety glasses, Safety goggles to prevent any injuries to the eyes. 	Rubber gloves to limit the contact of waste to the skin. 	Closed toe, water proof wellies, non-slip sole to prevent staff from accidently kicking or stepping on sharp objects or slipping in the refuse room. 
Respiratory Protection		
To protect staff against airborne contaminants use a face mask. 		

5.8 **Verification and Monitoring**

5.8.1 **Waste Data Collection**

Managers and Executives, with the support of Maintenance Team / cleaning team, shall maintain inventory records of waste streams and associated quantities of waste generated, recycled, reused, disposed of at the locations under their responsibility. The inventory shall comprise of:

- Type of waste;
- Generation source (machine, facility, building, area, etc.);
- Quantity (kg);
- Collection and storage arrangements;
- Disposal method;
- Disposal contractor / Destination.

The waste generation data shall be collected on a monthly basis (or as appropriate) and the inventory updated. An example of waste inventory record is provided in *Attachment 6.3.1*.

This information will be provided to, and aggregated by, the Environmental Manager in a database that the Environmental Manager will manage. Different waste types could be coded in accordance with the requirements of the local regulator or the EU list of wastes[2].

5.8.2 Waste Reports

Waste audits will be performed by the Environmental Manager with the assistance of the Maintenance Team twice a year. The outcomes will be presented to the EHSS Committee in waste audit reports. The audits will help refine waste streams and associated waste management taking into account the"4Rs" waste management concept, taking into account the Key Performance Indicators detailed in *Section 5.8.3*.

The waste audit reports, based on the questions suggested in *Attachments 6.3.2* and *6.3.3* will also contain the following information:

- Inventory of waste leaving the site in the preceding months;
- Findings from any internal or regulatory site inspections carried out in the previous months including:
    - Loss of containment;
    - Accidental releases / spillages;
    - Non-compliances;
- Aggregate year to date totals for waste generation and disposal;
- Year on year comparison to date for waste disposal;
- Details of any improvement measures implemented at the site.

Any regulatory reporting to the relevant authorities must be delivered in the form and at intervals stipulated by the relevant authorities, as applicable.

5.8.3 Key Performance Indicators

The following Key Performance Indicators (KPI's) should be used:

[2] Accessible from: http://ec.europa.eu/environment/waste/framework/list.htm (accessed 31 August 2017)

- Annual volumes of waste (per waste stream – i.e. hazardous and non-hazardous) disposed of at landfill (on-site / off-site) and/or incinerated and not reused, recycled or reclaimed;
- Annual volume of waste (per waste stream – i.e. hazardous and non-hazardous) reused, recycled or reclaimed;
- Annual percent change of volume of waste (per waste stream – i.e. hazardous and non-hazardous) produced compared to previous year;
- Annual percent change of volume of waste reused, recycled, reclaimed and disposed of compared to the previous year;
- Annual volume of contaminated soils generated and treated on-site;
- Description of implementation of segregation of waste streams (recyclables, general waste and hazardous waste): excellent / good / not good;
- Identification of reports of hazardous waste being mixed with general waste and vice versa: number; and
- Reports of illegal dumping of wastes: number.

Objectives of improvement in the KPIs' results should conclude the waste audit reports with a corresponding action plan.

5.8.4 **Continuous Improvement and Waste Action Plan**

Continuous improvement is sought via a programme of ongoing training and communication to be arranged by the Environmental Manager. Findings from the audit programme will be communicated to All Persons by posters in the canteens and main offices. Improvements measures will be devised by the Environmental Manager and the Maintenance Team / cleaning team.

Training sessions and communication on responsible waste practices will include sharing information such as:

- Where non-hazardous and hazardous wastes can be disposed of in the first place, then stored on-site before finally being disposed of safely inside or outside ST's premises;
- Hazardous waste disposal procedures (what must be collected vs. what can be disposed of safely down the drains);
- How non-hazardous and hazardous wastes must be segregated (which chemicals / hazardous materials and wastes cannot be mixed together);
- All personnel is responsible for keeping waste containers appropriately closed and labelled;
- Appropriate handling of hazardous and non-hazardous containers;
- Location and use of (chemical) spill kit.

5.9 **Decommissioning**

Prior to the commencement of the decommissioning stage, a dedicated waste management plan will be developed by the demolition contractor detailing estimations of quantities of all wastes expected during the demolition. It will be the responsibility of the demolition contractor and of ST in accordance in accordance with the Supply Chain Screening Procedure and the Contractor Management Procedure, to ensure that responsible avenues in accordance with the 4R's ethos are identified and used during the decommissioning phase.

5.10 Audit and Review Policy

This procedure will be reviewed annually by the EHSS Committee to ascertain the progress it has made in achieving the set aim, and on an ad-hoc basis by ST's Audit Function Unit.

Any significant changes made to the procedure will be announced to all staff, and training provided to ensure relevant staffs are made aware of updates.

6 Related Documents and References

6.1 External Document

- National legislation and policy on non-hazardous and hazardous waste
- International Guidelines and Standards:
  - Basel Convention (1989) ratified by Myanmar in January 2015
  - IFC Performance Standards 1 and 3
  - World Bank Group EHS Guidelines 1.3 Wastewater and Ambient Water Quality, 1.5 Hazardous Materials Management and 1.6 Waste Management

6.2 Internal documents

- [Communication, Participation and Consultation Procedure]
- [Incoming and Outgoing Document Procedure]
- [Legal Compliance Procedure]
- [Incident Classification table]
- Risk Matrix
- Storage and Handling of Hazardous Material Procedure
- Supply Chain Screening Procedure
- Incident Reporting Procedure
- Emergency Response Procedure

6.3 Attachments

6.3.1 Waste Inventory Format
6.3.2 Audit Checklist – Non-Hazardous Waste
6.3.3 Audit Checklist –Hazardous Waste
6.3.4 Waste Management Flowchart

Attachment 6.3.1 Waste Inventory Format

Waste Type	Generation Source (machine, facility, building, area, etc.)	Quantity (kg)	Collection locations	Receptacles / Bin Type	Disposal Method	Disposal Contractor/ Destination
General Waste						
Drink Cans						
Other metal items						
Plastic bottles/containers						
Paper (printing paper, packaging cardboards)						
Glass container						
Food Waste						
Cooking Oil						
Chemical Waste						
Clinical Waste						
Light bulbs						
Other						

Attachment 6.3.2 Audit Checklist – Non-Hazardous Waste

ST Department/ Area Name:		Date of Audit:
Name of staff completing checklist:		

Non-Hazardous Waste Management Audit Checklist	Yes	No	N/A	Comments / Action required	Action required by
1. Are waste containers appropriate for their intended use? (for example, food waste containers should have lids)					
2. Are different waste streams properly handled separately?					
3. Are bins clearly labelled?					
4. Is the number of bins / dumpsters adequate? (for example, the number is not adequate if waste overflows)					
5. Are bins / dumpsters in appropriate locations? (for example, away from air intakes, from doors, in relation to prevailing winds)					
6. Are bins / dumpsters emptied regularly? (for example, check the last three times when they were emptied)					
7. Is the waste removal schedule commensurate to the volume of waste generated and stored?					
8. Is waste stored in a well-ventilated room?					
9. Is waste stored leaking or negatively impacted on its surrounding environment (e.g. waste blowing, waste clogging waterways)					
10. If exhaust fans are use, do they operate properly?					
11. Are there any signs of odors, contaminants, vermin in the waste storage areas? (if yes, where)					

Attachment 6.3.3 Audit Checklist –Hazardous Waste

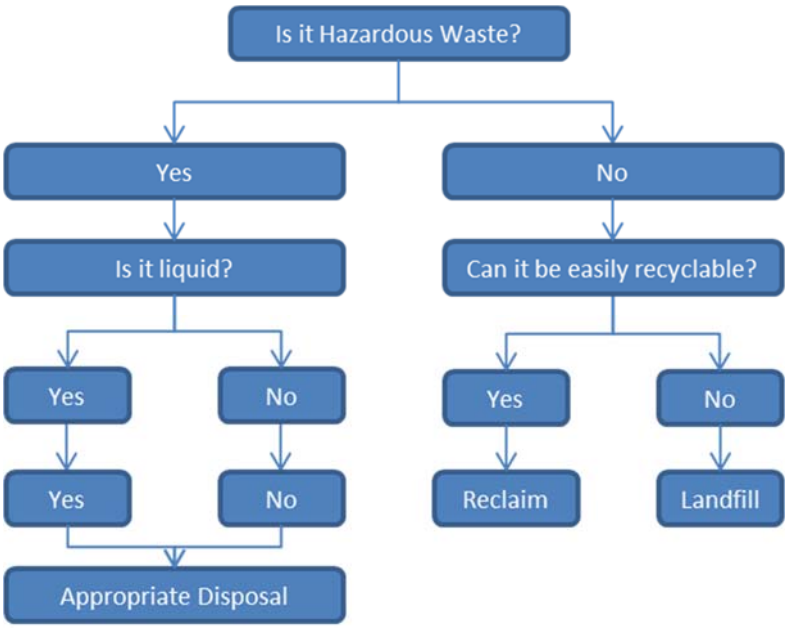
ST Department/ Area Name:		Date of Audit:
Name of staff completing checklist:		

Hazardous Waste Management Audit Checklist	Yes	No	N/A	Comments / Action required	Action required by
Hazardous Waste Labelling and Containers					
1. Are hazardous waste labels on all hazardous waste containers?					
2. If the waste container previously held other contents, are the previous labels removed or significantly defaced?					
3. Are waste containers kept closed at all times, except when adding or removing waste? Hazardous waste cannot be stored in open containers.					
4. Is hazardous waste container labelled as soon as the first hazardous waste is added to the container?					
5. Are full chemical names spelled out on the hazardous waste label?					
6. From the time the hazardous waste container is full, is it brought to the hazardous waste storage area as soon as possible?					
7. Are waste containers in good shape, leak-resistant and chemically compatible with the waste?					
8. For liquid waste, is it in puncture-proof, sealed container such that if it gets knocked over it won't spill?					
9. Is waste stored leaking or negatively impacted on its surrounding environment (e.g. waste blowing, waste clogging waterways)					
Hazardous Waste Storage Areas					
10. Are hazardous waste storage areas clearly designated and identified with a "Hazardous Waste Storage Area" sign?					
11. Is there easy access to the hazardous waste storage area? (for instance the instance is not blocked by equipment or supplies)					
12. Area areas where hazardous waste is generated and stored uncluttered and cleanable if there is a spill?					
13. Is the hazardous waste storage area communication board up-to-date about the chemical hazards, personnel and phone numbers?					
Other Waste Management					
14. Are there any not-compatible hazardous wastes stored in close proximity?					
15. Is a chemical spill kit available in the hazardous waste storage area? (N.B: the spill kits can be as simple as gloves, garbage bags, kitty litter, paper towel / blue pads, etc. in a plastic container)					
16. Is the chemical spill kit located in a suitable enclosed (not locked) high box clearly visible to anyone?					

Hazardous Waste Management Audit Checklist	Yes	No	N/A	Comments / Action required	Action required by
17. Does everyone in the Maintenance Team know how to use the chemical spill kit?					
18. Is there an emergency plan in case of emergency? And when was the last drill?					
19. Do hazardous waste containers have secondary containment, such as trays or tubs to contain a spill or in case of leakage from the primary waste containers?					
20. Who is designated to bring the hazardous waste items from the waste collection to the hazardous waste storage area?					

Attachment 6.3.4 Waste Management Flowchart

Hazardous Waste		*Non-Hazardous Waste*			
Oil, Oil Materials, Lubricants, Oily waters	Solvents	Food Waste, Organic Waste	*Recyclable*	Glass	*Recyclable*
Oily Rags, Oil-Contaminated Solids	Medical Waste, Expired Medication	Used Cooking Oil	*Recyclable*	Air Conditioning Filters	*Recyclable*
Batteries (Lead Acid, Nickel Cadmium)	Fluorescent Light Bulbs	Other Domestic Waste	*General*	Sodium Light Bulbs	*Recyclable*
Electrical and Electronic Equipment	Printer and Toner Cartridges	Paper, Cardboard	*Recyclable*	Fly Ash, Kiln Dust	*Recyclable*
Aerosol Cans (Empty)	Filters (Fuel / Diesel Oil) - Instrumentation	Metal Tins	*Recyclable*	Wood	*Recyclable*
Empty Chemical Drums	Tank / Silo / Process Washings	Scrap Metal	*Recyclable*	Inert Material	*Recyclable*
Paint Cans, Brushes, etc		Plastic Containers, Plastic Bottles	*Recyclable*	Soil, Spoil Rocks, Topsoil	*Recyclable*
		Sewage (Grey Water – Domestic)	*Recyclable*		



Annex G

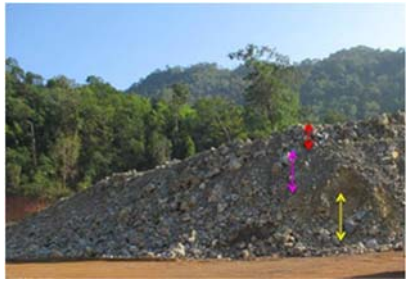
Photos of Equipment and Machinery at STC/STM Facilities

1 LIMESTONE QUARRY

Figure 1.1 Overview of Limestone Quarry

Figure 1.2 Rock-sheeted Haul Road Leading to Limestone Quarry

Table 1.1 Mining Operations at Limestone Quary

				
1. Clearing pit floor	2. Setting out drill pattern	3. Drilling	4. Sampling	5. Explosive charging
				
6.Blasting	7. Blending for QC	8. Loading and Hauling	9. Tipping /Dumping	

2 MUDSTONE QUARRY

Table 2.1 Overview of Mudstone Quarry






3 SHWE TAUNG APACHE CEMENT FACTORY

Figure.3.1 Schwe Taung Cement Factory Overview (as at Oct. 2016)

Figure 3.2 Limestone Crushing

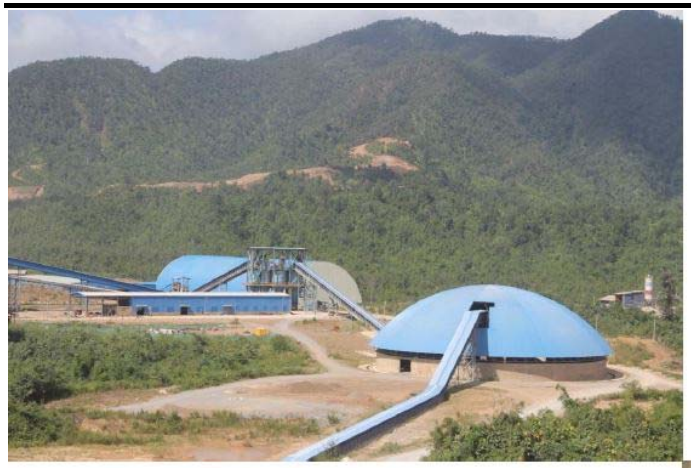
Primary Limestone Crusher

Crusher	:	Jaw Crusher
Type	:	PE 1500 x 1800
Design Capacity	:	400 tph
Actual Capacity	:	410 tph

Secondary Limestone Crusher

Crusher	:	Hammer Crusher
Type	:	PC2018
Design Capacity	:	400-450 tph
Actual Capacity	:	410 tph

Figure 3.3 Limestone Pre-Homogenising Shed



Limestone Storage

Storage Capacity : 15,000 tones

- **Limestone Stacker**

  Design Capacity : 325 tph

  Actual Capacity : 400 tph

- **Limestone Re-claimer**

  Design Capacity : 260 tph

  Actual Capacity : 200 tph

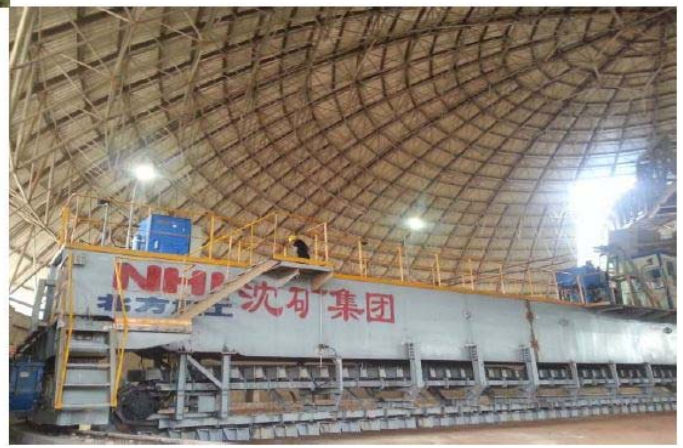
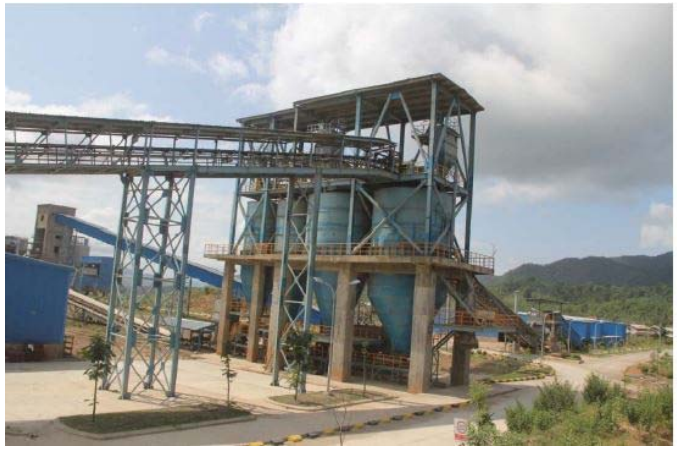


Figure 3.4 Auxiliary Material Crushing



Auxiliary Material Crusher

Crusher Type	:	Jaw Crusher
Type	:	PE 300 x 1300
Design Capacity	:	50 tph
Actual Capacity	:	50 tph

Figure 3.5 Raw Material Blending

Raw Mill

Mill Type	:	Vertical Roller Mill
Model	:	HRM2800
Mill table Diameter	:	2,800 mm
No. of Rollers	:	3
Design Capacity	:	130 tph
Actual Capacity	:	140 tph

Figure 3.6 Preheater

Preheater

Size Designation : C1-4M, C2-5.4M, C3-5.7m, C4-5.8. C5-6M

Exit Gas Temperature : 368-375

Pre-calciner Volume : 440 m^3

Calciner Gas Exit Temperature : 870-920°C

Main Burner Capacity : 5.7 tph

Pre-calciner Burner capacity : 7 tph

Figure 3.7 Kiln

Kiln		
Kiln Diameter	:	3.5 m
Kiln Length	:	54 m
Kiln Speed	:	0.434-4.34 rpm
Design Capacity	:	1,500 tpd
Actual Capacity	:	1,550 tpd

Figure 3.8 Clinker Silo

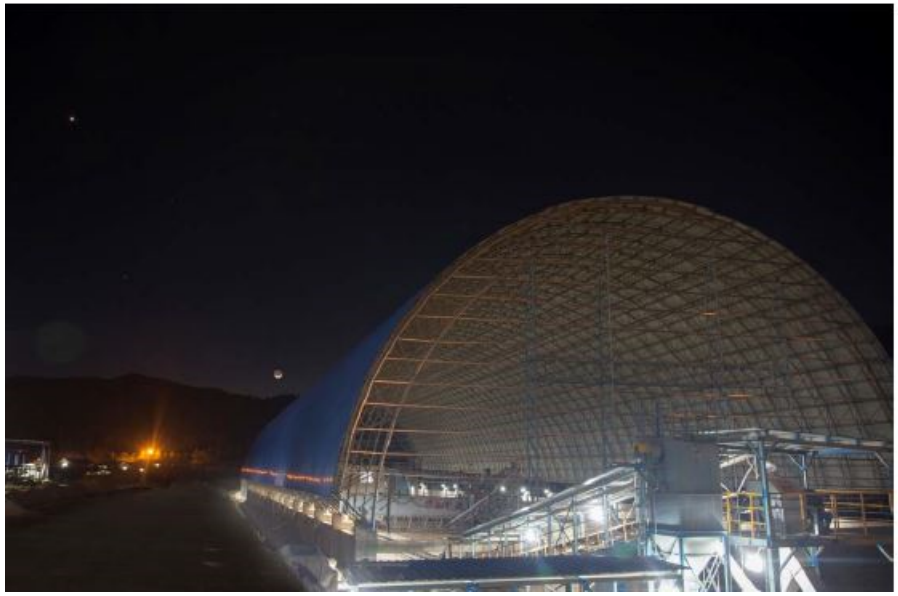
Clinker Silo

No. of Silo	:	1
Construction	:	Concrete
Capacity	:	25,000 ton
Diameter	:	25 m
Height	:	33.5 m

Figure 3.9 Cement Silo

Cement Silo		
No. of Silo	:	4
Construction	:	Concrete
Capacity per silo	:	6,200 ton
Diameter	:	15 m
Height	:	42 m

Figure 3.10 Coal Storage and Coal crusher



Coal Storage & Coal Crusher

Storage	: 2600 tones per pile
Number of Pile	: 2 piles
Crusher Type	: Double Teeth Roller Crusher
Design TPH	: 40 tph
Actual TPH	: 40 tph

Figure 3.11 Coal Mill

Coal Mill

Type	:	Vertical Roller Mill
Model	:	HRM 1900M
Mill table Diameter	:	1,900 mm
No. of Roller	:	2
Roller Diameter	:	1,500 mm
Design TPH	:	16-18 tph
Actual TPH	:	18 tph

Figure 3.12 Cement Mill

Cement Mill

Type	:	Ball Mill (Double Chamber)
Diameter	:	3.5 m
Length	:	13 m
Design TPH	:	50 tph
Actual TPH	:	60 tph

Figure 3.13 Packing and Distribution

Packer

Manufacturer	:	Haver & Boecker
Design	:	Rotary
Design TPH	:	110 tph
Actual TPH	:	100.19 tph

Table 4.1 Paluzawa Coal Berthing and Storage Area (including fuel storage area)





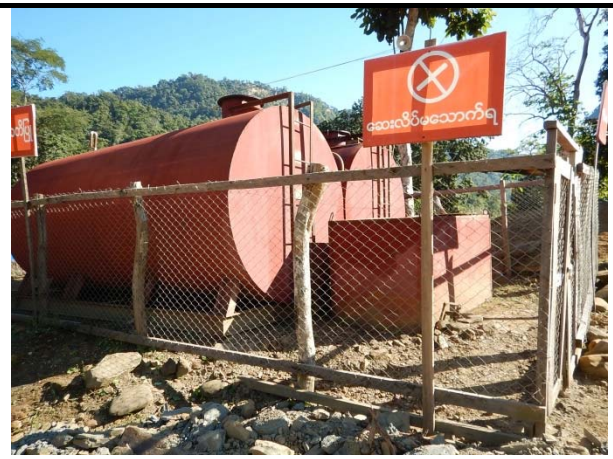

Table 4.2 Paluzawa to Base Camp Access Road

Table 4.3 Coal Mine






Table 4.4 Coal Mine Base Camp, Surroundings and Scoping Visit Stakeholder Engagement



Annex H

Stakeholder Engagement Meeting Minutes for Disclosure of Draft EIA

Minutes of Meeting (18.7.2017)

Meeting Details				
Project :	Supplementary ESIA for Shwe Taung Cement (STC) Cement Plant & Associated Facilities in Myanmar			
Venue	Novotel Hotel		**Region/ State**	Yangon
	Township		Village	-
Objectives	Public Forum to: 1. Share information about the Project "Expansion of a Cement Plant & Associated Facilities by the Shwe Taung Cement (STC) Company Limited in Myanmar". 2. Present findings of the draft Supplemental ESIA. 3. Exchange views with interested and affected parties which will be taken into account for finalisation of the Environmental and Social Impact Assessment (ESIA) Report for the Project.			
Date	18th July 2017 (Tuesday)			
Time	2:00 to 6:00 PM			
Attendee:	1) U Aung Zaw Naing, Group CEO, STG 2) U Kyaw Naing Soe, DMD, STC 3) U Ze Lum, SE, STC 4) U Aung Khaing Nyi, EE, STG 5) U San Myaing, Manager, STC 6) Mr. Piers Touzel, Partner, ERM 7) Ms. Becky Summons, Senior Consultant, ERM 8) Daw Khin Su Su Naing, Senior Consultant ERM 9) Daw Myat Mon Swe, Senior Consultant, ERM Government (6) NGOs (28) Media (2) Public (29) **Total No. of Attendees: (74)**			

Agenda:

Agenda Item	Time
Welcome Remarks by Emcee Daw Thida Swe **- Meeting objectives, agenda & introductions**	**2.00 – 2.15**
Introduction about STC & Project Overview ***Speakers:*** ***Group CEO Aung Zaw Naing, STG*** ***MD Kyaw Naing Soe, STC***	**2.15 – 2.45**
Findings of Supplementary ESIA Study- General Overview ***Speaker: Mr Piers Touzel, ERM***	**2.45 – 3.15**
Q&A Session ***Moderated by ERM Representative Daw Mya Mon Swe***	**3.15 – 3.45**
Coffee Break	**3.45 – 4.00**
Findings of Biodiversity Impact Assessment / Mitigation ***Speaker: Mr Piers Touzel, ERM***	**4.00 – 4.30**
Findings of Social Impact Assessment / Mitigation ***Speaker: Mr Piers Touzel, ERM***	**4.30 – 5.00**
Q&A Session **Moderated by ERM Representative Daw Mya Mon Swe**	**5.00 – 6.00**

Detailed note of discussion (Part I)

Q1 (U Ye Lin Myint, National Coordinator, MATA):

1. MATA has already sent our comments in an open letter to the IFC. How were impacts on the livelihoods of local people considered in the Supplemental ESIA and how were these impacts assessed?

2. How did you scope the Supplemental ESIA?

3. Was a health impact assessment undertaken? What was the finding of the health impact assessment? We would like to know detailed data of the dust assessment which you have explained that there is no unacceptable risk.

4. We understand that biodiversity impact will be discussed later and we would like you to disclose the detailed study data.

5. We would like to know the amount of coal consumption per day for existing plant and expanded plant and how do you manage the environmental impact of coal consumption.

6. How do you manage the waste generated from the Project activities? We also would like to know the impact of waste management and its mitigation measures?

7. How did you study the noise and vibration impact on villages around the cement plant?

8. As you said that 55% of the employees come from within 50 miles of the cement plant. We would like to know how many STC employees are from Pyi Nyaung and Kubyin villages? Why I have to ask this question is that most investors mentioned creating job opportunities, but they never mentioned the loss of job for local people because of the Project. So that I would like to know the impact assessment on livelihood and loss of current local job opportunity due to this Project.

9. How will you manage the water shortage issue at both communities around the cement plant and water usage which will be required for next line? How will you consider the water shortage issue for the local agricultural sector?

10. How will STC help the electricity supply for the villages along the power transmission line when STC connect the power from Ye Paung Son for second line?

A1 (Mr. Piers Touzel, ERM):

1) Livelihood Assessment: ERM undertook a socio-economic survey through discussions with village leaders; focus group discussions with women and famers and through a direct survey of 100 households sampled at random. If you don't mind we will explain this in a later session today.

2) Health Impact Assessment: We did not specifically do a health impact assessment. However a number of concerns related to health issues were raised by communities around the cement plant and coal mine. One comment raised in Kubyin was that there was an increase in skin disease in children which was thought to be related to a lack of water in the Kubyin River in the dry season. At the coal staging area in Paluzawa along the Chindwin River, residents said that the burning of coal was causing heath impacts from the smoke.

Post Meeting Note:

i. STC has made a doctor available to residents of Pyi Nyaung and Kubyin village who prescribed medication for the skin disease; and

ii. STC has not drawn water from the Kubyin River in the last 12 months so any water shortage in Kubyin this year is unrelated to the Project.

3) Biodiversity survey: It will be explain in a separate session later today.

4) Noise: We undertook noise sampling at Kubyin and Pyi Nyaung villages as well as at the cement plant office area and staff quarters. The monitoring result indicates that there is noise from the plant near the operation area, but residents in Kubyin and Pyi Nyaung villages should not be able to hear any noise from the plant because they are too far away. For noise from blasting in the limestone quarry, it is noted that there are no residents in the vicinity of

the area. Furthermore, the blasting is on the other side of the hill from Kubyin village and there is not a direct line of sight to Kubyin village and so blasting noise will be screened by the terrain.

A1 (U Kyaw Naing Soe, STC):

1) ***Coal Usage***: We are using coal as fuel for the kilns. One of the raw materials for cement production is calcium which will be obtained by taking away CO and CO2 from Calcium Carbonate of the raw materials through gas suspension in preheater. The kiln temperature is 1,450 Degree Celsius which is fuelled by coal. A maximum of 0.18 tonnes of coal is used per day and depends on the quality of the coal. It will be less if the coal quality is good. The coal ash is combined with other materials to produce cement, so that there is low ash content in air discharged unlike coal fired power plant. There is thus no waste in cement production process, however, the runoff from the coal storage area discharged to the stream is assessed as wastewater impacts in the ESIA study. We are now taking action to follow up ERM's advice on mitigation measures.

2) ***Employment***: 343 STC employees are from within a 50 mile radius of the plant and 6 people are from Pyi Nyaung and Kubyin. We welcomed local people to work at STC, but other business could generate more income for them. However, we will invite local people to try working at our plant and vocational training which will be arranged in the future for kiln operators, heavy vehicle drivers, administration etc. at STC.

3) ***Environmental survey data***: Environmental survey data were obtained in February and June by the Environmental Conservation Department of Mandalay Region for which we can provide the hard copy.

A1 (U Aung Zaw Naing, STG):

1) ***Water management***: The difference between the first and second line is that the first line is not included the waste heat recovery and thus the water usage in first line is less than the second line. It is correct that, overall, water usage will increase due to production of both lines. Our current plan is to pump water from Myithar stream and we will consider water supply for villages around the plant especially for Pyi Nyaung when installing this water supply. After the feasibility study, we will provide information on how water will be supplied to the plant and how much water we can supply to Pyi Nyaung.

2) ***Health Risk***: With regard to the health problem related to skin disease in Kubyin, we have plans to set up water purification plants in Kubyin and Pyi Nyaung.

Q2 (U San Lin, Managing Director, Pyinyawaddy Shwe Pyi Construction Company Limited):

1) We welcome the improvement of cement production for our country's infrastructure development. Good production practices according to national and international EIA standards for the Project activities and disclosure of project information should be pushed to other cement companies as well. I would like to know how to continuously monitor this good practice during production to follow the ESIA recommendations.

A2 (U Aung Zaw Naing, STG):

2) The impact assessment and mitigation measure explained in the presentation are initial findings. Firstly, we will follow relevant national and International ESIA standards to disclose the findings.

3) Secondly, environmental study findings / data obtained by third parties will be made available at an Information Centre which will be set up in Pyi Nyaung soon for disclosure. Not only for the current impacts identified but for the impacts in the future they will be assessed and with mitigation measure identified and implemented.

4) The third measure is that a HSE manager will be appointed at our new Environmental and Safety Department. We will also train employees at all levels to improve their environmental awareness.

5) The forth measure is we will comply with all environmental commitment if we contract with international organization such as IFC. We thus need to be transparent for all our activities. An independent director will have to be appointed to the board of directors. While local staff will be continuously trained, we will also hire foreign experts to manage compliance with procedures and guidelines.

Q3 (U Nyi Nyi Tun, Secretary, MRPZA):

1) Please explain if rice husk can be used as alternative fuel for heating. A lot of rise husks were disposed directly to the river everywhere which caused environmental impact.

A3 (U Kyaw Naing Soe, STC):

1) Rice husks are being used for the heating for cement production in other countries. In order for this to be a feasible option, we must have a continuous supply of rise husk . The rice production in Myanmar is about 12 million tonnes per year and rice husk is 20 % of rice production. Rice mills are using 50 % of the rise husk, but 2 million tonnes of rice husk is waste in Myanmar. The main rice cultivation areas are Mandalay, Magwe, Bago and Ayeyarwady regions. So we have to study the numbers of rice mills and usage of rice husk by them in Mandalay region and Naypyitaw for the long term sustainable supply as fuel. The benefit of using rise husk it is flammable, but transportation cost is expensive because it is so light. So we are considering using surplus rice husk from rice mills which are within 100 miles of the plant. Another benefit to use the rice husk is Silica content of rice which contributes to high strength of clinker. We will undertake a study of the feasibility of using rise husk to displace 10-15% of the coal used as fuel. Also waste engine oil is another alternative fuel that may be considered in the future. After the feasibility study on the rice husk use is complete, information will be disclosed to the public.

Q4 (U Win Maw, Deputy Director, Forestry Department, Yangon Region):

1) There are only 6 people from Pyi Nyaung working for STC now because of the illegal logging around Kubyin and Pyi Nyaung area. Creating job opportunities with good salaries for permanent and daily works can attract people to work in STC rather than logging which can be a CSR programme for forest conservation.

A4 (U Aung Zaw Naing, STG):

1) ***Job Opportunities***: We will try to create the job opportunities as we mentioned.

Q5 (U Hla Tun Tun Min, MATA, Mandalay):

1) ***Land and crop compensation:*** Communities have not yet been paid compensation for land and crops for the access road construction and power transmission line connected from Yay Paung Sone Substation.

2) ***Water shortage***: There is water shortage for the community because of the dam/ reservoir STC constructed which blocked the Poe Hlaung and Ye Shin Streams. How will STC manage this?

3) **Job opportunities**: All people around the plant said no jobs are available when they applied to STC and how can you arrange to have jobs for those people living in Pyi Nyaung?

A5 (U Aung Zaw Naing, STG):

1) ***Land and crop compensation:*** The access road was constructed along a former bullock cart track and 14 households have already been compensated for their land and crops in 2009-2010. We have documentation of these compensation records. Since the road was constructed nobody else has come forward seeking compensation from us till now.

2) ***Water shortage***: We use only Poe Hlaung stream. If water is available from Myittar Stream, water supply for nearby community like Kubyin and Pyi Nyaung will also be considered as I mentioned earlier.

A5 (U Kyaw Naing Soe, STC):

3) ***Land and crop compensation*** For the transmission line, it was done by four companies as a Joint Venture in 2011-2012. At that time, we knew that the area covered Yay Paung Sone reserve forest, natural forest, military owned land and vacant land. However, 4 Households in Oat Kyin village were compensated for their mango and banana plants. Up to now in 2017, nobody else has come forward claiming unpaid compensation. We will construct the second power line and all affected households will be compensated by coordination with related authorised departments.

Q6 (U Aung Thu Kyaw, Deputy Director, ECD, Yangon Region):

1) ***Environmental Data*****:** Environmental survey data obtained by ECD of Mandalay region is only representative for short-time period. As such, the survey data collected by third parties in the future monitoring surveys will have to be disclosed.

2) ***Livelihood restoration and resettlement action plan:*** For the affected people who lose their properties of land and crops, ERM has to consider those people.

3) ***Explanation of the production process***: should not include technical terms so people at all education levels can understand.

4) ***Air Modelling***: As ERM said that there is no impacts from air emission to people because all residential areas are far away from the plant and the emission especially NO_x, SO_X will be

dispersed to the hill area where no residents are living due to wind direction. However, the impact on natural areas and on people due to air emission and its mitigation measure should be explained without technical terms.

A6 (Mr Piers Touzel, ERM):

1) ***Air Pollution***: The chimney from the cement kiln is the main source of air emission from the cement plant. The second line will be constructed next to the existing line with similar discharge and similar chimney. The dominant wind direction is from the east to the west across the plant. If the wind direction is south west to north east what that means is that you do not get the impact in Pyi Nyaung village. Mainly because of the wind direction is east to the west, the air modelling indicates that the exceedance occurs at the top of the hill where there are no residents. In terms of long term monitoring, air monitoring equipment will be installed inside the chimney to measure the concentration of air pollutants. Dust deposition monitoring will be undertaken in Pyi Nyaung and Kubyin villages and data will be shared with local communities.

Q7 (U Thein Win, villager, Pyi Nyaung):

1) ***Water Shortage and impact of wastewater*:** My garden is near the end of Poe Hlaung Stream. How will the issue of water shortage by the blocking of this stream by the weir in summer be managed? And how will impacts from wastewater discharges to this stream be managed?

2) ***The labour charges of road construction:*** There are different labour charges for the road construction in Pyi Nyaung village. How STC is going to manage that?

3) ***Baseline survey***: Why was ERM's baseline survey for air quality done in one day? All villagers should be informed about the baseline survey requirement.

4) ***Public consultation***: Public consultation was done by ERM only with children in Pyi Nyaung. All villagers need to be invited to understand the ESIA. So next time, please invite all villagers.

5) ***Impact***: Information on all impacts has to be disclosed.

A7 (U Aung Zaw Naing, STG):

1) We will discuss with your entire group after this forum.

2) ***Water Shortage and impact of wastewater*:** Recycled water is being used and there is no industrial wastewater discharge. We will address water supply as I mentioned earlier.

3) ***Labour charges of road construction:*** We have donated concrete for road construction. Labour charges were arranged by subcontractor and we will rearrange this if there are any concerns.

A7 (Mr Piers Touzel, ERM):

4) The consultation undertaken by ERM has three main components: i) an initial consultation at scoping with village leaders; ii) community briefings at each of the affected villages; iii) 100 Household surveys and 15 focus group discussions in villages close to the project area.

During the consultation, STC shared information on Project activities and ERM explained the Supplementary ESIA, followed by socio-economic survey undertaken by ERM. We then conducted focus group discussion with women and farmers. A final round of consultation and disclosure on the draft ESIA findings is now being undertaken. I apologise if any individuals were unaware of the consultation sessions undertaken to date. It was not our intention to exclude anyone. We have another consultation meeting in Pyi Nyaung on this coming Saturday and will ensure that those represented here today are invited to attend.

Q8 (U Kyaw Thet Win, Upper Chindwin Youth Network, Paluzawa, Kalay District):

1) ***Coal Storage in Paluzawa*:** Was there any consideration on impact of coal transportation like accidental coal spill while carrying them by barges in Chindwin River.

2) ***Biodiversity survey***: do you have study / survey on biodiversity? Given Paluzawa area is most critical for biodiversity ERM has to cooperate with local experts for biodiversity survey.

3) ***CSR***: Community awareness on environmental issues needs to be improved such as by organizing workshops rather than only supporting community development through donations. What is the plan on this?

4) ***Grievance Mechanism in Paluzawa:*** If there is no contact manager at the coal mine, who will receive our grievance? STC need to arrange a Grievance Mechanism.

A8 (U Aung Zaw Naing, STG):

1) We apologise that further public consultation in Paluzawa has to be postponed because of flooding in Kalaywa, but the public consultation meeting will be held in Pyi Nyaung this coming Saturday.

2) We will try to upgrade the community awareness of environmental issue.

3) Because of the impact assessment and monitoring requirements as you mentioned, we engaged ERM as an International ESIA Consultant in order to comply with the International Standards and we will continuously monitor the environmental and social impacts.

A8 (Mr Piers Touzel):

Biodiversity:

4) In the next session, biodiversity survey results in Paluzawa of the coal mine area will be explained. This biodiversity survey was done by international biodiversity experts working alongside local specialists. To survey mammals at the forest, camera traps were installed in the forest. In the next presentation, photographs will be shown on we found.

5) We did not assess impacts due to accidental spills from barging coal in the river.

A8 (U Aung Zaw Naing, STG):

6) We will upgrade the local practice and address local concern of coal transportation downstream.

Detailed note of discussion (Part II)

Q9 (Daw Moe Moe Tun, Sein Lan Pyin Oo Lwin Environmental Conservation Association):

1) ***Job Opportunities*:** Mr. Piers said that ERM invited 100 Households and "all respondents described the existing Project as important for the community because they have job opportunities". However, STC said that there are only 6 peoples working at STC plant from Kubyin and Pyi Nyaung. Please explain discrepancy between the two pieces of information.

2) ***Question to the local people:*** how did you ask people the question related to "importance of the project to them"?

3) ***Lime Kiln:*** Mr Piers shows the local lime kiln business and villagers can work in lime kiln which causes big environmental impact. Why can't those people work at STC?

A9 (Mr Piers Touzel, ERM):

1) ***Lime Kiln:*** The lime kilns are the main source of employment in Pyi Nyaung and employ people in the extraction and transportation of limestone and fuel wood, transportation, lime production and trading. The reality is that taking firewood from the forest generates higher income than working at the cement plant.

2) ***Question to the local people:*** During the socio-economic surveys, we asked people to rate how important they considered the project to their community on a scale of 1-5, 1 being very important and 5 being not important at all. The households that were asked this question were selected at random by ERM.

3) **A9 (Mr Ben Li, IFC)**:

1) ***Question to the local people:*** For the question on how important the project is, it should be noted that the importance can mean it is important but it can be good or not good to them.

Q10 (Ms Lis Hlaing, IFI Watch Myanmar):

1) ***Public consultation***: ERM said that the words "Everyone that we spoke to". What is meant by the word "Everyone" and who are they? As per IFC policy, the invitation to the community should include all local people. Also information related to project activities should be disclosed before the consultation. The local people said that this invitation was made to 25 people through GAD officer which is not representative of the local community. Did the consultation include women or farmers or workers? Is that only with students? ERM said that "All respondents". What is the sample size of the respondents that you mentioned in your presentation?

2) ***Project Category***: Now that you have done the EIA. What is the category of this project? If the category is A, can you let us know? IFC has Performance Standard mentioned that the EIA should have thorough consultation with the community. You should have consulted with the community at least twice before preparing the EIA. Another point is that the Category A Project has very high risk of negative impact.

A10 (Mr Nicholas Michael, IFC):

Yes, the Project is Category "A".

A10 (Mr Piers Touzel, ERM):

1) ***Public consultation:*** 100 Households were selected at random for the survey. Those households were not selected by local government. There is another consultation opportunity for the community in the next couple of days in Pyi Nyaung. Ms Myat Mon Swe, Senior Consultant of ERM, will undertake the public consultation at the end of this week and will be happy to provide you details of the time and venue. This ESIA is not yet finished and the outcomes of this round of consultation will be incorporated into the Final Supplementary ESIA, which will also be disclosed.

A10 (Myat Mon Swe, ERM):

2) ***Public consultation:*** We did not only invite 25 people to the meeting. Before meeting with people to collect the socio-economic data, we informed communities about the meeting three days in advance. One of the focus group discussions with women was made in one of the local lime kiln business area with women workers. The "25 households per village" means we surveyed socio-economic data from the community through a questionnaire administered to 25 households in each village. 100 HH questionnaires were collected in total with 25 HH in Pyi Nyaung, 25 HH in Kubyin and 50 HH in Nanmawke, Paluzawa and Chaung Sone villages. We did not ask the village leader to select the people to attend the meeting. The meeting attendees of each consultation meeting were recorded. These consultation meetings were intended to disclose information of the new line project activities and to collect the socio-economic data of affected communities.

Q 11 (U Ye Lin Myint, National Coordinator, MATA):

1) ***Public Consultation***: We welcome further public consultation in local communities, but we would like to know when did you inform or invite people to attend this meeting. Who did the sharing of the information and what was the method of the invitation? All presentations should be explained using Myanmar language and using handouts. The invitation through the GAD leader by the company is not the right way to ensure that all villagers receive this invitation. How long we have for the invitation before the meeting is important. So we want to know the facts about the method of invitation. Our people cannot use internet and email. So if you have not yet invited them, please postpone the date of the upcoming consultation meeting. Also we want to have the women group discussion data. We thank you for inviting us to this public forum so that we can understand about the Project and give comments. Please let us know the procedure used for data collection.

2) ***Livelihoods and income***: We wold like to know the method of community livelihood impact assessment? ERM mentioned that there is no cultivation area, but how do you assess the water shortage for the local agriculture by the Project expansion? In this EIA report there is no information about income generation of the community. ERM said there is no footprint to the forest and nobody relies on the forest.

3) ***Access to water***: There is both traditional agriculture and orchards that may be affected. One of the villagers said that his orchard has water shortage due to construction of a water reservoir for the cement plant. The assessment of water supply is really important.

4) ***Concern of the public***: We also want to know people's concerns on the new line project.

5) ***Indigenous People***: We are wondering why the previous EIA has identified Indigenous Peoples (IP), but the Supplementary ESIA has not included an IP assessment which is an important part of IFC's Performance Standards. We would like to know why this ESIA did not address impacts to IPs?

6) ***Role of Flora and Fauna International (FFI)***: Was FFI a consultant and subcontractor of ERM for biodiversity issues?

A11 (Mr Piers Touzel, ERM):

1) ***Public Consultation***: I apologise that we did not give you the information in Myanmar language for today. The next round of public consultation will be held using local language. Please contact Myat Mon Swe for detailed information about the upcoming public consultation.

2) ***Data collection***: Data collection was done using questionnaires which include questions related to livelihood, sanitation and health impacts. We collected relevant data and used this to inform the social impact assessment. All survey result can be found in the social baseline chapter of the Supplementary ESIA Report. It was collected by randomly selecting households from five villages.

3) ***Role of FFI:*** In relation to the ESIA, FFI was a subcontractor of ERM to lead the biodiversity baseline surveys. We have a representative of FFI here who will explain their work to you.

A11 (Mr Ben Li, IFC):

4) ***Indigenous Peoples***: There are numerous reasons why we decided not to trigger PS7. These were based on the findings in the field (by IFC and ERM). There are various minorities in area but these are mostly second generation. They do not speak their ethnic language in their day to day lives and their cultures and traditions are integrated with Burmese culture. There are no significant ethnic traditions except those for Burmese culture. For example, in some other communities or cultures, there is an elder based decision making structure, such as local indigenous courts making decisions, but these were not found in area. Although this is not triggered, this Project also has secondary impacts of opening up access to areas and therefore livelihoods have been improved. The material adverse impacts are very limited on these communities. Therefore, we made the decision not to trigger PS 7 (IPs). This is not to say that we do not recognize that there are ethnic minorities in this community.

A11 (Mr Frank Momberg, FFI):

5) ***Role of FFI:*** Prior to Supplementary ESIA done by ERM, we have 7 years' experience in Myanmar on biodiversity surveys with our team of national and international experts with limestone specific expertise. Before this Supplementary ESIA, FFI had commenced surveys of limestone ecosystems at all the cement plants in Myanmar. Thanks for this forum which is the first national workshop for limestone ecosystem conservation as part of the consultation

for the ESIA of Shwe Taung Cement plant. I very much appreciate the commitment and openness of STC for funding the Biodiversity Action Plan which is the only limestone conservation programme to date in Myanmar. The biodiversity survey undertaken for STC's cement plant can serve as an example for other cement companies and limestone areas.

6) ***Cumulative impact***: One specific comment I have is about the lime kiln around the area which is not sustainable and impact also the community and cause deforestation. I appreciate if there is mitigation on reducing impact on the limestone extraction, firewood collection and lime production by other companies and local communities, with cumulative impact assessment through community and related forest department, community forestry programme to improve the lime production with sustainable way for reducing the environmental impact. Perhaps I would like to request that ERM consider a bit more on the cumulative impacts of the local limestone production not only for the cement site but also for the community of coal site where other companies are working.

A11 (Mr Piers Touzel, ERM):

1) ***Cumulative impacts:*** In relation to the limestone cumulative impact assessment I agree with you. The local communities extract the limestone from the limestone range and firewood from the forest and clear vegetation. Mitigation measures are important to reduce the impact to the community, including the biodiversity action plan to be funded by STC. In relation to the coal mine in Paluzawa area, there are another 3 or 4 companies mining coal, although and some of these are underground mines with smaller footprints. Auto ignition of coal is reported to be a problem by the local community and we have proposed measures to mitigate this.

Q12 (U Kyaw Thet Win, Upper Chindwin Youth Network, Paluzawa, Kalay District):

1) ***Biodiversity assessment*****:** We want to express our concern on impact to forest species and deforestation by illegal logging using the STC road in Paluzawa. We want to know if ERM has already assessed the loss of forest. The loss of the forest product such as bamboo, bamboo shoots, fruits and corn is also important and needs to be assessed. Do you have any flora assessment? Did you collect the data of the loss of properties of the community people and forest species by the coal production?

2) ***Transportation***: How to account for the responsibility for pollution in the Chindwin River from coal transportation, runoff from the coal mine area, impacts of road construction, and impacts on fishing grounds from accidental coal and oil spills in transportation. We have information how the environment was damaged and ERM should consider using this information and cooperating with us for the assessment.

A12 (Mr Piers Touzel, ERM):

1) Thank you for your offer of information on environmental damage. We agree that construction of the coal mine access road is having a serious impact and have recommended that its use in the upper sections be discontinued. In terms of the water quality assessment, we took water quality samples downstream of the coal mine and found that water quality was generally acceptable with the exception of elevated levels of suspended solids and some metals. We have recommended that alternative options be considered to the seasonal construction of the access road and Shwe Taung has indicated that they will discontinue use

of the upper section of this road from the end of the dry season this year. For your information on environmental damage, please pass this Ms Myat Mon Swe for our consideration.

A12 (U Aung Zaw Naing, STC):

2) We will keep in touch with the local expertise and CSO of Paluzawa to improve the habitat condition at the existing mine.

Q13 (U Hla Min Min Tun, MATA, Mandalay):

***Pollution*:**

1) ERM said that there is no dust impact on the community, however, community said that ash from cement plant can be seen on the leaves of trees, agricultural plantation that we have photos as proof. Dust and ash can be also seen on the surface of uncovered water containers. If they use the water, people suffer from skin disease. So we would like to clarify how to manage the dust impact? Also fish kills have been observed in the stream, and we want to know that it is being caused by the waste discharged from the cement plant to water resources or it is happened by other reasons. So how to control the waste and wastewater impact?

2) Why was consultation only undertaken with people related to the GAD officers? Most of the 25 people who attended this meeting were young people.

A13 (Mr Piers Touzel, ERM):

1) ***Ash***: We modelled air emissions from the cement plant kiln stacks together with dust from exposed areas of the mudstone and limestone quarries. Our assessment indicates that there should not be unacceptable dust impacts at either Pyi Nyaung or Kubyin Villages as a result of the project. This is a function of the prevailing wind direction and distance between the source of dust and the receptors. I would also point out that lime kilns in Pyi Nyaung village could be a source of ash and dust. In Kubyin village, all houses are located close to a dirt road that is not related to the project and each of these houses burns wood as fuel. The dirt road and wood burning are likely to be the sources of dust in Kubyin. We have installed 10 dust deposition gauges at various locations in Pyi Nyaung and Kubyin villages and around the cement factory to monitor long term changes in dust levels.

2) ***Representatives of the consultation*:** For our previous consultation the invitation was through village leaders. We apologise if we inadvertently missed some people who wished to attend and we will improve this as well as our means of invitation for the upcoming round of consultation.

Q14 (U Nyo Maung, GAD, Pyi Nyaung):

1) Representatives of the consultation: The number of only 25 consulted people that has been raised by others is wrong because I was there when ERM did the consultation. The invitation was open to all villagers before the meeting and for the socio-economic survey.

2) Fish death: Gold mining in the upstream reaches of Myint Thar is the cause of the fish kill that has been referred to. It is correct that we can see a layer of lime on the surface of water

containers, especially in winter season because our area is within a limestone range. But this does not mean it is caused by cement companies. It may be, but I would like to explain the existing condition in the surrounding area. The land problem is happening all over the country and not only in our area. I think that the land problem is less serious compared with other areas. According to what the company mentioned, this problem will be settled I believe. On the other hand, nobody doubts investors in our area support the communities' development. However, if there is impact on the communities please avoid any impact and please support development of the communities.

A14 (U Aung Zaw Naing, STG):

1) Thank you for the comments and we will commit to emphasize community development activities.

Q15 (Mr Ben Hardman, EarthRights International -ERI):

1) You mention earlier about the grievance redress mechanism. Can you please elaborate?

A15 (U Aung Zaw Naing, STG):

1) Managing grievance is very important to us as we want to hear any complaints from the community. Whatever national and international standard we are going to comply with, I would like to tell all of you that we are Burmese and we will work honestly for our national development. The people's benefit from our hearts is more important than just standards.

Q16 (Mr Ben Hardman, EarthRights International -ERI)

1) Have you already informed the local consultation meeting to the community?

A16 (U San Myaing, STC):

1) We have already invited people of 5 surrounding villages of our Project through GAD of Thazi Township, by placing notice on signboard in the main/ central areas of those villages and distribute the invitation letter to the people directly. We will undertake public consultation meeting with related departments and CSOs in Tharzi on 21st July and community consultation meeting will be held in Pyin Naung on 22nd July.

Photo:	
	
	

Minutes of Meeting (21.7.2017)

Meeting Details				
Project :	Supplementary ESIA for Shwe Taung Cement (STC) Cement Plant & Associated Facilities in Myanmar			
Venue	GAD Office Meeting Room (Thazi Township)		**Region/ State**	Mandalay
	Township	Thazi	Village	-
Objectives	Township Level Meeting to: 1. Share information about the Project "Expansion of a Cement Plant & Associated Facilities by the Shwe Taung Cement (STC) Company Limited in Myanmar". 2. Present findings of the draft Supplemental ESIA. 3. Exchange views with interested and affected parties which will be taken into account for finalisation of the Environmental and Social Impact Assessment (ESIA) Report for the Project.			
Date	21st July 2017 (Friday)			
Time	9:00 am to 11:00 am			
Attendee:	1) U Kyaw Naing Soe, DMD, STC 2) Daw Nang Maw Maw Aye, Assistant Director, STC 3) U Ze Lum, SE, STC 4) U Ye Myint, SE, STC 5) U Thein Myint Win, Senior Manager, STC 6) U Aung Khaing Nyi, EE, STG 7) U Thein Htay, EE, STC 8) U San Myaing, Manager, STC 9) U Kyaw Thiha, HSE Manager, STC 10) U Zaw Tint, Production Manager, STC 11) U Kyaw Win Thant, Assistant Manager, STC 12) Daw Ni Ni Aung, Staff -2 , STC 13) Daw Myat Mon Swe, Senior Consultant, ERM Government Representatives (32) CSO / NGO Representatives (3) Political Party Representatives (1) General Public (11) **Total No. of Attendees: (60)**			
Agenda:	1) Presentation of Project Details by U Kyaw Naing Soe, STC Representatives (presentation materials attached) – 9:00 am – 9:30 am			

	2) Presentation of Key Findings of Supplementary Environmental and Social Impact Assessment by Daw Myat Mon Swe, ERM Representatives (presentation materials attached) – 9:30 am – 9:50 am 3) Question and Answer Session (see below on detailed notes of discussion) – 9:50 am – 11:00 am.

Detailed Note of Discussion

Q1 (Community Leader, Thazi):

i. Appreciate STC's CSR activities and consideration of the safety of communities.

ii. Question is raised on the way to control and maintain blasting materials storage of the quarry as well as noise and vibration impact to the people.

iii. It is recommended that handout in Myanmar language including Project activities and objectives of the meeting to be distributed at the meeting for better understanding.

A1 (U Ze Lum, STC):

i. Noted the appreciation and recommendations.

ii. To respond to the concerns, blasting has to be registered with the Military Department and be approved based on detailed consideration of safety requirements. Transportation of the explosives to the storage will be in strict compliance with safety requirements and the storage is constructed in compliance with safety requirements of the Ministry of Defence. All explosives are stored as per required regulations. There is also security guard for 24 hours and the two main keys of the storage are kept and checked by heads of administration and mining departments of STC. The material in-out record is systemically recorded and must be carried out with strict material handling procedures.

iii. Vibration from mining is being controlled systematically with advanced technology so that there is no issue of noise and vibration which will affect local people.

Q2 (U Ko Oo, White Marker Group, Thazi):

i. To prevent conflicts between employee and employer, suggested that the Labour Laws and Regulations be explained clearly to all staff and contractors.

A2 (U Kyaw Naing Soe, STC):

i. Noted the comment. STC is currently doing this for all staff.

Q3 (Thazi Development Committee):

i. Environmental monitoring should be required and undertaken by third parties who are registered with the government or should be undertaken by government departments.

ii. What is the percentage of profit for the CSR budget?

A3 (U Kyaw Naing Soe, STC):

i. Environmental monitoring surveys were undertaken by the Environmental Conservation Department in February and June of 2017.

ii. STC has been undertaking monitoring of dust deposition around the cement plant and in two nearby villages since January 2017. This will be continued during the plant operations.

iii. Monitoring will also be undertaken according to recommendations of the Supplementary ESIA.

iv. For CSR, STC is continually implementing the CSR programme.

Q4 (Community leader, Thazi):

i. Given that Pyi Naung and Kubyin are Malaria areas previously, how does STC deal with Malaria in the area?

ii. Noted that STC contributed to the Pyi Nyaung's community development by upgrading the road for better transportation, is it possible for STC to support Thazi community development programs such as religious and social needs by selling cement directly from the plant for cost effectiveness?

A4 (U Kyaw Naing Soe, STC):

i. Direct purchase of cement from the STC may not be the cost effective way. However, STC will consider contributing to the Thazi's community development programs with the cement supply after discussion with relevant departments in detail on where it will be required.

ii. STC has test kits for Malaria in the company clinic for our staff. STC's doctor visits Pyi Nyaung and Kubyin once every two weeks to provide medical support for the local community to deal with Malaria.

(U Ze Lum, STC):

iii. Malaria is now rare is the area after the Malaria combat program of Thazi Township Health Department. STC has a plan to implement Malaria check program in communities.

Q 5 (Daw Min Min Naing, White Marker Group):

i. Is there any replantation program in the area for the cement plant expansion?

ii. We heard that the rate of infant mortality is increasing after using coal fuel at the cement plants in Thazi Township.

A5 (U Kyaw Naing Soe, STC):

i. Yes, there will be a replantation program associated with the cement plant expansion. STC plantation program will include at least 120 acres of German Acacia for the 600 acres of limestone quarry.

ii. We will get back to you about the data on infant mortality after checking with our medical doctor and consulting with township medical department.

Q6 (NLD Member):

i. The cement plant expansion project has to be built free from the cultivation area of the local peoples to avoid the any conflict of land/crop acquisition.

A6 (U Kyaw Naing Soe, STC):

i. The expanded cement plant is only 20 acres which is entirely within the existing plant area. Therefore, additional land acquisition is not required. The second power transmission line from Yay Paung Sone to Pyi Nyaung can use the same Right of Way (RoW) as the existing first line or about 100- 200 meter away from the existing RoW. We have already arranged to meet the potentially affected people who may own / use land along the second transmission line today at 2:00 pm at our base camp to inform and discuss with them about the second transmission line. For the access road constructed in 2009-2010, we have already compensated 14 people, however, recently we found out one person said that he was not being compensated. We will consider compensating him. For the first transmission line construction, 4 households were compensated. A Grievance Redress Mechanism will be set up that will involve STC, local government authorities, CSO and local people for transparency. An information centre will be established in Pyi Nyaung like a library to share the Project information and to receive any complaints from the people directly. Everybody can post the complaint directly to the post box at this information centre.

A6 (U San Myaing, STC):

ii. There are 8 IFC Performance Standards. We will do land acquisition, crop compensation and livelihood restoration, according to the IFC Performance Standard and government law. Moreover we also care about public awareness and protection of people.

Q7 (Township Election Committee, Thazi):

i. Request Shwe Taung to support reward program for the students who pass matriculation in Thazi Township and to contribute to the education sector.

A7 (U Kyaw Naing Soe, STC):

i. Yes we will support the reward program and we are supporting government scholarship programs in Pyin Naung and Thazi Township.

Q 8 (Thazi Development Committee):

i. Can STC provide discount to cement price for the road construction by Thazi Development Committee considering their donation in Pyi Nyaung?

ii. Can STC provide information regarding tax payment?

A8 (U Kyaw Naing Soe, STC):

i. Welcome to discuss the road construction as required.

ii. STC has paid 2.2 billion Kyats commercial tax for 2016-2017 Budget year and more than 9.6 billion Kyats for income and commercial tax by the Shwe Taung Development Co., Ltd in 2015-2016.

Q 9 (Staff Officer, Seain So):

i. With CO_2 emission from the cement plant, this can be offset by maintenance of existing forest by STC.

ii. For the illegal logging enhanced by the improved access road, STC has to prevent illegal logging together with relevant governmental department.

A9 (U Kyaw Naing Soe, STC):

i. STC is maintaining the forest by replantation as required by the Forestry Department. We also want to cooperate with the Forestry Department to ensure successful replantation program.

ii. Please also share your thoughts on how to prevent degradation of the existing condition of the forest.

Photo:

Minutes of Meeting (22.7.2017)

Meeting Details				
Project :	Supplementary ESIA for Shwe Taung Cement (STC) Cement Plant & Associated Facilities in Myanmar			
Office/ Department/ Organization	Aung Theintdi Monastery (Pyi Nyaung)		**Region/ State**	Mandalay
	Township	Thazi	Village	Pyi Nyaung
Objectives	Village Level Meeting to: 1. Share information about the Project "Expansion of a Cement Plant & Associated Facilities by the Shwe Taung Cement (STC) Company in Myanmar". 2. Present findings of the draft Supplemental ESIA 3. Exchange views with interested and affected parties which will be taken into account for finalisation of the Environmental and Social Impact Assessment (ESIA) Report for the Project.			
Date	22th July 2017 (Saturday)			
Time	14:45 to 17:30			
Attendee:	1) U Aung Zaw Naing, CEO, STG 2) U Kyaw Naing Soe, DMD, STC 3) Daw Nang Maw Maw Aye, Assistant Director, STC 4) U Ze Lum, SE, STC 5) U Ye Myint, SE, STC 6) U Thein Myint Win, Senior Manager, STC 7) U Aung Khaing Nyi, EE, STG 8) U Thein Htay, EE, STC 9) U San Myaing, Manager, STC 10) U Kyaw Thiha, HSE Manager, STC 11) U Zaw Tint, Production Manager, STC 12) U Kyaw Win Thant, Assistant Manager, STC 13) Daw Ni Ni Aung, Staff -2 , STC 14) Daw Myat Mon Swe, Senior Consultant, ERM NGOs (4) Political Party (6) Government (9) Public (120) **Total No. of Attendees: (153)**			

Agenda:	1) Presentation of Project Details by U Kyaw Naing Soe, STC Representatives (presentation materials attached) – 14:45 – 15:30 2) Presentation of Key Findings of Supplementary Environmental and Social Impact Assessment by Daw Myat Mon Swe, ERM Representatives (presentation materials attached) – 15:30– 16:20 3) Question and Answer Session (see below on detailed notes of discussion) – 16:20 – 17:30.

Detailed note of discussion

Q1 (Villager, Pyi Nyaung):

i. Appreciate STC and ERM efforts to organize this public consultation meeting for the ESIA.

ii. Feel satisfied with STC's commitment to handle grievances of the affected people.

iii. Understand the need of cement production for national development.

iv. Point out that STC should enhance opportunities of local Pyi Nyaung villagers to be employed by STC.

A1 (U Kyaw Naing Soe, DMD, STC):

i. Thanks for welcoming us and we will implement all our commitments.

ii. STC's priority is to create job opportunities for the communities around the cement plant. However, our positions require job related skills and education including passing matriculation and achieving Standard 10.

iii. Most people in Pyi Nyaung do not meet the education requirement because the village is far from town and education has not been a priority for a long time. A high school was established last year with support from STC, but most students are still studying. All students that pass matriculation must go to Meiktila for higher education. STC do not prefer to only require education level of achieving Standard 10 for their job as STC want to encourage students to continue education as graduate. I would like to request the parents of students of Pyi Nyaung to encourage students to be graduates. If there is difficulty in supporting the students to continue their education, STC will provide scholarship. To employ people who do not pass the matriculation for villages such as Oat Kyin, Mon Bin, Yay Paung Sone, Kubyin, Pyi Nyaung and Kyaw Saung Gyi, we will consider employing them in the field of machinery handling with vocational training. We will inform the community of upcoming employment opportunities. STC prefers to have employees from local communities near the plant rather than other areas.

Q2 (Villager):

i. How waste from the cement plant can cause impact on community health?

ii. How are you going to manage pollution? How are you going to disclose information regarding pollution from the cement plant?

iii. Environmental monitoring should be undertaken regularly with results disclosed to people living around the cement plant.

iv. Request STC to provide a library urgently. This has been a wish from the community for a long time but the local community cannot afford by themselves.

v. Request STC on behalf of the public to provide water supply.

A2 (U Kyaw Naing Soe, DMD, STC):

i. The information centre will be provided at a place available for rent and the location should be central to the public area. Community leaders will be consulted for the location.

ii. For pollution control, we will make sure by controlling according to the emission standards because our employees living in the staff compound at the cement plant will suffer first if there is pollution caused by Project activities and unhealthy condition can lead to loss of production. There are now 10 dust deposition gauges to monitor dust deposition; four in Pyi Nyaung and Kubin villages and 6 at the cement plant. In Pyi Nyaung, one gauge is in the GAD official's house and one is in the Chairman of the NLD' house. Also we will add more gauges between Pyi Nyaung and cement plant.

iii. We have also undertaken environmental surveys to inform the ESIA and to try to identify the cause of pollution, if any, to see if it is caused by STC Project or other sources. With the results, we can decide how to mitigate the impacts caused by STC and how to reduce the impacts of others. We have already monitored dust deposition for six months and all results will be disclosed soon.

iv. For pollution caused by dust, there are two parameters of concern, $PM_{2.5}$ and PM_{10}. $PM_{2.5}$ is very fine particle which can cause health problem if inhaled. We will distribute the pamphlet including information about monitoring at the Information Centre and also to public directly.

v. For water supply, STC will study water pumping from the Myitthar Stream and water will be supplied via pipeline with meter. We will request maintenance cost of the water supply to individual water usage as we would prefer community involvement. So I commit that STC will arrange the water supply to the Pyi Nyaung area together with 2nd line water supply to cement plant.

vi. The water quality of the Myitthar and Tharlun Streams will be examined and information will be disclosed at the Information Centre.

Q3 (Villager, Car Pyi Nyaung Qr.,):

i. Thanks to STC and ERM. All villagers have no grievances to STC for existing and new transmission lines. We, as parents, also appreciate STC donation of the two-storey school building and all education materials such as school bag, books and stationaries in Pyi Nyaung since 2013 and the care of health to the community up to now.

ii. For the water supply, the Myitthar Stream has water for the whole year which is the main source of water for community. For Yae Shin Stream water is only available in rainy season. We are concerned about water shortage due to the usage of water by the Project from the Myitthar Stream.

iii. Pollution: No concern on dust from the Project. However, the related departments and NGOs have to consider health impact of dust on behalf of local people because it is difficult for us to understand cement manufacturing technology and its potential impacts.

iv. Livelihood: Our livelihood is depending on transportation using the STC's roads. So request STC to allow using the roads as usual in the future.

v. Education: Thanks for the new school building which is being built by STC and STC donation of 5 million Kyats for funding the school.

vi. Job opportunities: We have no opportunities to be employed because of our education status which is understood. So we are trying to upgrade the education level. On the other hand, we need help from STC for students who have passed the matriculation with lack of finance by parents to continue to graduate level.

A3 (U Kyaw Naing Soe, DMD, STC):

i. Thanks for the recommendation and community support for STC activities. STC committed to set up the education fund.

ii. We will also undertake water supply assessment of Myintthar Stream and we will supply water to Pyi Nyaung.

Q4 (Village leader, Ya Htar Pyi Nyaung):

i. STC has already supplied electricity and stationary for the students. Request STC to support the educational fund, renovate the primary school built in Ya Htar Pyi Nyaung and access road to school which is destroyed. Also request for job opportunity for the people who did not pass the matriculation.

A4 (U Kyaw Naing Soe, STC):

i. Yes. We will fund the education and we will also fund 5 million kyats for support on electricity supply. We will further discuss renovation of the primary school. Our HR Department will inform people about job opportunities at STC.

A5 (Ya Htar Pyi Naung):

i. The number of households in Ya Htar Pyi Nyaung has increased from 50 to 120 now. Request STC to support educational fund for local residents. After primary education, they have to study in Pyi Nyaung School, so that the transportation fee is required for the students and requested STC to provide such.

A5 (U Kyaw Naing Soe, STC):

ii. We will donate 5 million Kyat for electricity supply and will further discuss on renovation of the school.

Q6 (Pyi Nyaung):

i. We would like to invite STC to visit to our village.

A6 (U Kyaw Naing Soe, DMD, STC):

i. Yes, we will visit your village.

Q7 (U Kyaw Naing Soe, DMD, STC):

i. Is there anyone in the villages who does not understand Burmese?

A7 (Leaders of the villages):

i. No.

Q8 (NLD member):

i. We would like to know how the biodiversity mitigation measures will be implemented in limestone area by STC. If the biodiversity action plan is implemented, please disclose relevant information in future.

ii. Suggest to set up village representative committee.

A8 (Mr. Jovy Tam, ERM):

i. We are helping STC to prepare a Biodiversity Action Plan. Under the plan, we will consider different options of offsetting the critical habitat which will be affected by the Project. The plan is being prepared in consultation with relevant government departments such as MONREC and NGOs such as FFI and WCS. The plan will be ready in September 2017 based on which actions will be implemented accordingly.

(**U Kyaw Naing Soe, DMD, STC):**

ii. We have already discussed with related department to undertake our biodiversity offset at Panlaung-Pyadalin Cave Wildlife Sanctuary. All relevant information, including but not limited to biodiversity, will be disclosed at the information centre.

Q9 (Villager, Pyi Nyaung):

i. Will road construction in Pyi Naung area be continued or not? Some roads are only 10 feet wide, so that they need to be widen for fire fighting vehicles to access. After finish the road construction, GAD and village head will need to extend the road to every house.

A9 (U Kyaw Naing Soe, DMD, STC):

i. Yes, we will support the road construction.

Photo:

Annex I

ECD Comments and Responses to Comments Table

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
1.	**1. Executive Summary** Executive Summary in both Myanmar language and English is needed.	Executive Summary in both Myanmar language and English is needed. In the executive summary, the following is needed to be included - Description and summary of significant impacts, social impacts, mitigation measure of the related impacts and monitoring plan, the result of public consultation, EIA's conclusion and recommendation of EIA.	A new Executive Summary in both English and Myanmar Language versions is added to the revised EIA.	See Section 1
2.	**2. Commitment** The project proponent need to submit a letter of endorsement in a format prescribed by the Ministry to state the following facts (a) The accuracy and completeness of EIA. (b) EIA has been prepared in strict compliance with applicable laws including EIA procedure and TOR for the EIA. (c) At all time the Project will comply fully with the commitments,	The project proponent need to describe the following commitments (a) The accuracy and completeness of EIA. (b) EIA has been prepared in strict compliance with applicable laws including EIA procedure and TOR for the EIA. (c) At all time will comply fully with the commitments, mitigation measures, and plans in the EIA report.	The Project Proponent will provide, along with the revised EIA, a letter of endorsement over the following commitments: (a) The EIA is as accurate and complete as reasonably feasible at the time of writing. (b) The EIA has been prepared in strict compliance with applicable laws including EIA procedure and the Terms of Reference agreed for the EIA. (c) the Project Proponent will fully comply at all times with the commitments, mitigation measures, and plans described in the EIA report.	The commitment letter is included in the EIA Report

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
	mitigation measures and plans in the EIA report.			
3.	**3. Chapter (1) Introduction** The information of project proponent and the third party preparing the EIA report need to be described fully.	- The project proponent contact address need to be mentioned - To describe detailed information of third party preparing the EIA report; - Include individual profile of environmental, social and health specialists including their education, experiences and consultant registration.	New sub-sections are added in the Introduction Section providing some information on the Project Proponent, including its contact address, and on the third party preparing the EIA.	New sub-sections are added under Section 2.3 for "Background to the Project Proponent" and Section 2.4 for "Background to the EIA Consultants".
3.	**4. Policy, legal, commitment and institutional framework** The law and rules applicable to EIA are described in page 15 to 18. However, additional information is need on: 1. Laws and procedures, notification and regulation issued by the relevant Ministries on environment, community, social security, health and safety, related to the Project.		The administrative framework section is revised to incorporate information on the relevant local institutional framework and on the Project Proponent's policies.	New sub-sections are added under Section 3 Administrative Framework: Sub-section 3.1 Local Policy, Legal and Institutional Framework, Sub-section 3.6: "Project-Related Contractual and other Commitments" and Sub-section 3.7 "Project Proponent Policies, Plans and Procedures"
	2. The commitment that the Project Proponent will comply fully with any existing laws and rules, and any regulations and notifications issued by the relevant Ministries.		The Project Proponent will provide, along with the revised EIA, a letter of endorsement.	The commitment letter is included in the EIA Report
5.	4. **Project Description and Alternative Selection** (a) The main part of project is mentioned in page from 2 to 11. Although the cement manufacturing process is explained in figures, they are needed to be elaborated in written format.	1. Need to include function, technical specification, engineering drawing, schematic drawing and photographs of machinery. 2. The cement production process in page 6 of Figure 2.4 should be explained in written format.	The project description section is revised to address the comments regarding the cement process, storage capabilities and project development and implementation time schedules and includes new dedicated sub-sections.	1. The implementation schedule of the project expansion is described in Section 4.1.3.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
		3. The layout shown in Figure 2.6 isn't seen clear and need to replace with high resolution photo. Need to indicate the new and existing building clearly on a map. 4. Information on how to store 7200 tons of cement per day, how much cement will be exported and distributed in a day is needed to be included. 5. The current implementation of the project expansion is needed to be described in the report. 6. The working schedule indicating the current situation of the Project and the implementation is needed to be described.		
5.	(b) Information is provided on raw materials, water and energy usage in the construction and operation process but is considered inadequate.	1. Provide information on the amount of raw materials needed (limestone, mudstone, coal) for the lifespan of the cement factory (30 years) versus raw material that can be extracted from the quarries and mines of the Project to estimate the balance, and how to meet future requirements if insufficient. 2. Provide information on amount of raw material, water and energy to be used in the operation process.	The project description section is revised to address the comments regarding raw materials (including water and energy) and includes new dedicated sub-sections.	1. Information on amount of materials required is provided in Sub-section 4.1.1. 2. Information on amount of raw materials that can be extracted from the quarries and mines is provided in Sub-section 4, which are sufficient for the lifespan of the cement factory. 3. Information on water usage and power demand is provided in Sub-section 4.1.2.
6.	***Limestone*** Limestone can be quarried from hill which is situated 800m east of the cement plant and its area is 600 acre. 750,000 tons of limestone is required in a year and if the production is expanded, additional 2 million ton of limestone is needed in every year.	According to No. (133) in EIA Procedure, it stated that EIA is required for limestone quarry which produce over 100,000 ton per year. It is required to conduct EIA on the limestone production separately.	The EIA has been first revised as one standalone document (incorporating the cement plant and its associated facilities, as per IFC's definitions, and namely the limestone quarry, the mudstone quarry and the coal mine) that addresses the comments received since the disclosure of the draft EIA.	Separate reports have been prepared according to the recommendations provided by ECD.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
7.	***Mudstone*** The mudstone quarry is situated in the western part of project area and its area is 165 acre. Currently, 97,000 tons of mudstone is extracted in a year; and if the cement plant expanded, the additional 260,000 tons is required.	According to Paragraph No. (133) in EIA Procedure, it stated that EIA is required for mudstone quarry which produce over 100,000 ton per year. It is required to conduct EIA on the mudstone production separately.	The EIA has been first revised as one standalone document (incorporating the cement plant and its associated facilities, as per IFC's definitions, and namely the limestone quarry, the mudstone quarry and the coal mine) that addresses the comments received since the disclosure of the draft EIA.	Separate reports have been prepared according to the recommendations provided by ECD.
8.	***Laterite, Gypsum and Sand and Other raw materials*** The need of other raw materials such as Laterite, Gypsum and Sand; and the amount used per year, place to buy, the amount to buy, storage place and methods aren't mentioned.	The amount of ton used per year and place to buy, the amount to buy, storage place and methods are needed to be described for other raw materials.	The project description section is revised to address the comments regarding raw materials, including laterite, gypsum and others, and includes new dedicated sub-sections.	Not relevant to the limestone quary in this EIA Report. Addressed in the separate EIA Report of the cement plant expansion project.
9.	***Electricity Supply*** The cement plant currently consumes 11 MW supplied via a 33kV transmission line. STC will construct a new 66kV transmission line. Additional supply to STC will be 36 MW and requires a new transformer on-site. A 2,000 kVA backup generator is deployed on site for instances of power outage. According to the ESAP, it mentions the alignment of the transmission line needs to be reviewed. - In page (), it mentions that fuel () is used and the storage plans for fuel, the installation of generator and its place are needed to be described. - 103.4 kWh of electricity is consumed for a ton of cement. The main fuel for electricity is coal. And even it mentions that 150,000 tons of coal is extracted in Chaung Sone village,	- According to the ESAP, it mentions the alignment of the transmission line needs to be reviewed - The amount of fuel to be used, storage of fuel, installation of generator and the photograph of installed place are needed to be included. - Specification of coal usage and other detailed technical information (e.g. the assessment of coal quality such as sulfur content, carbon content, volatile content, surface moisture, etc.) are needed to be included.	The project description section is revised to address the comments regarding power and fuel demand, including coal characteristics, and includes new dedicated sub-sections. The EIA consultants undertook a biodiversity survey along the planned route of the new transmission line and incorporated the findings in the revised EIA.	1. Information on power demand and related facilities is provided in Sub-section 4.1.2 2. Details of transmission line are provided under Sub-section 4.1.2 3. Not relevant to the limestone quary in this EIA Report. Addressed in the separate EIA Report of the cement plant expansion project.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
	Sagaing Region per year, the specification of coal usage and other details technical information (e.g. the assessment of coal quality such as sulfur content, carbon content, volatile content, surface moisture, etc.) are needed to be described.			
10.	***Water Supply*** There are two water reservoirs in the project area and water will be pumped from Ku Byin stream. The current water usage of the factory is 1,500 m^3, and if expanded it will be 3,400 m^3. Though the storage amount is 4 million and 4.5 million, the amount of water required per month in the process of cement production, housing and office are required to be estimated.	- To mention whether water can be accessed from Kubyin stream for the plant. - To mention water will be pumped from Kubyin stream. - It is estimated that daily water usage will be 5,300 m^3 considering the daily water usage for waste heat system is 1,900 m^3. Please describe the water volume required for the project activities in each phase. - To estimate and describe the amount of water usage for housing and office for a month.	The project description section is revised to address the comments regarding water supply assumptions and includes new dedicated sub-sections.	Information on water supply is provided in Sub-section 4.1.2
11.	Worker camp, toilet pit system, drainage system and waste disposal management system are needed to be described. Source and amount of solid waste, collection, storage and disposal option are needed to be described in details. Solid waste from the production of cement and clinker waste, cutting from processing raw materials, dust from smokestack, solid waste from packaging, office waste, and waste from worker camp are not described.	The worker camp, toilet pit system and drainage system, waste disposal management system needs to be described. 1) The solid waste should be divided into hazardous waste, non- hazardous waste, recyclable waste, and the amount of waste and storage, disposal and recycle methods, landfill sites are required to be described in photograph. 2) According to the ESAP, a certain area needs to be described for the used oil and the area has to be covered completely.	The project description section is revised to address the comments regarding waste and wastewater management systems, including toilet pit system during all phases of the Project and blasting material management, and includes new dedicated sub-sections. A waste management plan is included in the Environmental and Social Management Plan and has been provided as a new Annex (Annex F).	Wastewater treatment and waste management are presented under Sub-section 4.1.2 with new figures, describing waste and wastewater management systems (current and planned). A Waste Management Plan is also included in Annex F.
12.	No information on hazardous waste	1) The laboratory used materials and waste, chemicals, the used oil could	The project description section will be revised to address the comments regarding hazardous waste management and will	Waste management is presented under Sub-section 4.1.2.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
		produce hazardous waste, and thus the amount of hazardous wastes, the storage methods, the methods of waste disposed and the landfill sites are needed to be described in detail.	include new dedicated sub-sections. A waste management plan is included in the Environmental and Social Management Plan and has been provided as a new Annex (Annex F).	A Waste Management Plan is also included in Annex F.
	The study of current environment condition			
	Baseline environmental data is incomplete.			
13.	1) Survey for Air Quality The result of MESC's EIA report 2016 is mention in Figure 6.5 but the survey area isn't described. PM_{10}, $PM_{2.5}$, NO_2, SO_2 survey is undertaken. $PM_{2.5}$ value is higher than NEQG value. ERM has surveyed PM_{10}, $PM_{2.5}$, NOx, NO_2, and SO_2 in six places including 4 places in worker camp, 1 place in Kupyin village, 1 place in Pyinnaung village, but the result is not mentioned in table.	1) Survey for Air Quality In January 2017, ERM did additional survey on AQM1, AQM2 and AQM3 for NO_2 and SO_2 for 7 days. The result of survey is mentioned and compared with NEQG value. The monitoring time is different from the ESAP that show the survey time is 1 month. For air quality survey, the calibration record is needed to be described.	The Description of the Surrounding Environment – Environmental Baseline – Air Quality section and sub-sections is revised to address the comments regarding air quality as follows: 1) ERM acknowledges in the EIA that the MESC's survey area and methods are not described however the results are presented and discussed noting this limitation. The background PM2.5 and PM10 concentrations have been verified during additional baseline monitoring surveys in January 2018 and reported in the revised EIA. 2) ERM's survey method involved the use of passive diffusion tubes. Preparation and analysis of the diffusion tubes was undertaken in accordance with BS EN 13528. The analysis of the exposed tubes was undertaken using Ion Chromatography (United Kingdom Accreditation Service (UKAS) Accredited Method ISO/IEC 17025:2005). ERM surveyed NO2 and SO2 at three locations, and dust at six locations. An additional PM2.5/PM10 survey is planned for January 2018. All results will be reported in the revised EIA.	Sub-section 5.3.1 is revised to include baseline results of PM.
14.	2) Survey for Water Quality In January 2017 ERM's additional survey took place in five places, with results mentioned in Table 6.14. The baseline data are collected in January 2017. pH, TSS, TP, Temp, BOD, COD, Total Nitrogen, T-Coli and oil and grease is surveyed.	2) Survey for Water Quality The survey result for WP2 and WP3 of TSS and WP2 of total coliform is higher than NEQG value. As per ESAP analysis, domestic wastewater and storm water management plan are needed to present. IFC Board analyzed that industrial waste water management isn't required as water	The Description of the Surrounding Environment – Environmental Baseline – Water Quality section and sub-sections is revised to address the comments regarding water quality baseline survey results. The project description section is revised to address the comments regarding wastewater and stormwater management	Wastewater treatment is presented in Sub-section 4.1.2 The wastewater and stormwater management plan is referred to in the Environmental and Social Management Plan (Section 11).

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
		supply isn't essential for the production of cement.	and includes new dedicated sub-sections describing the conceptual plans available at the time of writing.	
15.	3) Survey for Noise In January 2017 ERM's additional survey is undertaken in the compound of factory and four places (N1, N2, N3, and N4) in worker camp. Noise data are mentioned in Table 6.14. The survey result for N1, N2 and N3 is presented in page 52 of Table 6.8. Result at N4 is not included.	3) Survey for Noise The night and day time survey result of N2 and N3 is higher than NEQG value. As per ESAP no exceedance of WBG guideline is recorded and is thus different from above. Though N2 and N3 are just temporary camp for the construction period, the noise level from construction is higher than NEQG value and it is not mentioned. This is different from content of ESAP.	The Description of the Surrounding Environment – Environmental Baseline – Air Quality section and sub-sections is revised to address the comments regarding noise as follows: 1) Baseline noise levels of N2 and N3 are discussed as exceeding the WBG guideline in Section 6.2. In accordance with EQG and WBG General EHS Guidelines, either one of the option should be adopted for analysis, ie 55/45dB(A) for daytime/night-time or results in a maximum increase in background noise levels of 3dB(A) as the standard. As background noise levels at the NSRs have been established, this is what is chosen to be taken as standard for noise assessment, which explains why the NEQG value is not mentioned in the assessment. Nonetheless, the revised Supplemental EIA recommends that these worker accommodation areas be relcoated to a distance of >500m of the plent to minimise noise (and air quality) impacts to workers and their families 2) Based on the site visit carried out in January 2017, the operational noise from existing cement plant is not noticeable at N1 and N4. Only noise from occasion traffic could be observed. Background noise environments for N1 and N4 are considered to be similar. Therefore, no monitoring was conducted at N4.	Sub-section 5.3 is revised to include clarifications.
16.	4) Survey for Biological species Plant and animals survey are undertaken in January 2017 by ERM which is mentioned in Table 6.17. The sample size, plot size and transect size aren't mentioned for the NEPS EIA report 2016. No mention of biological survey done as part of MESC EIA report in December 2016.	4) Survey for Biological species According to the 2017 survey of ERM, there is one endangered species of plant and five endangered mammal species. Three mammal species are near threatened –NT. Need to include results of wet season survey.	The Description of the Surrounding Environment – Environmental Baseline – Biodiversity section and sub-sections is revised to address the comments regarding biodiversity. The wet season biodiversity and reptiles at end of dry season surveys are now complete and the results are included in the Final EIA as new annexes.	Wet season survey results are included in Sub-section 5.4.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
17.	5) Soil Quality Survey The assessment of soil quality isn't done yet. There will be impact to soil quality if th dust from cement factory spread around and land in the soil. As the carbon content in dust is quite high, pH level of soil may become higher and conductivity and moisture content may change. As a result, the quality of agriculture land is damaged.	5) Soil Quality Survey The emission of dust and coal dust from project need to be calculated, and assessment of soil quality is required to be conducted in the affected area including villages and farm.	The Description of the Surrounding Environment – Environmental Baseline section and sub-sections is revised to address the comments regarding soil quality survey. Additional soil sampling and soil quality laboratory analysis have been undertaken at Pyi Naung and Kubyin Villages near the cement plant during the additional air quality survey, with the findings included in the Final EIA report.	Sub-section 5.5 is revised to include baseline results of soil survey.
18.	6) Socio-economic survey Kubyin village with 56 household is situated in 3 km to the north and Pyinnaung village with 535 household is situated in 7 km to the south of the cement factory. ERM collected the socio-economic survey data for 25 HH in Kupyin and 25 HH in Pyinnaung village in January 2017. Socio-economic, health, education, income, livelihood and living standards are collected, concerns and requirement of the local people are not described.	6)Socio-economic survey - To justify adequacy of surveyed HH number. - To describe the concerns/comments and requirement of local community.	The Description of the Surrounding Environment – Socio-Economic Baseline section and sub-sections will be revised to address the comments regarding the adequacy of the number of surveyed households in the five villages closest to the cement plant and the coal mine areas. The concerns and comments that were raised by the surveyed households are described in the analysis of the survey questionnaires for each village	Sub-section 6.1 is revised to provide justification of sample size. Concerns and comments raised by stakeholders are described in Section 12 for Stakeholder Engagement.
19.	The current and future development plans of government are not mentioned.	- To describe the current and future socio-economic development plans, sectoral plan and related information of national, state and regional, and city/township levels.	The Description of the Surrounding Environment – Environmental Baseline is revised to address the comments regarding current and future public development plans with a new sub-section dedicated to the matter.	Clarifications are provided under Sub-section 5.2
20.	Natural disasters are not mentioned.	- To include information about earthquake, Tsunami, extreme events on weather, flooding, drought, forest fire happened in the concerned region of project area and protection, mitigation measures for each potential impact, and then add in EMP.	The Description of the Surrounding Environment – Environmental Baseline is revised to address the comments regarding natural disasters with a new sub-section dedicated to the matter.	Clarifications are provided under Sub-section 5.3.5

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
21.	Health data of 25 HH from Kubyin and 25 HH from Pyinnaung are described.	- To describe the baseline health information about mortality, disease, accidents, injury etc. of related area of project (or) Tharsi Township.	The Description of the Surrounding Environment – Socio-Economic Baseline section and sub-sections is revised to address the comments regarding health data and a new sub-section added to focus on health-related information in the Tharzi Township.	Clarifications are provided under Sub-section 6.1.2
22.	Related cultural components are not mentioned.	- To include information on cultural components such as historical places, religion places, traditional knowledge and believes and cultural custom around the project area with maps.	The Description of the Surrounding Environment – Socio-Economic Baseline section and sub-sections is revised to address the comments regarding cultural heritage. Cultural components have been reviewed along the right of way for the transmission line.	Clarifications are provided under Sub-sections 6.2
23.	Related visual components are not mentioned.	1) To describe the visual components including agriculture, mountain, rivers, streams, lake etc. 2) To describe the impact on visual components and then describe the mitigation measures of those impacts and add in EMP.	The Description of the Surrounding Environment – Socio-Economic Baseline section and sub-sections is revised to address the comments regarding landscape and visual baseline and impact assessment.	Clarifications are provided under Sub-section 8.6.
24.	**(b) Impact Assessment and Analysis**			
	To add more impact assessment in Section 8 as it is considered inadequate although the following is assessed. 1) Impacts to Air quality, Noise, Waste and Biodiversity at construction phase. 2) It is described that the air quality impact will be within 500 m of construction activities. **3)** Even N2 and N3 are mentioned as temporary staff quarters, there is no discussion on exceedance of noise standards at these areas.	1) The following are needed to be added to the Impact assessment for Construction Phase with mitigation measures and monitoring plan: (a) Water pollution (b) Sewage (c) Wastewater discharged (d) Hazardous/ chemical waste (e) Soil contamination (f) Ground water pollution (g) Impact on the occupational health and safety (h) Impact on Community health and safety (i) Impact on natural disaster (Earthquake, flooding, land slide, fire, etc.) 2) To describe water volume used by construction activities, staff quarter and office, wastewater volume and existing wastewater management	The Impact and Risk Assessment and Mitigation Measures: Construction Phase section is supplemented to address the comments regarding the assessment of additional potential impacts. The project description section is revised to address the comments regarding water and wastewater management systems and data, fuel storage and construction camps management, and includes new dedicated sub-sections. The revised Supplemental EIA recommends that these worker accommodation areas be relcoated to a distance of >500m of the plent to minimise noise (and air quality) impacts to workers and their families	The Project only included operation phase of the limestone quarry. The Section Project Description is revised and include clarifications under Sub-section 4.1.2

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
		3) To describe sewage management, underground soak pit, impact assessment of soil contamination 4) To describe the management of soil contamination by e.g. fuel storage together with photographs. 5) To describe management activities of the construction area, worker's camps, sewage septic tanks (Toilet Pit) and activities of mitigation of impacts, to be added with monthly reports and photographs.		
25.	**Operation Phase:** To add more impact assessment in Section 9 as it is considered inadequate although the following is assessed. Impacts on Air quality, Water quality, Noise Waste and Biodiversity and labour form other places are assessed.	The following are needed to be added to the impact assessment for operation phase with mitigation measures and monitoring plan: 1) Soil contamination (eg. cement dust, oil spillage) 2) Natural disasters (eg. Earthquake, flooding, land slide, fire, etc.)	The Impact and Risk Assessment and Mitigation Measures: Operation Phase section is supplemented to address the comments regarding the assessment of additional potential impacts (soil contamination and natural disasters).	The Impact and Risk Assessment and Mitigation Measures Operation Phase section is revised with Sub-section 8.7 Natural disasters are described under Sub-section 5.3.5 and their likely impacts clarified in the same sub-sections.
26.	**Impact assessment of Air quality:** Impact of dust by storage of raw materials and products, grinding, emissions from kiln, coal usage and clinker are assessed.	**Impact assessment of Air quality:** 1) To describe estimated emission by vehicles, dust by packing, odors types and area, condition of emission to air, way of discharge and volume of waste 2) To describe specification of coal used 3) It is found that SO_2 and NO_2 for Ambient Air Quality are measured. $PM_{2.5}$ and Ozone have to be done at further measurement and describe the result in the report. 4) The result of emission from cement production is described for SO_2, NO_2 and PM in Table 9.2 and 9.3. As NEQG mentioned, the other parameter like CO2, Mercury, Dioxin, HC and Total Metal should be required to measure.	The Impact and Risk Assessment and Mitigation Measures: Operation Phase section and sub-sections is revised to address the comments regarding air quality as follows: 1) The EIA chapter presents the combined emission rate for particulate matter. The detailed approach, discussion and the estimation of fugitive dust emissions from material storage, handling, processing etc. are discussed in Annex C2 and the relevant assumptions and emission factors used for each process are presented in Annex C3. 2) Coal specifications is detailed in the revised Project Description Section 3) Additional baseline sampling have been undertaken for PM2.5 and PM10 sampling at Pyi Naung and Kubyin for 14 days. We do not consider ozone measurement relevant to the air emissions from the project. 4) The United States Environmental Protection Agency (USEPA) Air Pollutant Emission factors (AP-42) for Portland	The Section Impact and Risk Assessment and Mitigation Measures: Operation Phase is revised and include clarifications under Sub-section 8.1

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			Cement Manufacturing was used as a key source of information for developing the emission inventory for the Project (see Annex C2). The guidance document states that the primary emissions from cement manufacturing are NOx, SO2 and PM and these have therefore been given detailed consideration in the quantitative impact assessment. The guidance states that only small quantities of VOC, NH3, chloriune, HCl, and heavy metals are emitted and these substances have therefore been screened out of the assessment. 5) The EIA report includes the requirement for a sampling platform and ports to be installed on the kiln exhaust stack. A continuous in-stack emissions monitoring system will be installed to measure CO/CO2, O2, NO2 and SO2. Hydrocarbons could be sampled periodically from the kiln stack. However Hg, metals and dioxin measurement cannot be undertaken on a continuous basis since these all exist in both the gaseous and solid state. Measurement of these three parameters from cement kilns is complex and requires specialized sampling and analytical equipment. As far as ERM is aware, there are no third parties in Myanmar capable of undertaking the sampling and analysis of Hg, metals and dioxin to credible international standards (eg USEPA Test Methods). The project description section is revised to address the comments regarding coal characteristics, and includes a new dedicated sub-section.	
27.	**Impact assessment of Water quality:** Baseline data of TSS at WP2 and WP3 and total coliform value are over the NEQG standard. It was concluded that it was due to the runoff from coal storage area. The volume of wastewater discharged from operation is not described.	**Impact assessment of Water quality:** 1) To describe volume of water required for operation 2) Volumes of discharged wastewater, brown water of each project phases are needed to calculate. 3) There will be a spill response plan as mentioned in page 163 and the spill response plan has to be described. 4) There is no information on ways to collect, store, treat, transport and discharge wastewater from the project which should be mentioned.	The Project Description section is revised to address the comments regarding water use, stormwater and domestic wastewater management systems (collection, treatment and discharge systems in place and planned), associated location maps and drawings (available conceptual designs of stormwater and domestic wastewater management systems), and includes relevant new dedicated sub-sections. The Description of the Surrounding Environment – Environmental Baseline – Water Quality section and sub-sections is revised to address the comments regarding water quality baseline survey results. There is no routine process water discharge to the Kubyin	The Section Project Description is revised and include clarifications under Sub-section 4.1.2 The Section Description of the Surrounding Environment: Environmental Baseline – Water Quality is revised under Sub-section 5.3 The Section Impact and Risk Assessment and Mitigation Measures: Operation Phase is revised and include clarifications under

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
		5) Location Maps, Engineering Drawings and photographs of drainage condition, sewage system, wastewater treatment system and final discharge point to the environment are needed to be described. 6) Water of the Kyubin river is being used as drinking water for local peoples. Result of water quality testing at final wastewater discharge point is required to be described and compared with NEQG standards.	River. Stormwater flows into several waterways that ultimately flow into the Kubyin River and the sampling results at these locations is already presented in the EIA. A spill response plan is included in the Environmental and Social Management Plan as part of the Emergency Response Procedure. The spill response plan is clarified in the revised Impact and Risk Assessment and Mitigation Measures section and sub-sections.	Sub-section 8.2 A wastewater and stormwater management plan is included in the Environmental and Social Management Plan under Section 11.
28.	**Impact assessment of Noise:** The noise data at N_1 and N_4 are described in Annex D. And it is found from the analysis that there is no impact due as the result is within the standard. Even it is mentioned that baseline data of N_2 and N_3 are over the NEQG standards, there is no mention for that in the impact assessment.	**Impact assessment of Noise:** - To describe the factory layout plan map including points of noise sources - To describe detail specification of machine to reduce of noise (e.g. Silencers) and its application status, then compare the noise data before and after application.	The Impact and Risk Assessment and Mitigation Measures: Operation Phase section and sub-sections are revised to address the comments regarding noise.	Noise impact is scoped-out for the quarry as presented in Section 7
29.	**Impact assessment of Waste:** Non-hazardous waste will be disposed in a pit during the operation phase which is described in Figure 9.12. However, there is no information on volume of waste.	**Impact assessment of Waste:** 1) All waste should be separated as hazardous waste (e.g. Filter bags), non-hazardous waste (Domestic waste), recyclable waste, dangerous/ chemicals (Chemicals, Diesel) and types of waste are needed to assess individually. Then impact assessment and way of discharge of waste should be described after calculation of estimated volume of waste 2) The area of landfill and waste volume have to be calculated and described 3) Describe the WMP.	The Project Description section is revised to address the comments regarding waste management systems, including hazardous and non-hazardous and landfill requirements, and include new dedicated sub-sections. The Impact and Risk Assessment and Mitigation Measures: Operation Phase section and sub-sections are revised to address the comments regarding waste. A waste management plan is included in the Environmental and Social Management Plan and has been provided as a new Annex (Annex F).	The Section Project Description is revised under sub-section 4.1.2 The Section Impact and Risk Assessment and Mitigation Measures: Operation Phase is revised under Sub-section 8.4 A Waste Management Plan is also included in Annex F.
30.	Plant and animals survey are undertaken in January 2017 by ERM which is mentioned in Table 6.17.	**Impact assessment of Biodiversity habitats:** 1) It is difficult to evaluate the impact assessment without data of the biodiversity survey in wet season and the	The assessment of impacts for ecosystem services has been completed in Annex E3. The priority ecosystem services that required impact assessment include timber and wood products, water and erosion regulation. All of these items are assessed and mitigations recommended within the EIA.	The Section Impact and Risk Assessment and Mitigation Measures: Operation Phase is revised and include additional sub-sections under 8.3

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	The sample size, plot size and transect size aren't mentioned for the NEPS EIA report 2016. No mention of biological survey done as part of MESC EIA report in December 2016. According the 2017 survey of ERM, there is one endangered species of plant and five endangered mammal species. Three mammal species are near threatened –NT. It is described that there is Panlaung Pyadaline Wildlife protect area 3-4 mile far from the factory. It is described that the biodiversity survey in wet season will be done and submitted later, The detail assessment of Biodiversity habitats are described in Annex E.	impact assessment should be revised with the wet season data. 2) To describe the survey methodology 3) Even the distribution for IUCN Redlist of Endangered Species is described in Map 2 of page 43 in Annex E, species name are not mentioned. Even conclusion of 7 Endangered and Critical Species are described in Annex E, page 9, Table 3, there is no conclusion of Vulnerable (Vu) species. Frequencies, density, dominance of each species are needed to be described. Population density and distribution map of each IUCN Red List Species are needed to be described too. Then the distribution of each IUCN Red List Species can be evaluated, 4) It is described that the replantation plan of the local species will be included in EMP. As such, detail plan has to be described in the EIA. 5) To describe the Biodiversity Action Plan and Biodiversity Monitoring and Evaluation plan as per ESAP.	The Impact and Risk Assessment and Mitigation Measures: Operation Phase section and sub-sections are revised to address the comments regarding biodiversity as follows: 1) Wet season biodiversity surveys are now complete and the results will be included in the Final EIA. 2) Survey methods are described 3) It is standard practice to undertake biodiversity surveys with the aim of identifying species presence for the purposes of EIA. We have not undertaken a population survey of endangered species and have insufficient data to describe distribution and population density. This is not typically required for EIAs 4) The species selected for rehabilitation planting should reflect a representative mix of local species. This is described in the Final EIA. 5) BAP has now been prepared and is included in the Final EIA.	The BAP is included as a new Annex E
31.	Although the ecosystem services survey was done in 2017 during public consultation, there is not description on assessment of impacts.	- To describe assessment on ecosystem services and mitigation measures to reduce impacts.	The Description of the Surrounding Environment – Environmental Baseline – Biodiversity section - Ecosystem Services Assessment sub-section details the methodology to assess priority ecosystem services and the complete dataset for the ecosystem services assessment is contained in Annex D3. The Impact and Risk Assessment and Mitigation Measures: Operation Phase section and sub-sections are revised to address the comments regarding ecosystem services.	The Section Impact and Risk Assessment and Mitigation Measures: Operation Phase is revised and include additional sub-sections under 8.3 The BAP is included as a new Annex E
32.	In page no 197, impacts of influx management is assessed.	- To describe population and socio-economic status of project related villages and pros and cons of project activities and the mitigation measures of the impacts.	The Description of the Surrounding Environment – Socio-Economic Baseline section describes the populations and socio-economic status of the villagers living around the Project sites. The Impact and Risk Assessment and Mitigation Measures: Operation Phase section contains an Influx Management sub-section that assesses the likely impacts of influx population and mitigation measures.	Sub-sections 6 clarify these points. Influx impact is discussed in the separate EIA Report for the cement plant expansion project and not relevant to the limestone quarry.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
33.	There is no assessment of occupational health and safety and community health and safety.	- To describe the Community Health and Safety and OHS Management Plan.	The Description of the Surrounding Environment – Socio-Economic Baseline section and sub-sections is revised to address the comments regarding health data and a new sub-section added to focus on health-related information in the Tharzi Township. The Policy, Legal and Institutional Framework includes details on the Project Proponent's policies and Occupational Health and Safety system. These include or will include Waste Management, Storage and Handling of Hazardous Material, Emergency Response, Contractor Management procedures as well as stormwater and wastewater management plans that contribute to community health and safety protection. These are based on the "plan-do-check-act" environmental management system' s philosophy and ensure answers and corrective actions are implemented. The Environmental and Social Management Plan section is revised to incorporate details on the above where relevant.	The Section 6 Description of the Surrounding Environment: Socio-Economic Baseline is revised The Section 11 Environmental and Social Management Plan is revised
34.	There is no assessment on cultural and visual components.	- Include impact assessment on cultural places. - To describe visible component characteristics such as land, mountain, rivers and creeks, ponds and lakes and visual and landscape impacts. - To describe the detail mitigation measures to reduce the impacts.	The Impact and Risk Assessment and Mitigation Measures: Operation Phase section and sub-sections are revised to address the comments regarding cultural and visual components where relevant.	Cultural heritage is clarified under Sub-section 6.1.3 The Landscape and Visual Impact assessment is included under Sub-section 8.6
35.	Impact of project on climate change is not considered.	- Include basic analysis of emission from the project on climate change through research findings and estimation. - If emission of the project leads to global warming, it should be assessed with mitigation measures described.	The Revised EIA is revised to address the comments regarding climate change.	Not relevant to the limestone quary in this EIA Report. Addressed in the separate EIA Report of the cement plant expansion project.
36.	The natural disasters impacts of the project are not assessed.	- Natural disasters cause by project activities (e.g. Earthquake, flooding, Land slide and industrial risks- e.g. holding the danger materials, spills, fire, explosion, car accidents, damage at production factory and workshop, etc.)	The Description of the Surrounding Environment – Environmental Baseline is revised to address the comments regarding natural disasters with a new sub-section dedicated to the matter.	Clarifications are provided under Sub-section 5.3.5

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
		have to be analyzed with its potential severity. - To describe the mitigation measures of this impacts and implementation of monitoring.		
37.	No impact assessment of decommissioning phase and closure and post-closure phase.	1) To described the detail assessment of impacts for air, water, soil pollution, noise and vibration, odor, trees, animals and ecosystem, topography and landscapes, environmental and social impacts, health and safety impacts, Emergency cases and other accidents at decommissioning phase and closure phase, and mitigation measures for each impact and protection methods. 2) Besides, topography and landscape development plan has to be considered at post closure phase.	1) The details of the decommissioning phase for the Project are not known however activities will likely include deconstruction of structures and buildings and include similar activities, emissions to air and impacts as during the operation phase (see Section 8.1). It is therefore recommended that mitigation and management implemented during the operation phase is similarly applied during the decommissioning phase. 2) The development of closure plans for the limestone and mudstone quarries as well as coal mine will be included in the requirements of the Environmental and Social Management Plans.	The Sub-section 11.311.4 of the Environmental and Social Monitoring Plan provides mitigation measures for the decommissioning (and closure and post-closure) phase
38.	The cumulative impact assessment caused by the project activities and other projects nearby is not described.	1) To specify and assess the cumulative impact of other activities of project (e.g. limestone and mudstone production, usage of generators for electricity supply, etc.) and describe the methodology and approach for the assessment of cumulative impacts. 2) To specify and assess the cumulative impact of the proposed project and other projects nearby and describe the methodology and approach for the assessment of cumulative impacts. 3) To describe the mitigation measures of the cumulative impacts.	A new section "Cumulative Impact Assessment" is added.	The Section 10 Cumulative Impact Assessment is added
39.	**(c) Environmental Management Plan (EMP)** ***Budget for EMP implementation:*** Budget for the monitoring plan is not described. There is no estimation for the budget to use for mitigation measures.	1) To describe the detail budget of mitigation measures, monitoring plans, empowerment for the staffs, training, employment of environmental conservation staffs, vehicles and machinery.	The Environmental and Social Management Plan section are revised to incorporate details on monitoring plan, training, budget where relevant.	The Section 11 Environmental and Social Management Plan is revised

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40.	Not enough information on EMP and Environmental Monitoring Plan.	1) For natural disaster and accidental events, mitigation measures, Disaster Management Plan and emergency response plan must be considered separately. For those plans, the objectives, legal regulations, organizational responsibilities and accountabilities, maps and layout plans, photographs, implementation plan, management plans, monitoring plans and cost have to be fully described.	The Environmental and Social Management Plan section is revised to incorporate details on monitoring plan, training, budget where relevant. Disaster Management Plan and Emergency Response Plan are included as plans under the Environmental and Social Management Plan – Detailed Plans.	The Section 11 Environmental and Social Management Plan is revised
41.	Even it is described that the Project will comply with monitoring plan, it is found that the information is not enough. The monitoring plan was described in Table 11.1 and 11.2.	Environmental Monitoring plan has to be done and the following facts are needed to include; 1) To collect data of Ambient Air Quality, Ambient Noise and Vibration at raw material area, factory and nearest villages of cement factory two times per year. 2) Measurement for Air Emission from stack has to be compared with Air Emission levels for cement manufacturing and Lime manufacturing of National Environmental Quality (Emission) Guideline (NEQG) in page number 86. 3) The result of the 4 discharge points have to be compared with concerned parameter of NEQG and the mitigation measures must be described if the result exceeded the standards. 4) The indoor air quality measurement (SO_2, NO, CO_2, CO, O_3, VOC, etc.) for the health and safety of the staffs, especially for the directly affected workers (e.g. dust, emission gas, noise) are needed and monitoring their health status should be done by two times medical check-up per year. 5) Cumulative impact assessment and its mitigation measures are needed to be described in EMP.	The Environmental and Social Management Plan section and sub-sections are revised to address the comments regarding the monitoring plan as follows: 1) Environmental monitoring requirements are included in the EMP. We do not consider vibration from the plant operation relevant since the closest houses are approximately 3 km from the source of vibration; 2) Table 11.1specifies "*Emission concentrations of NOx, SO2 and PM from the existing and proposed kiln system and clinker cooler will not exceed those outlined in the Myanmar national Environmental Quality (Emission) Guidelines (2015) for cement and lime manufacturing and should be further reduced as far as practicable*"; 3) Comparison against NEQG limits is specified; 4) An occupational exposure monitoring programme for workers is added. Typically this would include particulate matter and perhaps SO2 and CO in the kiln area. 5) The environmental monitoring plan includes reference to relevant potential cumulative impacts.	The Section 11 Environmental and Social Management Plan is revised
42.	Even it is described that the implementation of monitoring	- Plan for employment of environmental conservation staffs and the occupational	The HSE organisation of STC is described in the Environmental and Social Management Plan section and sub-sections.	The Sub-section 11.6 Environmental and Social Management Plan - Institutional

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
	activities will be controlled by HSE team of STC, there is no information about the positions and duties of the members of HSE team.	terms and references for them are needed to describe. - To describe the detail positions and duties of HSE team of STC.		Setting and Implementation Arrangements is revised
43.	***Potential Development training:*** Even the environmental development training plan is described, there is not information on the cost for that.	- To describe the empowerment and training plan for environmental conservation staffs who will implement the EMP. - To describe that detail individual cost of monitoring plan, employment of HSE staffs for monitoring, empowerment and training for staffs, etc. to implement the EMP.	The Environmental and Social Management Plan section is revised to incorporate details on monitoring plan, training, budget where relevant.	The Section 11 Environmental and Social Management Plan is revised
44.	***Environmental Monitoring Report:*** No information on environmental monitoring report.	1) As the EIA procedure: Notification No (616/2015), Chapter (9), Section (108), it is required that the Project Proponent shall submit monitoring reports to the Ministry not less frequently than every six (6) months or periodically as prescribed by the Ministry.	The Environmental and Social Management Plan section and sub-sections is revised to address the comments regarding the monitoring plan.	The Section 11 Environmental and Social Management Plan is revised
45.	**(d) Public Participation** ***Result of Public consultation:*** It is described in EIA report 2016 by MESC that the public consultation for the second line was held in General Administration Department Office on 23rd December 2017 and 33 local peoples attended. In this report, the concerns of the local community are water supply in summer season, electricity supply and permission to grow in reserved forest by Forest Department. It was described that project proponent will supply water and electricity in EIA report 2016 by MESC.	- Page 26 to 34 of the EIA report done by ERM describes the public consultation meeting for scoping stage in November 2016 and socio-economic survey and group discussion done in January 2017 and explained the project activities and impacts. - For those socio-economic survey and baseline survey were done together with public consultation at the same time. The objectives, contents and methodology of public consultation, comments received from public must be described under the title of "Public consultation and information disclosure". - The ways to address public comments, problems and concerns must be described in the chapter of public consultation.	The Stakeholder Engagement section and public consultation sub-section are revised to reflect the outcomes of the additional disclosure and consultation undertaken by the EIA consultants and by STC from July to September 2017. The Project Description section is revised and a new Policy, Legal and Institutional Framework section, Project-Related Contractual and other Commitments are added to address the comments related to the concession arrangements.	Section 12 is revised to include results of stakeholder engagement and how stakeholders' concerns are considered in the Supplemental EIA. New sub-sections are added under Section 3 Administrative Framework: Sub-section 3.1 Local Policy, Legal and Institutional Framework, Sub-section 3.6: "Project-Related Contractual and other Commitments" and Sub-section 3.7 "Project Proponent Policies, Plans and Procedures" Permission for the mining of the mudstone quarry is described in the separate EIA Report for the mudstone quarry expansion.

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
	However, there was no public consultation and information disclosure in EIA report done by ERM. ***Land Acquisition and Resettlement Action Plan:*** Map in Annex mentioned the permission of mudstone production for 71 acre, but permission for 165 acre was not described in map.	1) Due to the reserved forest area, the permission of related departments are need to be described, and permission for 165 acre of mudstone area and its map must be described.		
	Corporate Social Responsibility-CSR			
46.	There is no information for CSR activities	To describe the CSR information as % of investment and CSR activities of project owners	The Policy, Legal and Institutional Framework Section, Project Proponent Policies, Plans and Procedures sub-section are revised to address the comments regarding CSR activities.	New sub-sections are added under Section 3 Administrative Framework: Sub-section 3.1 Local Policy, Legal and Institutional Framework, Sub-section 3.6: "Project-Related Contractual and other Commitments" and Sub-section 3.7 "Project Proponent Policies, Plans and Procedures
	General Advice			
47.	1) To include this table as annex of the revised report when it is submitted. This amendment table need to include following facts; Chapter, Paragraph, Suggestion and Comments, Amendment (or) Explanation/ solution and page number of revised report.		This table must be added as an Annex	This table is added as a new Annex
48.	2) According to the EIA procedure, it is instructed to submit both hard and soft copies. The report must be submitted in CD/ Digital format together and it should be disclosed in website of Project owner and described the web link.		The Draft EIA has been disclosed and the Final EIA will be disclosed as required.	[point noted]

#	Subject	Comment	Response to Comment	Revised EIA Section / Sub-section
49.	3) To describe the list of commitment according to the EIA report in a commitment letter		The Project Proponent will provide, along with the revised EIA, a letter of endorsement over the following commitments: (a) The EIA is as accurate and complete as reasonably feasible at the time of writing. (b) The EIA has been prepared in strict compliance with applicable laws including EIA procedure and the Terms of Reference agreed for the EIA. (c) the Project Proponent will fully comply at all times with the commitments, mitigation measures, and plans described in the EIA report.	The commitment letter is included in this Final EIA Report.
50.	4) To describe the commitments in the revised report including the management plan as required in the ESAP.		The Project Proponent will provide, along with the revised EIA, a letter of endorsement over the following commitments: (a) The EIA is as accurate and complete as reasonably feasible at the time of writing. (b) The EIA has been prepared in compliance with applicable laws including EIA procedure and the Terms of Reference agreed for the EIA. (c) the Project Proponent will fully comply at all times with the commitments, mitigation measures, and plans described in the EIA report.	The commitment letter is included in this Final EIA Report.

Annex J

Process of STM Limestone Quarry and Mine Plan

Process of STM Limestone Quarry

1. Clearing pit floor

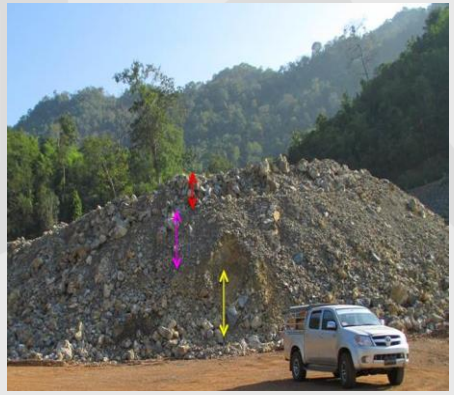
2. Setting out drill pattern

3. Drilling

4. Sampling

5. Explosive charging

6.Blasting



7. Blending for QC

8. Loading and Hauling

9. Tipping /Dumping

Process of STM Limestone Quarry

Drilling in Limestone Mine

Process of STM Limestone Quarry

Process of STM Limestone Quarry

Limestone mine (panoramic view)

Process of STM Limestone Quarry

Limestone mine (bird’s-eye view)

LIMESTONE MINE PLANNING

FOR

PYINYAUNG CEMENT PLANT

Shwe Taung Development Co., Ltd.

REFERENCE TO

ENGINEERING CONSULTANCY SERVICES

Module III - Mine Planning

Engineering Division, SCG Cement co.,Ltd.

PREFACE

This report is the Limestone Mine Planning report of Pyinyaung cement plant project, Referring to the Agreement of Consultancy Services Module III : Mine Planning

The report is based on the result of exploration activities where had been conducted during year 2009 – 2010

Since the exploration result had been submitted, the continuation work for limestone mine planning was prepared by SCG Cement Co., Ltd.

SCG Cement Co., Ltd.

Exploration Result

PT.Shwe Taung Development Co.,Ltd.(STD) under consulted by SCG Cement Co.,Ltd. was explored Limestone and submitted result as follow:-

- Topography
  Conduct by ground survey cover all Limestone concession.
- Drilling result
  Total 14 holes.
- Surface mapping
  Mapping of rock type, orientation (strike/dip angle) of bedding plane
- Surface sampling
  Total 156 surface sampling.

Mine Planning

Mine Planning Parameters

The given parameters used for mine design are:-

Limestone consumption

5,500 tons/day clinker

2,992,000 tons/year limestone

Mining Method

Truck & shovel (Excavator)

Truck Scania, 22 Cu.m.

Excavator Liebherr 964, bucket 2.5 – 5 Cu.m.

Rotary Drill, hole diameter 4 inch

The minedesign parameters used for planning are:-

Cut benches

Bench Height	10 m.
Berm Width	4-5 m.
Overall slope	45 degrees

Mining roads

Total Width	10 m.
Surface Width	8 m.
Safety Berm Width	1 m.
Gutter Width	1 m.
Gradient	10%

Computer modeling

Generate by MineSight Program.

Quality Block Dimensions 10 X 10 X 5 m.

The quality of each block was interpolated by Inverse Distance Weighting Method using trend search with 14 drill holes data and 156 surface sampling data (strike azimuth 0 degrees, dip 45 degrees).

Block quality show %SiO2, %Cao, %Al2O3 and %Fe2O3. And Cut off grade by %SiO2 Rang 0-3, 3-6, 6-9 and >9.

Detail Plan and Mine Design

Stage	Year	Elevation (MSL)	Production (M.Ton)	Details
2	1	795 - 710	0.9	Produce limestone from Mountain B Decrease level of working until + 710 MSL. And develop mining road M4 from level +710 MSL. to level +740 MSL. Develop mining area from top of Mountain C.
3	2.2	740 - 700	3.1	Produce limestone from Mountain A, B and C decrease level of working until + 700 MSL. And develop mining road M5 from level +700 MSL. to level +800 MSL. Develop mining area from top of Mountain D.
4	1	820 - 700	4.0	Produce limestone from Mountain D decrease level of working until + 700 MSL.
5	9.7	700 - 650	13.7	decrease level of working until + 650 MSL.
6	11.5	650 - 600	25.2	decrease level of working until + 600 MSL.
7 Final Pit	11.6	600 - 550	36.8	decrease level of working until + 550 MSL.

Remark : SG 2.7
Geology factor 0.7
Mining factor 0.9

Reserves and Quality

Limestone Mine for Pyinyaung Cement Plant(5500 TPD Process)

Stage : 2

BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
740	321,653	547132	2.50089	50.2598	0.80451	0.087	3.368	
730	422,732	719,067	2.716	50.232	0.776	0.085	3.292	
720	528,971	899,780	3.172	49.825	0.829	0.089	3.276	
710	305,697	519,991	3.858	49.709	0.776	0.086	3.096	
TOTAL	**1,579,053**	**2,685,969**	**3.062**	**50.006**	**0.796**	**0.087**	**3.258**	**0.9**

Stage : 3

BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
750	80	136	9.06	43.00	0.51	0.08	6.62	
740	19,417	33,028	5.298	50.949	0.646	0.140	1.422	
730	395,552	461,129	4.231	52.468	0.683	0.099	0.568	
720	731,974	1,245,088	4.715	51.819	0.666	0.097	0.937	
710	1,107,238	1,537,618	4.785	51.084	0.659	0.092	1.517	
700	2,217,868	3,273,820	4.448	50.362	0.658	0.084	2.282	
TOTAL	**4,472,049**	**6,550,819**	**4.560**	**50.968**	**0.661**	**0.090**	**1.717**	**2.2**

Stage : 4

BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
820	280	476	1.85	54.16	0.70	0.11	0.17	
810	6,026	10,250	3.05	53.51	0.73	0.10	0.18	
800	16,309	27,742	5.03	52.41	0.79	0.08	0.18	
790	36,259	61,677	5.87	51.88	0.71	0.07	0.23	
780	66,649	113,370	4.97	52.31	0.65	0.08	0.28	
770	101,306	172,322	4.23	52.76	0.62	0.08	0.30	
760	129,878	220,922	3.49	53.22	0.62	0.08	0.27	
750	147,283	250,528	3.13	53.46	0.67	0.08	0.30	
740	163,574	278,239	2.60	53.78	0.72	0.08	0.33	
730	186,671	317,527	2.37	53.66	0.71	0.09	0.54	
720	211,560	359,864	2.59	52.93	0.65	0.10	1.03	
710	233,564	397,292	2.65	52.93	0.67	0.09	1.01	
700	305,155	519,069	2.68	52.68	0.65	0.09	1.15	
TOTAL	**17,142,715**	**2,729,278**	**4.59**	**50.52**	**0.68**	**0.08**	**1.98**	**0.9**

Stage : 5

BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
690	2,947,328	5,013,405	4.306	50.478	0.691	0.081	2.220	
680	3,303,759	5,619,694	4.369	50.440	0.690	0.079	2.194	
670	3,528,754	6,002,411	4.547	50.154	0.675	0.078	2.304	
660	3,642,303	6,195,557	4.703	50.369	0.667	0.076	2.000	
650	3,720,571	6,328,691	4.932	51.097	0.665	0.078	1.272	
TOTAL	**17,142,715**	**29,159,758**	**4.571**	**50.508**	**0.678**	**0.079**	**1.998**	**9.7**

Stage : 6

BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
640	3,797,891	6,460,213	5.009	51.284	0.658	0.084	1.051	
630	3,900,284	6,634,383	5.804	51.685	0.652	0.091	0.397	
620	4,035,157	6,863,802	5.837	51.781	0.685	0.097	0.334	
610	4,188,998	7,125,486	5.492	51.966	0.654	0.098	0.350	
600	4,238,119	7,209,040	5.502	51.900	0.667	0.102	0.362	
TOTAL	**20,160,449**	**34,292,924**	**5.536**	**51.679**	**0.663**	**0.092**	**0.533**	**11.5**

Stage : 7

BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
595	2,101,937	3,575,395	5.26	51.91	0.66	0.10	0.37	
590	2,089,141	3,553,629	5.16	51.91	0.69	0.10	0.39	
585	2,074,351	3,528,471	4.98	52.11	0.68	0.10	0.29	
580	2,058,726	3,501,893	5.11	51.91	0.66	0.10	0.29	
575	2,045,571	3,479,516	4.81	52.04	0.66	0.10	0.30	
570	2,032,560	3,457,385	4.95	52.00	0.62	0.10	0.30	
565	2,016,060	3,429,318	5.20	51.72	0.65	0.09	0.31	
560	1,994,584	3,392,787	4.87	51.88	0.66	0.10	0.30	
555	1,970,616	3,352,018	5.11	51.72	0.69	0.11	0.30	
550	1,940,871	3,301,422	5.10	51.68	0.70	0.11	0.30	
TOTAL	**20,324,417**	**34,571,833**	**5.06**	**51.89**	**0.67**	**0.10**	**0.32**	**11.6**

Summary BENCH TOE	INSITU ORE (BCMS)	RUN OF MINE (TONNES)	INSITU GRADES					MINE LIFE (YEARS)
			SIO2	CAO	AL2O3	FE2O3	MGO	
820	280	476	1.85	54.16	0.70	0.11	0.17	
810	6,026	10,250	3.05	53.51	0.73	0.10	0.18	
800	16,309	27,742	5.03	52.41	0.79	0.08	0.18	
790	36,259	61,677	5.87	51.88	0.71	0.07	0.23	
780	66,649	113,370	4.97	52.31	0.65	0.08	0.28	
770	101,306	172,322	4.23	52.76	0.62	0.08	0.30	
760	129,878	220,922	3.49	53.22	0.62	0.08	0.27	
750	147,363	250,664	2.61	52.79	0.79	0.09	1.06	
740	504,644	858,399	2.60	52.18	0.75	0.09	1.65	
730	1,004,955	1,497,723	3.21	51.80	0.73	0.09	1.68	
720	1,472,505	2,504,731	3.76	51.41	0.71	0.09	1.74	
710	1,646,499	2,454,901	4.20	50.90	0.71	0.09	1.94	
700	2,523,026	4,291,667	4.23	50.64	0.66	0.08	2.14	
690	2,947,317	5,013,386	4.31	50.48	0.69	0.08	2.22	
680	3,303,676	5,619,553	4.37	50.44	0.69	0.08	2.19	
670	3,528,736	6,002,380	4.55	50.15	0.67	0.08	2.30	
660	3,631,928	6,177,910	4.71	50.39	0.67	0.08	1.98	
650	3,699,012	6,292,019	4.94	51.12	0.67	0.08	1.25	
640	3,764,108	6,402,748	5.01	51.30	0.66	0.08	1.03	
630	3,854,239	6,556,061	5.58	51.57	0.63	0.09	0.59	
620	3,977,690	6,766,051	5.90	51.72	0.68	0.09	0.34	
610	4,122,013	7,011,544	5.60	51.92	0.67	0.10	0.34	
600	4,163,378	7,081,906	5.48	51.94	0.66	0.10	0.36	
590	4,107,165	6,986,288	5.21	51.91	0.67	0.10	0.38	
580	4,038,606	6,869,669	5.04	52.01	0.67	0.10	0.29	
570	3,979,742	6,769,541	4.88	52.02	0.64	0.10	0.30	
560	3,909,134	6,649,437	5.04	51.79	0.66	0.10	0.30	
550	3,807,457	6,476,484	5.13	51.68	0.69	0.11	0.30	
TOTAL	**64,489,900**	**109,139,821**	**4.48**	**51.74**	**0.69**	**0.09**	**0.97**	36.5

E230500. E230750. E231000. E231250. E231500.

N2310750. N2310500. N2310250. N2310000. N2309750. N2309500. N2309250. N2309000.

N

SCALE 1:2,000

0 10 20 30 40 50 60 70 80 90 100

Level +710MSL

Mining Road M1, 760m.

Mining Road M2, 690m.

Level +710 MSL

year 0.9

Mountain C

Mining Road M4, 320m.

Coordinate System:MYANMAR DATUM2000(UTM)

Reference Ellipsoid: Everest 1830

Level Reference= M.S.L(Myanmar Survey Department)

PROJECT: Limestone Mine Planning	OWNER: Pyinyaung Cement Plant
TITLE: Stage : 2	DESIGNED / CHECKED / APPROVED
DWG. NO. 002	DATE 10/01/2017
DRAWN	SHEET 03 / TOTAL 19

SCG CEMENT

Engineering Division, SCG Cement Co., Ltd.

E230500. E230750. E231000. E231250. E231500.

N2310750. N2310500. N2310250. N2310000. N2309750. N2309500. N2309250. N2309000.

Mountain D

+800

Mining Road M5, 970m.

+700

N

SCALE 1:2,000

0 10 20 30 40 50 60 70 80 90 100

Year 3.1

Level +700 MSL

Mining Road M1, 760m.

+700

+650

+670

Level +700 MSL

Year 3.1

+705 +715 +725 +735 +745

+650

+625

Level +700 MSL

Year 3.1

Coordinate System:MYANMAR DATUM2000(UTM)

Reference Ellipsoid: Everest 1830

Level Reference= M.S.L(Myanmar Survey Department)

PROJECT: Limestone Mine Planning		OWNER: Pyinyaung Cement Plant	
TITLE: Stage : 3		DESIGNED	
		CHECKED	
		APPROVED	
SCG CEMENT	DWG. NO. 002 / DATE 10/01/2017	DRAWN	SHEET 04 / TOTAL 19
Engineering Division, SCG Cement Co., Ltd.			

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N2310750. N2310500. N2310250. N2310000. N2309750. N2309500. N2309250. N2309000.

N

SCALE 1:2,000

0 10 20 30 40 50 60 70 80 90 100

Level +700 MSL

Year 4

Mining Road M1, 760m.

Coordinate System:MYANMAR DATUM2000(UTM)

Reference Ellipsoid: Everest 1830

Level Reference= M.S.L(Myanmar Survey Department)

PROJECT: Limestone Mine Planning	OWNER: Pyinyaung Cement Plant
TITLE: Stage : 4	DESIGNED / CHECKED / APPROVED
DWG. NO. 002	DATE 10/01/2017
DRAWN	SHEET 05 / TOTAL 19

SCG CEMENT

Engineering Division, SCG Cement Co., Ltd.

E230500. E230750. E231000. E231250. E231500.

N2310750. N2310500. N2310250. N2310000. N2309750. N2309500. N2309250. N2309000.

N

SCALE 1:2,000

0 10 20 30 40 50 60 70 80 90 100

Level +650 MSL

Year 13.7

Level +650 MSL

Year 13.7

Level +650 MSL

Year 13.7

Coordinate System:MYANMAR DATUM2000(UTM)

Reference Ellipsoid: Everest 1830

Level Reference= M.S.L(Myanmar Survey Department)

PROJECT: Limestone Mine Planning		OWNER: Pyinyaung Cement Plant	
TITLE: Stage : 5	DESIGNED		
	CHECKED		
	APPROVED		
SCG CEMENT	DWG. NO. 002	DATE 10/01/2017	DRAWN
	SHEET 06	TOTAL 19	
Engineering Division, SCG Cement Co., Ltd.			

E230500.
E230750.
E231000.
E231250.
E231500.
N2310750.
N2310500.
N2310250.
N2310000.
N2309750.
N2309500.
N2309250.
N2309000.

N

SCALE 1:2,000

0 10 20 30 40 50 60 70 80 90 100

Level +600 MSL

Year 25.2

Level +600 MSL

Year 25.2

Coordinate System:MYANMAR DATUM2000(UTM)

Reference Ellipsoid: Everest 1830

Level Reference= M.S.L(Myanmar Survey Department)

PROJECT: Limestone Mine Planning		OWNER: Pyinyaung Cement Plant	
TITLE: Stage : 6		DESIGNED	
		CHECKED	
		APPROVED	
SCG CEMENT	DWG. NO. 002 / DATE 10/01/2017	DRAWN	SHEET 07 / TOTAL 19
Engineering Division, SCG Cement Co., Ltd			

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N2310750. N2310500. N2310250. N2310000. N2309750. N2309500. N2309250. N2309000.

N

SCALE 1:2,000

0 10 20 30 40 50 60 70 80 90 100

Level +550 MSL

Year 36.8

Level +550 MSL

Year 36.8

Coordinate System:MYANMAR DATUM2000(UTM)

Reference Ellipsoid: Everest 1830

Level Reference= M.S.L(Myanmar Survey Department)

PROJECT: Limestone Mine Planning		OWNER: Pyinyaung Cement Plant	
TITLE: Stage : 7 Final Pit		DESIGNED	
		CHECKED	
		APPROVED	
SCG CEMENT	DWG. NO. 002 / DATE 10/01/2017	DRAWN	SHEET 08 / TOTAL 19
Engineering Division, SCG Cement Co., Ltd.			

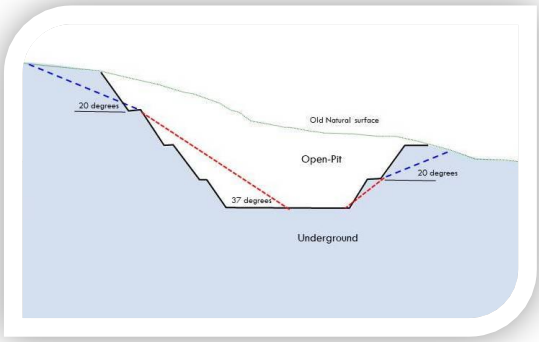
Annex - K

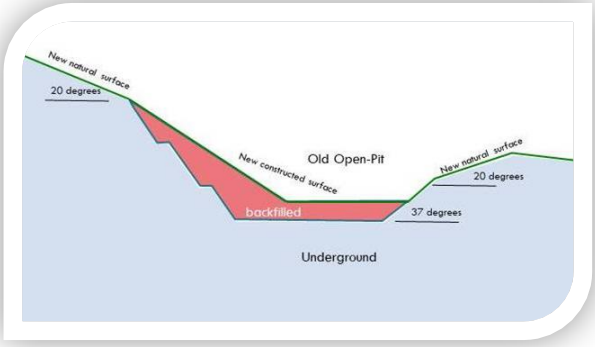
STM Conceptual Mine Closure and Rehabilitation Plan

SHWE TAUNG MINING COMPANY, LIMITED
(PYINYAUNG)

SHWE TAUNG MINING COMPANY, LIMITED (STM)

CONCEPTUAL
MINE CLOSURE AND REHABILITATION PLAN





DECEMBER, 2017

Executive summary

Shwe Taung Mining Company Limited (STM) operates a limestone mine and a mudstone mine in Pyinyaung area, Thazi Township and a coal mine in Paluzawa area, Kalewa Township. This conceptual mine closure and rehabilitation plan is prepared for a prerequisite to fulfill the requirements for complying Myanmar Mines Law, Myanmar Environmental Conservation Law as well as the Performance Standards (PSs) of International Finance Corporation (IFC).

The purpose of this Mine Closure and Rehabilitation Plan is to describe how STM operation will be successfully closed and rehabilitated to achieve the agreed post-closure, land-uses and the agreed environmental outcomes for identified values. The plan also outlines the performance criteria that will be used to measure successful closure and rehabilitation.

For closure planning purposes, the site has been broken up into closure domains. The closure requirements and implementation works are similar within each domain, but may vary between domains. The various elements within each domain will be closed and rehabilitated where applicable to a specified/agreed standard. Rehabilitation and closure standard measures, closure design principles and completion criteria are documented.

Post-closure monitoring is also included in this plan to ensure these requirements are appropriately understood and costed. At this stage of planning, the monitoring requirements are generalised, but over time, the post-closure monitoring program and schedule will be tailored to suit agreed completion criteria requirements. Ongoing monitoring, data collection and observation during operation are acknowledged as a key component in eventual relinquishment of the site.

This document describes aspects of the planned stakeholder engagement program. Such engagement and consultation on mine closure will only be meaningful closer to the closure date when the implications of closure on the post-closure community can be defined and understood.

This Mine Closure and Rehabilitation Plan will later be supported by risk-based concept level (pre-feasibility) closure engineering designs that use best practice technology. The level of detail in the plan is commensurate with the early stages of planning.

Closure planning is a continually evolving process, and actions carried out in recent years to improve the accuracy and certainty of the Mine Closure and Rehabilitation Plan include:

- engagement of demolition consultants to refine major plant demolition plans, estimates and methodologies;
- development of preliminary TSF cover designs including design and performance criteria;
- undertaking a preliminary/desktop contaminated site assessment to define the level and extent of any ground contamination and improve volumetric estimates; developing a preliminary stakeholder engagement framework for commencing regulator engagement;
- conducting annual closure planning reviews including detailed review of the closure risks and the associated risk controls.

The integrated closure planning system followed within STM, ensures that additional studies (and research where required) will be carried out to provide design data and to increase certainty and confidence in the design and implementation strategy well in advance of closure execution works. Outcomes from the research, study and consultation will be fed into the closure plan review as part of the continuous improvement and development of this Mine Closure and Rehabilitation Plan.

Contents

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List of Figures

1. Introduction

In this plan, the term 'rehabilitation' refers to the re-establishment of biota on areas disturbed as part of the proposed development, and the processes necessary to achieve re-establishment. The term 'closure' relates more to the decommissioning of the various components of the development and the establishment of a landform that will ensure the final site does not leave unsuitable hazards to health, safety and the surrounding environment. As the two processes are closely related and interdependent, they are addressed in a single management plan.

1.1 Mining operation background

STM is operating a limestone mine, at Thapyay-Taung Limestone Deposit, in Pyinyaung Village Track, Thazi Township, Meikhtila District, Mandalay Region. The mine site is located at (3.8) miles north of Pyinyaung Village.

The limestone from the deposit is being exploited by open-cut mining method. It is won from the mine by conventional drill & blast, load and haul with heavy mining machineries. Limestone is transported to the crusher of the STC's Cement Plant.

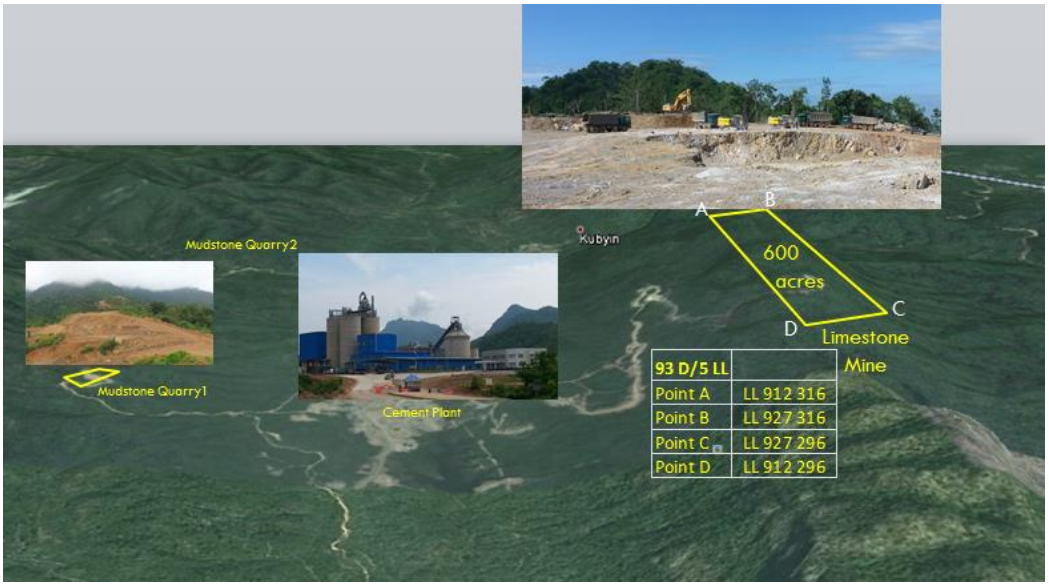


Figure 1 limestone mine site

The limestone from the deposit is being exploited by open-cut mining method. It is won from the mine by conventional drill & blast, load and haul with heavy mining machineries. Limestone is transported to the crusher of the STC's Cement Plant.

STM is also operating a coal mine to fulfill fuel requirement for STC cement plant at Pyinyaung. The mine is situated by Chaungson village, Paluzawa area, Kalewa township, Kale distrct in Sagaing Region. The mine site is located at (25) miles north of Kalewa town.

The coal is mined by open-cut mining method. It is won from the mine by conventional excavation with excavators (drill & blast in latter date), load and haul with heavy mining machineries. The coal is transported to the staging area at Paluzawa, shipped by barges to Mandalay Jetty and hauled to the STC's Cement Plant.

1.2 Legal and regulatory requirements

Each STM site must comply with all applicable laws and other legal requirements and provide proof of such compliance as required.

For specific purpose, the acts and laws that Shwe Taung Cement Co., Ltd shall comply with are as follows:

1) Myanmar Mines law
2) he Conservation of Environmental Law (2012)
3) The Conservation of Environmental Rules (2014)
4) Conservation of Water Resources and River Law (2006)
5) Conservation of Water Resources and River Rules (2013)
6) The Motor Vehicles Law (2015) and Existing Rules (1989)
7) issued by respective Regional/State government, and
8) International Treaties and Agreements related to Environmental Conservation

Where applicable laws and other legal requirements do not require performance at least to the level of this Policy and/or to IFC PS6, activities must be conducted in a manner that is consistent with this Policy, taking into consideration any social and cultural sensitivity of communities.

These require that the closure planning (for decommissioning, remediation and rehabilitation) of all STM's operations must be fully integrated into Life of Asset planning. Updates to the Mine Closure and Rehabilitation Plan are reported to the Minister for Natural Resources and Environmental Conservation. Environmental Management and Monitoring Report (EMMR) (soon to become the Annual EPMP Report).

1.3 Mine Closure and Rehabilitation Plan purpose

The primary purpose of this Mine Closure and Rehabilitation Plan is to:

- describe the proposed post-closure landforms and land-uses and the performance criteria that will be used to measure successful closure and rehabilitation;
- demonstrate that there is an adequate level of engineering and planning in support of the Life of Asset closure cost estimate and hence the derivation of closure and rehabilitation accounting provision;
- demonstrate that risk-based closure planning at STM mine is fully integrated into Life of Asset Planning to ensure that the appropriate level of study (and where necessary research), engineering and management will be implemented during the remaining life of the operation in order to achieve successful closure with acceptably low post-closure risks.

Within this context, the secondary purpose is to:

- identify and document the legal requirements, liabilities, obligations, commitments, design and completion criteria for closure;
- identify, document and manage risks associated with closure in consideration of IFC Performance standards and the guidance note provided by the Myanmar Government;

- provide the basis for the ongoing review of rehabilitation and closure assumptions, risks and risk controls, and the ongoing refinement of closure designs and planning;
- integrate closure planning with Life of Asset planning;
- identify and schedule opportunities for progressive rehabilitation (where practical);
- identify the need for further research, assessments and studies in order to ensure the reduction of the uncertainties around closure and the effective and optimum use of available resources and technology;
- ensure, through a consultative process, that the plan developed is technically achievable, agreed to and followed during the operating life to minimise rework and life-of-mine costs;
- address the social and community aspects associated with closure including socio-economic impacts following closure of the operation, long-term liabilities to STM and the government and public, and support end land use opportunities that will benefit the post-closure community.

1.4 Land tenure and use

STM has two leased concessions for large scale production JV with Mining Enterprise1 (ME1):

1) Limestone mine (600 acres)
2) Coal mine (3378.2 acres)

Agreement contract term for both are 25 years and extendable. Preparation is being made to sign a lease agreement contract for mudstone.

1.5 Evolution and Revisions of the Mine Closure and Rehabilitation Plan

Closure and rehabilitation planning is regarded as being initially conceptual, becoming progressively more detailed through an integrated and systematic process (see Figure 2). Planning for mine closure and rehabilitation must be sufficiently flexible to allow for operational changes as well as changes in technology and/or regulatory requirements. The planning process is also ongoing as more detailed information about site-specific closure risks and rehabilitation comes to hand, allowing certainty around closure success to be progressively increased. This evolutionary process is consistent with relevant government and industry guidelines and aligns with the STM Life of Asset closure planning requirements.

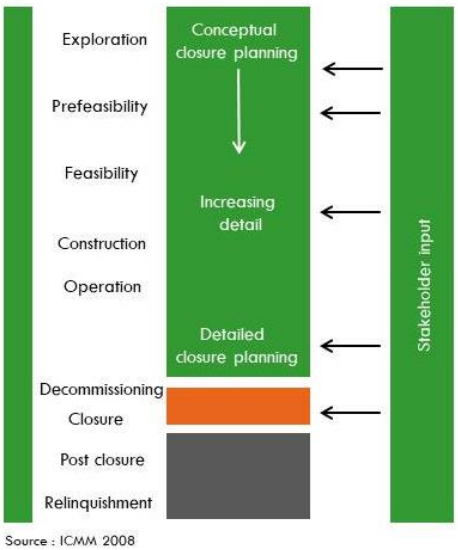


Figure 2 Closure planning process (from ICMM2008)

Closure plans within STM are reviewed for any material changes on an annual basis for or the purposes of closure financial provisioning.

The Mine Closure and Rehabilitation Plan will continue to be reviewed and updated annually, in preparation for potential events such as a material change in operating parameters. Wherever possible and practical, closure planning and closure risk assessments will continue to involve relevant internal and external stakeholders.

2. Environmental characterization

2.1 Physical environment

2.1.1 Topography

The topography in and around the cement plant area comprises considerably flat terrain with an average elevation of 350 m above MSL. The areas where the limestone and mudstone mines consist are mountainous. The limestone mine started from 775 m bench and the mudstone mine started from 775 m bench.

2.1.2 Climate

The Climate at site can be described as a tropical monsoon climate with a hot and dry season (pre-monsoon), a rainy season with moderate rainfall (monsoon) and a cool season (post-monsoon). It is characterized by strong monsoon influences, has a considerable amount of sun, moderate rainfall, and high humidity. The hot dry season (summer) is from March to middle of June. The rainy season (monsoon season) starts from the middle of June to the end of September. The cool season (winter) starts from November to and continues till the end of February. The average temperatures ranging from 18 degrees C in winter to 29 degrees C in summer. The monthly maximum temperature was recorded at 41.6 °C in April. The monthly minimum temperature was recorded at 9.5 °C in January.

2.1.3 Rainfall

STM has it own rainfall measuring station at site. The station has a record of daily rainfall measurements from 2012 to date. Monthly average rainfall and the largest recorded daily rainfall for each month are presented in Table 1. The largest daily rainfall event recorded in 6 years was 5 inches (125 mm) on 11 October 2017.

Total Monthly Rainfalls from 2012 to date are depicted in Table

RAINFALL (mm)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
2012	-	-	-	67.5	175.0	227.0	91.0	95.0	285.5	153.0	67.0	-	**1161.0**
2013	11.0	-	11.0	7.0	127.0	100.0	56.0	173.0	289.5	133.0	2.5	15.0	**925.0**
2014	-	-	-	43.5	93.0	170.0	74.5	103.0	82.5	142.5	5.5	1.0	**715.5**
2015	38.5	-	-	6.0	42.5	117.0	281.0	181.0	282.0	203.0	-	-	**1151.0**
2016	15.0	-	-	75.0	205.0	465.0	386.0	364.0	328.0	525.5	242	-	**2605.5**
2017	35	-	23	117.0	304.0	318.0	202.0	343.0	402.0	378.0	109		**2231.0**
6 yrs' mth avg	**24.9**	**0.0**	**17.0**	**52.7**	**157.8**	**232.8**	**181.8**	**209.8**	**278.3**	**255.8**	**85.2**	**8.0**	
6 yrs' month max	**35.56**	**0.00**	**23.37**	**76.20**	**121.92**	**121.92**	**76.20**	**91.44**	**106.68**	**127.00**	**101.09**	**8.128**	
										11-Oct-17			

Table 1: Total Monthly Rainfall at Cement Plant Complex

2.1.4 Hydrology

The Project is located in the Kubyin Reserved Forest region within the Kubyin valley watershed. There is a small Kyauk tala creek at the north of the project. Clean storm water from the Thapyay taung flows

into it and the creek merges with Kupaung Stream at Kubyin village. The water impoundment area east of the factory was transformed into two reservoirs. The two reservoirs have a combined capacity of 50 million gallons of water. There was no precedent of major flooding during the rainy season or wet months. The two reservoirs lie in a north south direction

2.1.5 Surface Water Resources and Quality

There are no big flowing-streams in this area. Three water sources, namely Yay Shin creek, Polaung creek and Kubyin creek exist. Water for the cement Plant is harvest rain water collected in the two reservoirs with a total storage capacity of 50 million gallons. Backup water is sourced from the weir at Kubyin creek in summer time.

ERM's baseline study for ESIA indicated that water quality impacts could be a potentially significant issue for the construction and operation of the cement plant, for example, in case of contaminated run-off from the coal storage area as well as sediment loaded run-off from the mudstone quarries. Potential contamination of stream water from the above sources may affect the Kubyin Village which is located downstream of the cement plant and mudstone mines. Therefore, four water samples from the places were collected and analyzed. Water sample from the coal staging area has concerns and is being monitored.

2.2 Biological environment

2.2.1 Flora

The most abundant plant (big trees) in term of number was *Celits tetrandra* followed by *Adina cordifolia is* and *Bombax ceiba*. In small trees *Antidesma bunius* dominated others followed by *Bauhinia acumunata* and *Croton oblongifolius*. The most abundant shrub in term of number was *Chromotaena odorata* followed by *Barlerias trigosa* and *Calotropis procera*.

The most abundant herb in term of number was *Gynandropsis gynandra,* followed by *Achyrathes aspera* and *Curcuma longa*. The most dominant climber was *Argyreia nervosa,* followed by *Mucuna purriens* and *Butea parviflora*.

A total of 204 species of natural plants were found, identified and recorded. The large majority were angiosperms while a few bryophytes and pteridophytes were also found. Of the 239 species recorded 204 species were natural plants (natural biodiversity) belonging to 65 families while 35 species were artificial plants (cultivated biodiversity) belonging to 23 families. Plants were also categorized according to size and nature as big tree, tree, climber, climber-creeper, shrub, shrub-creeper, creeper, herbs, epiphytes, bamboo palm and grass etc.

2.2.2 Fauna

In term of diversity the family Muscicapidae was represented by 7 species and dominated all other families. That was followed by the families Falconidae, and Timalidae with 4 species each. Then followed the families Ardeidae, Dicruridae, Pycnontidae and Phylloscopidae with 3 species each. The remaining 33 families were each represented by only 1 – 2 species. No globally threatened species were recorded during the survey. All the species found were commonly found ones. None of them were included in the IUCN Red List. The area was not in the designated Important Birds Area (IBA) or Protected Areas System (PAS) of Myanmar. There was no natural lake or wetland nearby which acted as bird sanctuary or area where birds aggregated.

2.3 Socio-economic and cultural environment (anthropic)

Ku Byin Village is a remote, poor and backward village under the jurisdiction of Pyi Nyaung Village Tract. It is about 8 miles north of Pyi Nyaung Village which is situated on the Meit-hti-la- Taung-gyi Highway. Formerly Kubyin Village was accessible only by foot or by bicycle. The access road (motor road) built by Shwe Taung Cement Co., Ltd, has let them easy access to Pyi Nyaung village and to other regions. There are a few small farms (yar) where rice, the main crop, is grown. Rice is grown for only one season per year. There are no paddy field in the area and no substantial agriculture. Except for a few rice farmers most villagers are involved in cutting trees for fuel wood and for the production of charcoal. Many also work as labourers for the Forest Department in teak nursery and teak plantation work. There are also few gardeners or orchard workers. Many also work in seasonal jobs such as farmhand, collection of bamboo shoots and mushrooms etc. There is no full time hunter or fisherman. The severe or even total depletion of fish and wildlife no longer support such occupation. No one could eke out a living as full time fisherman or hunter. As it was not feasible to catch fish by the usual cast net a few had occasionally resorted to fishing by means of electric shocking. It is difficult to estimate the household income for each household. The growth rate of the local economy and the local GDP are unknown.

3. Closure and Rehabilitation Framework

The term 'rehabilitation' adopted by STM is often used interchangeably in various references and guidelines with 'restoration' and 'reclamation'. Rehabilitation is defined as "a process where disturbed land is returned to a stable, productive and self-sustaining condition, taking future land use into account.

The rehabilitation sequence is normally considered to comprise of the following activities:

- developing designs for appropriate landforms for the mine site;
- creating landforms that will behave and evolve in a predictable manner, according to the design principles established;
- establishing appropriate sustainable ecosystems.

3.1 Operational Environmental Management Framework

STM conducts all operational activities in an environmentally responsible and sustainable manner in alignment with the STM Charter and Sustainable Development Policy. Among other things, the Sustainable Development Policy also:

- details the company's aspirations towards zero harm to people, host communities and the environment and towards working to achieve leading industry practice;
- stipulates that all STM operations would develop, implement and maintain management systems for sustainable development that drive continual improvement and ensure that the policy objectives are met.

The Closure and Rehabilitation Framework forms part of the site-wide Environmental Management Framework, which is the overarching strategy for capturing and translating the obligations, commitments and management measures presented in the ESIA and other relevant documents.

The environmental management framework has, as its implementation mechanism, a project-wide Environmental Management System (EMS), consistent with the IFC performance Standards and ISO Environmental Standards.

3.2 Final land use

For the purposes of conceptual closure planning and financial provisioning, the final land uses have been defined, as far as is reasonably achievable, as:

- Special mining lease -
  - land use for rehabilitation at original ground level – revegetated vacant crown land with potential for restricted grazing;
  - above ground raw material storage facilities and below ground open pit – vegetation free vacant crown land with restricted public and fauna access;
  - above ground waste rock storage facility – naturally revegetated vacant crown land with restricted public and fauna access.
- Areas outside of special mining lease – land use consistent with neighbouring properties.

The final closure land uses will be negotiated with the stakeholders and communities nearer the mine closure date. It is possible that a variety of land uses will be discussed and negotiated in order to ensure that the post-closure land uses promote and support the viability and sustainability of the post-closure communities that will remain in the region after closure of the mining operation.

3.3 Closure outcomes and assessment criteria

The high level closure outcomes and assessment criteria for STM are summarised in Table 2, from which site-specific, domain-specific and area-specific assessment criteria are derived. The environmental outcomes are based on post-closure, to be achieved in the long term following closure and rehabilitation activities. The activities undertaken during closure would be carried out to comply with the outcomes and compliance criteria in place during the mines operation.

Table 2 Post-closure outcomes and assessment criteria

EM Program	Environmental outcome	Assessment criteria	Applicable domain
Use of Natural Resources			
Land disturbance and rehabilitation	Rehabilitation provides a geotechnically and geochemically stable and safe environment to reduce the need for long-term monitoring and maintenance	Rehabilitation of sites and its integration into adjacent land uses occurs as soon as reasonably practical and in accordance with the Leading Practice Sustainable Development Program for the Mining Industry. Erosion resistant landforms achieved such that post-closure remediation works are not required. areas.	1-6
Spread of pest plants and animals	No significant increase in the areas of infestation or abundance of declared pest plants, plant pathogens or pest animal populations as a result of closure.	No material difference in abundance of declared pest species compared to appropriate reference areas. No introduction of new self-sustaining declared pest populations post-closure as a result of STM activities.	1-6
Aquifer level drawdown	No significant adverse impact on third party groundwater users.	Groundwater quality and yield, for third partyusers, commensurate with agreed future land use.	1-6
Operation of industrial systems			1-6
Particulate emissions	No adverse impacts to public health as a result of particulate emissions from the final landforms achieved.	NEPM (ambient air) limits for public exposure or the relevant criteria at the time of closure.	1-6
Generation of			1-6

EM Program	Environmental outcome	Assessment criteria	Applicable domain
industrial wastes			
Embankment stability of waste dump	Final landforms geotechnically stable.	No significant embankment failure.	1-6
Tailings and Rock Storage Facility (RSF) seepage	No significant adverse impact on vegetation as a result of seepage from the RSF post-closure. No compromise of existing and future land uses on adjoining areas as a result of seepage from the RSF post-closure.	Surface water quality commensurate with agreed future land use (for third party users).	1-6
Stormwater discharge	No significant adverse impact on local drainage patterns and water quality, arising from discharge associated with the final landform, which would compromise existing water use and water-dependent ecosystems.	All contact stormwater maintained within designated stormwater management areas.	1-6
Solid waste disposal	No significant adverse impacts from solid wastes following closure.	Relevant criteria at the time of closure, for surface water and groundwater and for air quality. Landfill facility decommissioning and/or rehabilitation in accordance with SA EPA landfill guidelines and requirements.	1-6
Containment of waste rock	Maintain structural integrity of the RSF.	No unplanned structural failure to the RSF resulting in a significant adverse impact to third party surface and groundwater users.	7
Employment and accommodation of people			
Community interactions and workplace interactions	Communities in which STM operates value their relationship with us.	Safe conditions and controls to restrict inadvertent access to unsafe environments following rehabilitation .	1 -6

4. Stakeholder and community

4.1 Stakeholder consultation strategy

The involvement of stakeholders in developing agreed closure outcomes, performance criteria and future land use is an important component of the rehabilitation and closure planning process. One of the primary objectives of the Mine Closure and Rehabilitation Plan is to ensure that stakeholder needs, concerns and aspirations are taken into account when closure planning.

A consultation process is also required in order to develop overall mine closure and rehabilitation outcomes and criteria for end land use, cultural and heritage values, government regulation and other legal requirements. The process also provides the framework for on-going consultation in accordance with government and community expectations.

STM has systems in place to identify stakeholder risks and concerns related to the operations. These concerns are addressed in an Annual Community Relations Plan. Future stakeholder engagement for closure planning would be undertaken in the same spirit as the current operational engagement, and using the established processes as a minimum. The main issues that the Community Relations Plan will need to address with regards to mine closure and rehabilitation planning are:

- complete identification of stakeholder groups, as well as their topics of interest and degree of influence;
- effective two-way communication of closure issues, specially related to potential economic activities after cessation of mining, land use objectives, potential residual risks and predicted post-closure performance;
- conflict resolution when different stakeholders have contradictory expectations (e.g. land use alternatives).

In order to ensure that consultation and engagement is carried out at the appropriate time, STM Public Relation representative(s) participate in the annual closure planning review and closure risk assessment review.

A high-level stakeholder engagement plan for closure will be prepared at an appropriate lead time for stakeholder engagement regarding any scheduled progressive closure activities.

4.2 Closure and rehabilitation stakeholders

A consultation process is required to develop overall closure outcomes and criteria for end land use, cultural and heritage values, government regulation and other legal requirements.

Owing to the extensive remaining life of the mine and the current consultation processes for the operation and for the STM expansion studies, discussions with interested parties and stakeholders about closure planning of the existing operations have not been undertaken. Stakeholder and public consultation will be held at appropriate stages during the evolution of the mine and the Mine Closure and Rehabilitation Plan to ensure community engagement in the process. The following is a list of stakeholders to involve in future closure consultation processes:

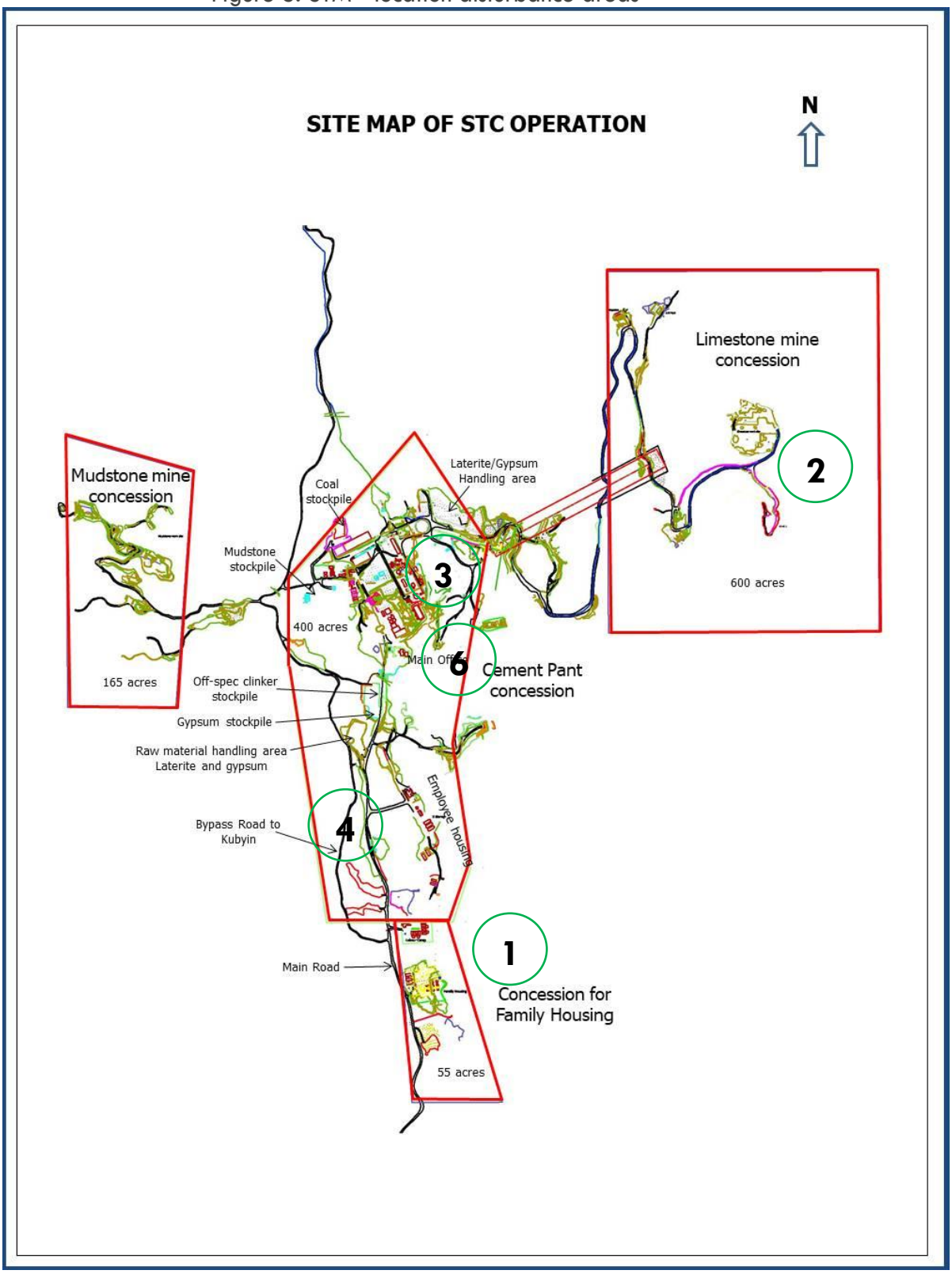
4.2.1 Stakesholders in surrounding

- Pyinyaung and Kubyin Village communities;
- GADs from Kubyin and Pyinyaung;
- STM employees, contractors and suppliers;
- the local providers of State Government services – specifically health, education and police;
- the NGOs and CSOs
- local businesses
- Community welfare associations.

5. Closure domains

The current areas of disturbance subject to closure planning are shown in Figure 3

Figure 3: STM - location disturbance areas



For the purposes of rationalising closure planning across a large area with different operational and post-closure land uses, the site is broken into domains, or areas that have similar closure methodologies, landforms and land-uses. These are described in Table 3.

Table 3: Closure domains

Domain No.	Mangemment Domain	Components
1	Town facilities	▪ Mine town ▪ Base camp ▪ Clinic ▪ Messing hall
2	Cement plant and administration facilities	▪ administration buildings; ▪ cement plant and supporting infrastructure (For example ponds, bunds, tanks and powerlines); ▪ roads; ▪ stockpile footprints; ▪ stormwater diversion bunds and channels;
3	Open cast mine	▪ clearing and grubbing over approximately 400 acres ▪ excavated area of approximately 7 acres ▪ mine haul roads ▪ stormwater diversion bunds, as required ▪ stockpiling of topsoil
4	Raw material storage Facility (RSF)	▪ Limestone stockpile ▪ Gypsum storage area ▪ Mudstone stockpile ▪ Laterite stockpile ▪ Col stockpile ▪ Batching plant Aggregate stockpile
5	Miscellaneous	▪ core yard; ▪ mine roads; ▪ stormwater diversion bunds and channels; ▪ Explosive Magazine Areas; ▪ mine water settling and evaporation ponds; ▪ stockpile including old mullock pile site; ▪ Cement Aggregated Fill (CAF) ▪ Plant and associated crushing, screening and backfilling infrastructure; ▪ backfill limestone (for CAF) quarry and haul roads; ▪ miscellaneous quarries and borrow pits; ▪ waste management area; ▪ roads; ▪ wer lines; ▪ exploration sites; ▪ monitoring sites; ▪ Arid Recovery area; ▪ Water and wastewater treatment facilities; ▪ residual infrastructure, such as power lines, roads and hardstand.any disturbance areas associated with open pit mining area that are located outside of the actual pit boundaries.
6	Wellfields and associated infrastructure	▪ water storage ponds; ▪ water distribution pipelines; ▪ access roads and tracks.

6 Closure design principles

Closure principles are specific measures against which the design of closure structures and other elements are measured. The design principles for STM closure are summarised in Table 4.

Table 4: Closure Design principles

Parameter	Design principles
Design life	Landforms integrity to be maintained in perpetuity.
Design storm	Restore natural drainage lines.
Post-closure land-use	Native Bushland Revegetated land available for grazing e.g. areas outside SML. Vacant Crown Land Non-revegetated, not suitable for grazing or any access e.g. TSFs, open pit.
Surface water	No unacceptable impairment of surface water quality. Regional surface flows returned to pre-mining. Local surface water flows mimic natural analogues as far as practical.
Groundwater	TSF or RSF seepage will not cause unacceptable off-lease impact. No unplanned impairment of surface water or groundwater to the extent that it adversely impacts third party users or groundwater dependent ecosystems.
Erosion	Erosion rate on TSF slopes will not affect the cover integrity within the design lifetime. Landforms mimic natural analogues. Erosion rates no greater than erosion rate at natural analogue landform.
Air	Air quality equal to or better than surrounding land-use.
Soil	Soil quality equal to or better than analogue landform or land-use.
Safety	Public and wildlife access appropriate to final landform/use of each domain.
Vegetation	Vegetation in rehabilitated ecosystem sustainable and as comparable as reasonably practicable with analogue landform and land-use.
Terrestrial and avian wildlife	TSF runoff and or standing water quality not toxic to avian fauna. Stock fencing around TSFs and open pit to minimise (not exclude) fauna visitation.

7. Closure implementation standards

The various elements within each domain will be closed and rehabilitated where applicable to a specified/agreed standard. The standards are listed in Table 5.

Table 5: Key rehabilitation and closure standard measures

	MANAGEMENT APPROACH
Pre-closure	
Clearing management	▪ Clearing or other vegetation disturbance would only be undertaken in a controlled manner with permits in place. ▪ Baseline information, such as vegetation type, condition and resources would be recorded prior to clearing of vegetation. ▪ Where beneficial, seeds and other propagules would be collected.
Topsoil stockpile management	▪ Viable topsoil would be removed and managed to maintain viability. ▪ Allow natural re-seeding of long-term topsoil stockpiles. ▪ Stabilise stockpiles where necessary to minimise erosion. ▪ Topsoils will be prioritised and matched to appropriate landform. ▪ Dispersive soils, where not specifically required for rehabilitation of associated taxa or communities, would be buried in the backfill limestone quarry. ▪ All topsoil stockpile footprints would be rehabilitated. ▪ The surface of all areas to be actively rehabilitated would be ripped to alleviate compaction, prior to replacement of topsoil. ▪ The potential for constructing store-and-release surfaces as habitat for certain taxa would be investigated.
Final closure	
Landforms other than RSF and open pit	▪ The ground surface landforms will mimic the regional dune and swale landform where practical and where adequate materials are available. Pastoral landforms may occur where grazing will not damage rehabilitation.
Open pit landform (if constructed)	▪ The open pit cavity will remain as is at the completion of mining. ▪ Any infrastructure located within the open pit at the completion of mining will be decommissioned and removed.
Decommissioning	▪ Develop decommissioning plan to safely decommission all electrical equipment, piping, and mechanical equipment. ▪ Decommission all plant and equipment in accordance with decommissioning plan. ▪ Groundwater wells no longer required would be plugged with concrete and decommissioned as per regulatory requirements.
Demolition of buildings, plant and infrastructure	▪ Demolish and remove minor infrastructure (e.g. pipe racks). ▪ Demolish all structures, buildings and concrete footings to a depth of 500 mm. ▪ Carry out a survey to capture all redundant services and update site drawings to reflect any changes. ▪ Carry out a survey to capture any services that may need to remain, and develop a register accordingly. ▪ Leave buried services >500 mm depth in place if they pose no environmental risk. ▪ Remove all pipelines and services brought to surface during ripping. ▪ Demolish all tanks and plant.

	▪ Dispose of all demolition debris as appropriate for the level of contamination.
Disposal of plant, equipment and demolition debris	▪ Future re-use of energy, rail and water infrastructure, would be determined prior to closure. All above ground infrastructure and below ground tanks and footings would be removed and recycled or disposed of to landfill. ▪ The potential to recycle the ferrous scrap steel from the site would be investigated and implemented where possible and practical. ▪ Plant and infrastructure materials that cannot be taken off-site will be buried in the backfill limestone quarry.
Disposal of soil and rockfill materials	▪ Uncontaminated fill – backfill water storage and/or evaporation ponds once empty. ▪ Uncontaminated (hydrocarbon) demolition debris and plant in the backfill limestone quarry void. ▪ Hydrocarbon contaminated soil and demolition debris in a suitably designed and constructed landfill.

Project Component	Management Approach
Disposal of hazardous materials	▪ Maintain Life of Asset hazardous materials register. ▪ Determine required disposal action, document in register, and plan and dispose in hazardous waste facility depending on hazard classification.
Topsoiling rehabilitation sites	▪ If topsoil is available: ▪ inspect area and remove all rubbish and debris; ▪ spread shallow topsoil to pond areas if available; ▪ seed with local provenance species to blend with surrounding habitat.
Re-seeding rehabilitation sites	▪ A combination of hydro-mulching and direct seeding and planting would be used to revegetate rehabilitated areas. ▪ Planting would be used for recalcitrant flora of local conservation significance. ▪ Seed mixes would be developed for each major community type, with the proportions of each seed reflecting end-point criteria, seed quality and germination expectations. ▪ Germination would be maximised by applying appropriate pre-treatments, such as scalding, smoke (water) treatment and scarification. ▪ The RSF and Open pit would not be re-seeded, rather natural rehabilitation would occur.
Fauna habitat	▪ Where available, place fauna habitat structures e.g. logs, rocks and leaf litter/mulch in rehabilitated areas. ▪ Target density would be determined by research and availability.
Fire control	▪ Develop revegetation strategy so that fire susceptibilities of rehabilitated areas are equivalent to analogue sites.
Surface drainage	▪ Re-contour rehabilitated sites to reinstate natural contours and drainage lines. ▪ Reinstate natural contours and drainage lines on swales. ▪ Where necessary provide surface water management features e.g. sedimentation basin, low cross-contour banks, spillway: ▪ to return mine-scale surface water flows and quality to pre-mining; ▪ to ensure that on a local scale concentrated flows do not damage rehabilitated areas or threaten their sustainability;

	▪ to ensure that ponding will drain sufficiently quickly and thus will not drown vegetation. ▪ Contour rip all areas to relieve compaction and promote vegetation growth and infiltration. ▪ Cross rip drainage lines to minimise erosion.
Roads and tracks	▪ Rip and seed all access tracks not needed for care and maintenance inspections and/or monitoring activities. ▪ Re-contour dunes on dune crossings and remove clay/fill where present (e.g. haul roads) back to sand dune surface.
Closure of miscellaneous ponds	▪ Remove contaminated materials and dispose to landfill. ▪ Remove access tracks, push down any raised embankments and backfill base of ponds with uncontaminated material. ▪ Batter slopes to stable erosion slope and rip along contours to relieve compaction. ▪ Complete drainage and revegetation.
Closure of miscellaneous ponds	▪ Evaporate remaining liquor or remove to a suitably designed and constructed landfill (SDCL). ▪ Remove piping, pumps, liners, scuttle culverts and dispose. ▪ Remove contaminated materials and dispose to SDCL. ▪ Remove access tracks, push down any raised embankments and backfill base of ponds with uncontaminated material. ▪ Batter slopes to stable erosion slope and rip along contours to relieve compaction. ▪ Complete drainage and revegetation.
Care and maintenance	▪ Install feral fauna controls if required. ▪ Implement weed control where necessary, promoting natural seeding. ▪ Manage grazing on newly revegetated areas using stock fencing if required.

	Management Approach
Miscellaneous quarries and borrow pits	▪ Investigate and if possible obtain authorisation to use miscellaneous quarries and borrow pits for disposal of demolition debris and uncontaminated plant and equipment. ▪ Transfer haul road base material onto pit walls and floor. ▪ Cover any demolition debris to a suitable depth with appropriate cover material. ▪ Complete surface drainage, topsoiling and revegetation where appropriate and practical, and commence care and maintenance and monitoring.
Backfill (limestone) quarry	▪ Bury uncontaminated plant, equipment and demolition debris, in selected area of quarry base. ▪ Cover demolition debris to a suitable depth with any road and hardstand materials not suitable for surface rehabilitation purposes. ▪ Construct appropriate surface drainage for the pit floor. ▪ Transfer haul road base material onto pit walls and floor.
Roads	▪ Remove remaining road base to backfill limestone quarry and for use in rehabilitation. ▪ Remove road base and other obstructions from drainage lines to minimise erosion. ▪ Remove road base from dune crossings to adjacent borrow pits. ▪ Remove barriers where they occur across drainage lines and carry out cross-contouring of drainage lines to minimise erosion.
Exploration areas	▪ Maintain register of any residual exploration areas disturbed at the mine as part of resource definition drilling activities. ▪ Remove casing where appropriate. ▪ Plug the holes at the surface with concrete.
Town facilities	▪ Remove all pipelines and services and those brought to surface during ripping (leave buried services >500 mm depth in place if they pose no significant environmental risk). ▪ Remove contaminated materials to suitable landfill ▪ Remove bitumen surfaces, road base, concrete kerbing and footpaths to backfill limestone quarry and/or Town landfill. ▪ Remove vegetation not indigenous to the area. ▪ Where practical, salvage infrastructure (transportable elements). ▪ Demolish fixed infrastructure.
Powerline and powerline corridor	▪ Remove powerline infrastructure. ▪ Dispose of inert demolition debris within a suitable local landfill or in the backfill limestone quarry.
Miscellaneous areas	▪ Dispose of Waste Management Centre materials in suitable local landfill or in the backfill limestone quarry. ▪ Rip up bitumen roads and underlying road base and dispose appropriately. ▪ Remove lighting and other related infrastructure.
Wellfields and associated infrastructure	▪ Decommission production bores and cap (permanent). ▪ Leave monitoring bores in place for post-closure monitoring. ▪ Decommission lines and remove related surface infrastructure including breather valves, pump stations, powerlines and above ground piping. ▪ Bury inert demolition debris and pond liners in pond excavation, local landfill, or on site (backfill limestone quarry).

	▪ Remove hard-stand from pumping stations to adjacent borrow pits. ▪ Remove road base and other obstructions from drainage lines. ▪ Backfill ponds with any available wall materials and re-contour to blend with sand dunes or local landforms. ▪ Deep rip compacted soil left by access tracks and hard-stand areas. ▪ Remove related surface infrastructure.
Arid Recovery	▪ Investigate handing over to current partners – may entail financial support to ensure sustainability (e.g. endowment fund).

8. Level of studies and engineering

This Mine Closure and Rehabilitation Plan is based on an opencast mine configuration and mining and production at 3.1 million tonnes per year (Mtpy) rates. STM has gained government approval to introduce open pit mining as well as cement plant expansion to increase the cement production rate.

In addition, given the long remaining mine life (approximately 35 years) at STM limestone mine, engineering for closure has not been progressed beyond concept level.

9. Closure schedule

9.1 Final closure and rehabilitation

This Mine Closure and Rehabilitation Plan is based on the current opencast mine configuration and mining and production rates. It also includes the expansion components that were commenced prior to deferral of activities (including clear and grub of the open pit and construction of an initial base layer. The current Life of Asset Base Plan indicates that the mining operations will cease in 2087, at which stage mine closure activities would commence.

Detailed planning for final mine closure execution (i.e. residual demolition, disposal and earthworks) would commence 5 to 10 years before the scheduled closure date for the mining operations. Rehabilitation and closure (inclusive of progressive rehabilitation) will commence, at the latest 10 years prior to the expiry of the Government approval or as amended by subsequent approvals.

9.2 Progressive closure and rehabilitation

STM recognises that the progressive rehabilitation of mining disturbances while the operation is still active plays an important role in closure planning. STM is committed to progressive rehabilitation where practical (i.e. where the rehabilitation opportunity meets criteria established to assess the value of progressively rehabilitating a particular area).

Progressive rehabilitation offers a number of benefits in that it:

- may mitigate existing risk issues associated with the disturbed land (e.g. dust or seepage);
- provides information, data, knowledge and experience that may assist in successfully rehabilitating land disturbed by mining activities;
- reduces the residual disturbance to be rehabilitated at final closure; and ☐ provides evidence to stakeholders that STM is committed to, and is capable of, successfully closing and rehabilitating the mining operation to achieve the stated post-closure land use.

The STM operation has rehabilitated several disturbed areas that are no longer required by the mining operations as well as exploration sites, and will continue to progressively rehabilitate lesser disturbances as the opportunity arises. Progressive rehabilitation opportunities that have been identified for STM include:

- general disturbed areas across the site that are no longer used or required;
- rock, sand or clay borrow pits that have been mined out;
- exploration areas that have not yet been rehabilitated;

9.3 Relinquishment planning

The current closure planning nominally allows for a post-closure care and maintenance and monitoring period leading up to relinquishment of 10 years.

While this may appear to be a short duration in terms of demonstrating the stability of landforms and tailings closure covers, it is not unreasonable given that evidence for these will be gathered from the studies, research, implementation and monitoring of STM whilst in operation and progressive rehabilitation works.

It is, however, recognised that the actual relinquishment period will be determined by the duration required to fully demonstrate that the residual closure works achieve the closure performance criteria, and that the care and maintenance period may extend beyond 10 years.

A more accurate estimate of the relinquishment period will be established in the detailed planning period leading up to final closure, when the performance criteria and likely monitoring durations for the residual closure works can be established.

10. Risk management

Rehabilitation and closure risk register

Closure risk management requires an iterative approach that aims to eliminate or reduce the likelihood and/or consequence of events to a level considered to be as low as reasonably practicable. For relinquishment of a closed operation, the residual risk must be considered tolerable and acceptable by stakeholders and regulators.

A closure risk assessment will be carried out potential pre- and post-closure risk events related to the rehabilitation and closure of the limestone mine.

Table 6 : Likelihood look up table

A	**Almost Certain**	Could occur more than once in a year, or is of a continuous nature, or the likelihood is unknown.
B	**Likely**	Could occur over a one or two year budget period and will probably occur during the mine lifetime. Has generally occurred in similar projects.
C	**Possible**	Could occur in most mines and has occurred in a minority of similar projects.
D	**Unlikely**	Could occur in some mines, but is not expected to occur.
E	**Rare**	Has almost never occurred in similar mines but conceivably could.

Table 7 : Consequence look up table

1	**Insignificant**	Possible impacts but without noticeable environmental consequence; no medical treatment required; or low level social impact.
2	**Minor**	Very local consequence with no significant long-term changes; medical treatment injury; may be simply rehabilitated or alleviated at some cost without outside assistance; not of significant concern to wider community.
3	**Moderate**	Significant local environmental changes but can be rehabilitated or alleviated with difficulty at significant cost and with outside assistance; days lost due to injury; or moderate, medium-term social impacts.
4	**Major**	Substantial and significant environmental changes only partially able to be rehabilitated or alleviated at major cost; single fatality; or significant public concern.
5	**Catastrophic**	Serious or extensive environmental changes (not able to be practically or significantly rehabilitated or alleviated); multiple fatalities; widespread health effects on public; extensive and long term social impacts with serious public or media outcry; or the consequences are unknown.

Table 8: Resulting risk level

			LIKELIHOOD				
			Rare	Unlikely	Possible	Likely	Almost certain
			E	D	C	B	A
CONSEQUENCE	Insignificant	1	Low	Low	Low	Moderate	High
	Minor	2	Low	Low	Moderate	High	High
	Moderate	3	Moderate	Moderate	High	High	Extreme
	Major	4	High	High	Extreme	Extreme	Extreme
	Catastrophic	5	High	Extreme	Extreme	Extreme	Extreme

11. Post-closure monitoring, care and maintenance plan

A detailed post-closure monitoring and care and maintenance plan will be developed during the detailed planning for final closure to ensure that:

- there is sufficient and appropriate monitoring in place to be able to track and demonstrate the achievement of closure performance criteria for the various closure landforms;
- there is a management plan in place to model the post-closure performance to provide predictive assessments of the post-closure landforms e.g. drain-down of the oxidized material handling facilities
- there are sufficient resources allocated to ensure that all required inspections and monitoring is carried out, and that any care and maintenance activities required are carried out promptly and to the desired standard;
- there are adequate financial provisions to carry out the above activities, with a contingency allowance for post-closure 'risk events' (i.e. as per those discussed above)

11.1 Rehabilitated sites

The framework for the rehabilitation monitoring program would be based on Ecosystem Function Analysis (EFA)

The actual post-closure monitoring and care and maintenance timeframe will depend on the complexity of the closure landform, the post-closure land-use, and the completion criteria. For the purpose of closure financial provisioning, rehabilitation monitoring is estimated to occur for 10 years after closure. Post-closure monitoring activities for which costing has been included in the provision are summarised in Table 9.

Table 9: Approximate post-closure monitoring requirements

Item	Frequency
Ecosystem function analysis	1st, 2nd, 3rd, 5th and 10th years
Groundwater monitoring and analysis	Annually
TSF, RSF and open pit	Six monthly for the first 2-3 years – then annually
Waste disposal and capacity inspection	Annually
Fauna survey	1st, 2nd, 3rd, 5th and 10th years
Weed/feral animal control and inspection	Quarterly in first year and then annually to year 10
GAB recovery monitoring	Quarterly in first year and then annually to year 10

11.1.1 Components of EFA

EFA comprises three components (Kearns and Barnett, 1998):

- landscape function analysis (LFA), in which the site is assessed with respect to the control of vital resources, such as water, organic matter, nutrients and propagules;
- vegetation dynamics, in which species composition and growth characteristics are assessed in relation to LFA;
- habitat complexity, in which the habitat quality for a range of vertebrate fauna is assessed.

11.1.2 Monitoring program

An amended EFA monitoring program that addresses all three components would be prepared and conducted on an annual basis, following initial rehabilitation works and until satisfactory trajectories are determined. The amendments are described below. Additional monitoring related to other programs that would be carried out during and after rehabilitation and closure is listed in Table 10.

11.1.2.1 Soil profile reconstruction

To ensure that reconstructed soil profiles are prepared in accordance with the rehabilitation design and that there are no unconsidered limiting factors to plant re-establishment, each year's rehabilitation block would be sampled, prior to topsoil replacement. Sampling would involve digging one or more test pits in the newly prepared ground and assessing the exposed soil profile, having particular regard for soil compaction parameters. Sampling sites would be representative of the wider rehabilitated area, but would also include specific habitat types, such as sites that would be designed for store-and-release (if any), deep draining or high value flora.

11.1.2.2 Vegetation monitoring

Qualitative assessment of rehabilitation would be undertaken on a regular basis during the first growing season following establishment, and up to 15 months of age. Seed germination, plant establishment and survival, species richness and weed establishment would be key parameters monitored during this period.

Quantitative monitoring of rehabilitation would commence in the second spring following rehabilitation (15 months) and continue on an annual basis until the third assessment, at which time the monitoring interval would be extended to a triennial basis (once every three years).

The following procedure would be developed and implemented.

- Permanent belt transects of 20 contiguous 1 m x 1 m quadrats would be established using metal fence droppers with an orientation perpendicular to the contour ripping so as not to be influenced by a single rip line.
- A hand-held GPS would record the start and end coordinates of each transect.
- The start point of the transect line would be utilised as a permanent photographic point with the photo taken directly along the transect line.For each species within a quadrat the number present, percentage ground cover, and maximum plant height would be recorded. Summarised data would provide mean density values (no. plants per square metre), mean percentage ground cover, and mean maximum plant height, and an importance value index (or IVI), which considers frequency, density, and cover for each species recorded along a transect line.
- Rehabilitation blocks (as distinguished by vegetation type and rehabilitation age) would be sampled with adequate replication of permanent belt transects to ensure the data is representative of the vegetation present. This would be demonstrated via graphing of 'species-area curves'.

11.1.2.3 Soil and landform description

A soil and landform description would be made using the following data collected from five quadrats along each permanent belt transects:

- soil texture and upper soil profile (0-–30 centimetre (cm)) assessment;
- soil surface roughness and resistance to disturbance (semi-quantitative measure ranked from 1 to 5);
- observations on erosion type and severity (semi-quantitative measure from 1 to 5);
- incorporation and subsequent deposition of coarse organic debris and type (semi-quantitative measure from 1 to 5);
- per cent bare ground;
- per cent cryptogam cover;
- per cent litter cover and type.

11.1.2.4 Topsoil nutritional status

Topsoil would be sampled annually to determine long-term trends in soil nutrition. Three sub-samples would be collected along each permanent monitoring transect and a random selection of combined samples would be sent for laboratory analysis. The following parameters would be analysed:

- per cent organic carbon;
- pH;
- electrical conductivity;
- exchangeable sodium percentage (ESP);
- nitrate and ammonium nitrogen;
- phosphorus;
- potassium;
- exchangeable cations;
- trace elements (e.g. copper, zinc, manganese, boron).

11.1.2.5 Erosion monitoring

Post-closure monitoring would be undertaken to confirm all earthworks were stable, substrates where suitably hospitable to vegetation and surface water movement was not significantly impeded or causing large scale erosion. Erosion would be assessed by visual inspection of all disturbed areas on a six monthly basis during the first two years or immediately following significant rainfall or wind events. Annual inspection would occur after two years.

Table 10: Additional monitoring

Issue	Monitoring objective	Parameters
Health of nonhuman biota	To ensure that vegetation in the natural and rehabilitated environments does not pose an unacceptable risk to the health of non-human biota	▪ key metals on soils and vegetation (including radiation decay products)
Fauna reestablishment	To identify use of, and pressures on, fauna habitat in rehabilitated areas	▪ same method as per baseline surveys (for comparison) ▪ quantitative assessment of ant and spider holes, lizard burrows, animal scats
Feral animals	To ensure feral animals do not compromise rehabilitation performance	▪ number/impact of feral animals
Grazing pressure	To ensure grazing impacts do not compromise rehabilitation performance	▪ visual indicators of excessive or selective grazing
Weeds	To ensure weed impacts do not compromise rehabilitation performance	▪ numbers and diversity of weed species along transects and disturbed areas

11.2 Care and maintenance of rehabilitated areas

Ongoing care and maintenance will be carried out on rehabilitation areas that do not achieve the agreed rehabilitation standards to bring them up to the necessary standard. The rework will be determined by the cause of the lower than prerequisite standard, and by what residual work is required to achieve the agreed completion standards.

12 Financial provisioning

12.1 Rehabilitation and closure accounting provision

STM recognises that where mining activities give rise to an obligation for site closure and rehabilitation, financial provision for the closure activity must be recognised at the time that the environmental disturbance is made.

STM will implement several key controls to ensure that all assets and operations within the Group are able to meet their closure obligations and commitments including the integration of closure planning into Life of Asset planning. If the asset (project) is shut suddenly, STM would be fully aware of the obligations and costs required to keep the site in care and maintenance or to close and rehabilitate the site.

12.2 Providing for unplanned closure scenario

Site closure may be initiated in a number of different scenarios including: planned closure, unplanned or sudden closure and temporary closure.

Although some of the objectives, processes and implementation timeframes would vary for each scenario, the STM aspiration to 'zero harm' would still apply. STM internal requirements and planning processes would ensure that adequate financial provisioning would be in place to ensure that mine closure would be conducted to the satisfaction of the project's stakeholders. A Bank account has been open in MEB Bank foe Mine closure provision.

12.3 Unplanned closure

Best Practice requires that closure planning recognise and allow for the risk of sudden, forced and/or early mine closure by preparing contingencies that take into account the site's non-productive status.

In the event that the STM operation is required to close earlier than forecast, the mining operations would continue to be treated as an operational asset, with the necessary resources being provided to meet all existing health, safety, environment and community standards until closure, rehabilitation and relinquishment are complete.

At the earliest possible time, a risk assessment would be conducted and any measures required to ensure ongoing health and environmental compliance would be implemented as soon as practicable. The Mine Closure and Rehabilitation Plan would be reviewed and revised, with the foundations of the new plan being a consultative risk assessment of the operations at the time, with the aim of identifying priority issues and assigning appropriate management resources to achieve an acceptable and timely outcome.

12.4 Temporary closure (care and maintenance)

In the unlikely event that the operation is required to be shut down on a temporary basis (i.e. there is an assumption that the operation would recommence once economic or other issues had been resolved) similar management controls would be put in place as described for unplanned closure. Temporary closure would also trigger a thorough risk assessment, the development of a care and maintenance plan, and a full review of the Mine Closure and Rehabilitation Plan in the light of an increased risk of early closure.

13 Summary Site-Specific Rehabilitation Plan

13.1 Prior to Mining Activity

Prior to mining activities, the following actions are required to prepare for site rehabilitation following the completion of mining activities:

- A site nursery is to be established to grow native seedstock propogated from collected native indigenous seed from the coal mining site.
- A flora survey is to occur to identify the existing flora values of the proposed site. Lists of threatened flora and a general list of flora identified during surveys in 2017 are listed in ESIA Report.
- A seed collection activity is to occur during late spring in order to gather seed for propogation in the site nursery.
- Propogation activities are to occur on collected seed stock in the site nursery. Propogation and nursery care are to continue for the life of the mine.
- A full time nursery attendant is to be charged with matinaning flora within the nursery.
- No invasive or introduced species are to be cultivated for replanting or landscaping.

13.2 Stakeholder Consultation

Prior to site rehabilitation activities, the following consultation will occur:

- Undertake one round of consultations with the local community to understand needs and expectations of rehabilitated land use. The planting composition can be adjusted where

appropriate (eg. Creation of community forests) and the community can be engaged in the rehabilitation process.

- Undertake consutlation with the Forest Department to understand their expectations of rehabilitated land use and if these are aligned to those of the local community. Based on Forest Department feedback, undertake a second round of consultations with the local community, if required.

All rehabilitation will be of native indigenous species, in areas that were previously natural habitats. Non-native tree plantations may be established on areas cleared prior to development. A supporting map of such areas will be developed/maintained to inform what type of rehabilitation is required and at which locations.

13.3 Landform Reshaping

The following activities will be undertaken during land shaping:

- Land reshaping is to occur to return landform to disturbed sites using heavy earth moving equipment.
- All land surfaces are to be reshaped with a maximum gradient of 40degrees, with a preferable gradient of 27 degrees in side slope
- All drainage features are to be reshaped according to natural flow regimes.
- Sediment basins are to be retained below reshaped areas during rehabilitation.
- Best practice sediment and erosion control measures are to be utilized to reduce overland flow and concentration of waterflow.

13.4 Erosion and Sediment Control Measures with Best Practices

Topic	Control Action Measures
Road maintenance	Undertake regular maintenance of roads and road drainage structures. Roads should be inspected regularly, particularly during or after periods of heavy rain to identify issues such as build-up of sediment, deposition of road base sediment in watercourse, riling and scouring of the road surface, flattening out or crossfall. Where these signs are observed, assess severity of erosion and undertake light or heavy road grading to maintain the road profile. In instances where ineffective road drainage was identified to be the issue, design and implement suitable drainage along the affected road
Material stockpiles	All stockpiled materials on site must be covered with a tarpaulin and/or stock piled beneath a sheltered area with provisions to ensure it will not be washed away
Erosion control blankets	For laying of erosion blankets, first ensure that the ground surface is free of grass and objects (rocks and sticks etc). The upslope mat should be placed such that it overlaps the top of the next downslope mat. Secure the mat with staples
Reducing sedimentation into natural watercourses	Accord a level of protection to streams and rivers within the project area, erecting sediment fences where appropriate at vulnerable areas to filter sediments from rainwater flowing into streams and rivers. A series of sedimentation pools may be established in a step wise manner at drainage from the project area that discharges into natural streams and rivers.
Reducing erosion at rehabilitated areas	Drainage systems around rehabilitated areas should be designed to channel bulk of water flow away and through the placement of rock-lined waterways to reduce the velocity of flow. In certain cases the rehabilitated area lies in the path of a natural drainage line within the landscape or at the base of a natural channel/ road where large quantities of water will be flushed towards during heavy rain events.

13.5 Topsoiling/ Soil Replacement and Protection

The following activities are required during soil replacement:

- Obtain compost or fertilizer for application to the soil matrix to provide organic material, if available.
- The compost/fertilizer mixture should be screened and treated with herbicide/fungicide to eliminate the viability of invasive species within the mixture to as low as possible
- Based on the Rehabilitation Plan and expertise from the land rehabilitation expert, lay the compost material at the selected location and cover with erosion control blanket as soon as possible
- Soil laying is best done during the dry season where loss of soil due to large downpours can be avoided. However, given planting should be best timed during the wet season when water is plentiful, the plan may accommodate this by laying soil the end and start of the dry and wet seasons respectively and implement erosion control immediately

13.6 Vegetation Planting

The following activities are required during vegetation planting:

- Engage the community to undertake the planting and maintenance work (weeding, fertilizer) and include remuneration where appropriate
- Select plant species native to the project area, preferably sourcing most individuals from the on-site nursery. A variety of fruiting species, nutrient cycling / fixation species should be selected based on the natural vegetation characteristics of the area
- During the wet season, plant native seedlings (obtained from site nursery) into soil, adopting an intensive and high density planting pattern
- Fertilise the planted saplings with generic fertilizer
- Lay mulching (dead plant matter) around the saplings to reduce desiccation and weed growth
- Water daily in the absence of heavy rainfall for 6-8 weeks after planting to allow the plant to establish itself.
- Continue weeding regularly
- Where required, reforestation experts or ecologists from NGOs can be engaged to provide advice on reforestation/rehabilitation activities
- Fence freshly planted areas to prevent animal intrusion and grazing

13.7 Management and Monitoring

The following activities are required for the management and monitoting of rehabilitated areas:

- Permanent vegetation monitoring plots: Establishment of at ten 20 m by 20 m monitoring plots throughout the project area and undertake annual surveys of flora species within these plots to track recovery. Number of species and abundance should be recorded and then compared on a year-on-year basis.
- As the plots will require walking off-trail to access, this could impede plant regeneration. Therefore, monitoring involving vegetation plots should be undertaken only after 5 years after the start of rehabilitation.
- Canopy denseness tracking using satellite imagery: Review of satellite /drone imagery to assess canopy denseness on an annual basis. Identify spots that appear to be regenerating slowly and investigate on the ground.

Specific Monitoring Requirements – Paluzawa Coal Mine:

- The following activities are required for the management and monitoting of rehabilitated areas for the coal mine concession:
- Using transect surveys on accessible trails and along roads, count number of species and abundance of birds and diurnal mammals.
- The surveys are to be complemented with annual local community interviews on their perception of the rate of recovery and wildlife that has been sighted utilising the rehabilitated areas.

Specific Monitoring Requirements – Pyinyaung Limstone Mine
The following activities are required for the management and monitoting of rehabilitated areas at the limestone concession:

- For the Limestone, it is unlikely that the original karst condition and substrate composition can be restored. Therefore, monitoring based on karst fauna would not be advised.
- Transect surveys on accessible trails and along roads to count for species and abundance of birds and diurnal mammals are recommended.
- The surveys are to be complemented with annual local community interviews on their perception of the rate of recovery and wildlife that has been sighted utilising the rehabilitated areas.

Annex - L
Occupational Health and Safety Policy

SHWE TAUNG
Building Materials

OCCUPATIONAL HEALTH AND SAFETY POLICY

The health and safety goal of STBM is to ensure those who are working with the company are free from work related injuries and occupational illnesses.

While management is accountable for the prevention of workplace injuries and occupational illnesses, employees at each level of the organization in STBM are expected to contribute towards achieving this health and safety goal.
This expectation applies to all the parties having a working relationship with STBM.

Everyone working in and with STBM is expected to:

- Intervene when observing unsafe acts and unsafe conditions
- Comply with the company's health and safety rules and regulations
- Actively take part in the health and safety program and activities organized
- Respect the safety devices installed and provided to safeguard from danger
- Only work on tasks or machinery that you are authorized to do so

In ensuring overall implementation of health and safety throughout the organization, health and safety objectives will be integrated into the systems at all level of the management. Tasks can only start after the risk control measures have been put in place for the identified hazard.

STBM will ensure that all the relevant health and safety legal requirement are being complied with and addressed. The concept of continual improvement will be the driving mechanism towards achieving this goal.

Chief Executive Officer

Michael Andrew Cowell

May 2023

Annex - M
Environmental Management Fund, CSR Fund and Mine Closure Fund of STM Limestone Quarry

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Telephone: 95-1-8603345, 8603346, Fax: 95-1-8603347

သို့

ဦးဆောင်ညွှန်ကြားရေးမှူး

အမှတ် (၁) သတ္တုတွင်းလုပ်ငန်း

သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန

နေပြည်တော်။

စာအမှတ် ။ ။ STM-MD-328-2023

ရက်စွဲ ။ ။ ၂၀၂၃ ခုနှစ်၊ ဒီဇင်ဘာလ (၁၅)ရက်

အကြောင်းအရာ ။ ။ <u>ထုံးကျောက်နှင့် ရွှံ့စေးလုပ်ကွက်များအတွက် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးရန်ပုံငွေ၊ သတ္တုတွင်း ပိတ်သိမ်းမှု နှင့် ပြန်လည်ထူထောင်မှု ရန်ပုံငွေနှင့် CSR ရန်ပုံငွေများ ဆောင်ရွက်ထားရှိပြီးကြောင်း တင်ပြခြင်း။</u>

ရည်ညွှန်းချက် ။ ။ (၁) အမှတ် (၁) သတ္တုတွင်းလုပ်ငန်း၏ (၀၅.၁၀.၂၀၂၃) ရက်နေ့ ရက်စွဲပါ စာအမှတ်၊ ၆/၂/၂ (3 Fund)/၂၀၂၃ (၁၄၉၂၈)

ရည်ညွှန်းချက် ။ ။ (၂) အမှတ် (၁) သတ္တုတွင်းလုပ်ငန်း၏ (၀၅.၁၀.၂၀၂၃) ရက်နေ့ ရက်စွဲပါ စာအမှတ်၊ ၆/၂/၂ (3 Fund)/၂၀၂၃ (၁၄၉၄၇)

အထက်အကြောင်းအရာပါကိစ္စနှင့်ပတ်သက်၍ အမှတ်(၁)သတ္တုတွင်းလုပ်ငန်းမှ ရန်ပုံငွေ(၃)ရပ် ထည့်ဝင်ပေးသွင်းရန် ရည်ညွှန်းချက်ပါစာဖြင့် အကြောင်းကြားလာပါသဖြင့် ကျွန်တော်များ ရွှေတောင်သတ္တုတူးဖော်ထုတ်လုပ်ရေးကုမ္ပဏီ လီမိတက်၏ မန္တလေးတိုင်းဒေသကြီး၊ သာစည်မြို့နယ်၊ ပြည်ညောင်ဒေသတွင် တည်ရှိသော ထုံးကျောက်နှင့် ရွှံ့စေး လုပ်ကွက်များအတွက် သာစည်မြို့၊ မြန်မာ့စီးပွားရေးဘဏ်တွင် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးရန်ပုံငွေ (Environmental Management Fund EMF)၊ သတ္တုတွင်းပိတ်သိမ်းမှုနှင့် ပြန်လည်ထူထောင်မှုရန်ပုံငွေ (Mine Closure Fund MCF) နှင့် Corporate Social Responsibility (CSR) ရန်ပုံငွေများအား ဆောင်ရွက်ထားရှိပြီးဖြစ်ပါကြောင်း အောက်ဖော်ပြပါ Bank Account များနှင့်တကွ လေးစားစွာဖြင့် တင်ပြအပ်ပါသည်။

စဉ်	လုပ်ကွက်အမည်	ဘဏ်စာရင်းအမည်	ဘဏ်စာရင်းအမှတ်	ထည့်ဝင်ခဲ့သည့် ငွေပမာဏ
၁။	ထုံးကျောက်	Mine Closure Fund-MCF	CF220	126,313,940
၂။	ထုံးကျောက်	Environmental Management Fund-EMF	CF221	63,156,970
၃။	ထုံးကျောက်	Corporate Social Responsibility-CSR	OA020470	63,156,970
၄။	ရွှံ့စေး	Mine Closure Fund-MCF	CF218	1,830,632
၅။	ရွှံ့စေး	Environmental Management Fund-EMF	CF219	915,316
၆။	ရွှံ့စေး	Corporate Social Responsibility-CSR	OA020470	915,316

လေးစားစွာဖြင့်

ကျော်နိုင်စိုး

ဒုတိယအုပ်ချုပ်မှုဒါရိုက်တာ

ရွှေတောင်သတ္တုတူးဖော်ထုတ်လုပ်ရေးကုမ္ပဏီ

မိတ္တူကို

- ရုံးလက်ခံ

စာရင်းပြောင်း

မြန်မာ့စီးပွားရေးဘဏ်

၂၀ ခု၊ 6.12.23

(ကျောဘက်တွင် ဖော်ပြထားသည့်အတိုင်း)

ငွေပေါင်းကျပ် ...

ကို ကောက်ခံပြီး CF. 221

၏ စာရင်းသို့ ထည့်သွင်းပါမည့်အကြောင်း။

ကျပ်	ပြား
631,569,70	24

စာရင်းသွင်းပြီး။

မန်နေဂျာ

မြန်မာ့စီးပွားရေးဘဏ်

A 13 a

စာရင်းပြောင်း

မြန်မာ့စီးပွားရေးဘဏ်

၂၀ ခု၊ 6.12.23

(ကျောဘက်တွင် ဖော်ပြထားသည့်အတိုင်း)

ငွေပေါင်းကျပ် ...

ကို ကောက်ခံပြီး CF. 220

၏ စာရင်းသို့ ထည့်သွင်းပါမည့်အကြောင်း။

ကျပ်	ပြား
126,313,940	48

စာရင်းသွင်းပြီး။

မန်နေဂျာ

မြန်မာ့စီးပွားရေးဘဏ်

A 13 a

စာရင်းပြောင်း

မြန်မာ့စီးပွားရေးဘဏ်

၂၀ ခု၊ 6.12.23

(ကျောဘက်တွင် ဖော်ပြထားသည့်အတိုင်း)

ငွေပေါင်းကျပ် ...

ကို ကောက်ခံပြီး CF. 218

၏ စာရင်းသို့ ထည့်သွင်းပါမည့်အကြောင်း။

ကျပ်	ပြား
1830,632	20

စာရင်းသွင်းပြီး။

မန်နေဂျာ

မြန်မာ့စီးပွားရေးဘဏ်

A 13 a

စာရင်းပြောင်း

မြန်မာ့စီးပွားရေးဘဏ်

၂၀ ခု၊ 6.12.23

(ကျောဘက်တွင် ဖော်ပြထားသည့်အတိုင်း)

ငွေပေါင်းကျပ် ...

ကို ကောက်ခံပြီး CF. 219

၏ စာရင်းသို့ ထည့်သွင်းပါမည့်အကြောင်း။

ကျပ်	ပြား
915316	10

စာရင်းသွင်းပြီး။

မန်နေဂျာ

မြန်မာ့စီးပွားရေးဘဏ်

A 13 a

T.F. No.1 NOTE - To be prepared by the payer in duplicate. **Art. 5, C.A.C.**

မှတ်ရန်အချက်။ ။ ငွေပေးသွင်းသူက မိတ္တူနှစ်စောင်ရေးသွင်းရမည်။

0A.020470

ချလန်နံပါတ်	**Chalan No.** ORIGINAL **Credit.**
[illegible] ငွေတိုက်အရာရှိ၊	**To**
[illegible] အတွက်၊	**THE TREASURY OFFICER**
[illegible] ကပေးရန်ရှိသည့်	
ငွေပေါင်း(စာဖြင့်) [illegible]	PLEASE receive the sum of Kyat *(in words)* ________
[illegible] ငွေ(ဂဏန်းဖြင့်) 915316/10	K *(in figures)* ________
ကိုလက်ခံပါမည့်အကြောင်း။ ________	being the amount payable by ________
________ အာဏာအရပေးပါကြောင်း။	on account of * ________
	Authority under which payment is made is ________
[illegible] မြို့	**STATION** ________ :
6.12.23 နေ့စွဲ၊ ငွေပေးသွင်းသူ၏ လက်မှတ်၊	*Dated,* 915316/10 20 — *Signatures of the payer.*

Examined and entered. *Treasurer.* *Head Accountant*

Received the sum of Kyat *(in words)* ________

K *(in figures)* ________ on the above account

STATION ________ :

Dated, ________ *Treasurer.* *Head Account.* *Treasury officer.*

* Full details should be given. If on account of previous payment, the month, date of payment, number of voucher, etc. should also be stated.

* အကြောင်းအရာများကို ပြည့်စုံစွာရေးထည့်ရမည်။ အလျင်က ထုတ်ပေးထားသည့်ငွေအတွက်ဖြစ်လျှင်၊ ထိုသို့ ထုတ်ပေးသည့် ဘောက်ချာနံပါတ်၊ လနှင့် နေ့ရက် စသည်တို့ကို ရေးထည့်ရမည်။

T.F. No.1 NOTE - To be prepared by the payer in duplicate. **Art. 5, C.A.C.**

မှတ်ရန်အချက်။ ။ ငွေပေးသွင်းသူက မိတ္တူနှစ်စောင်ရေးသွင်းရမည်။

0A.020470

ချလန်နံပါတ်	**Chalan No.** ORIGINAL **Credit.**
[illegible] ငွေတိုက်အရာရှိ၊	**To**
[illegible] အတွက်၊	**THE TREASURY OFFICER**
[illegible] ကပေးရန်ရှိသည့်	
ငွေပေါင်း(စာဖြင့်) [illegible]	PLEASE receive the sum of Kyat *(in words)* ________
[illegible] ငွေ(ဂဏန်းဖြင့်) [illegible]/24	K *(in figures)* ________
ကိုလက်ခံပါမည့်အကြောင်း။ ________	being the amount payable by ________
________ အာဏာအရပေးပါကြောင်း။	on account of * ________
	Authority under which payment is made is ________
[illegible] မြို့	**STATION** ________ :
[illegible] နေ့စွဲ၊ ငွေပေးသွင်းသူ၏ လက်မှတ်၊	*Dated,* ________ 20 — *Signatures of the payer.*

Examined and entered. *Treasurer.* *Head Accountant*

Received the sum of kyat *(in words)* ________

K *(in figures)* ________ on the above account

STATION ________ :

Dated, ________ *Treasurer.* [illegible]/24 *Head Account.* *Treasury officer.*

* Full details should be given. If on account of previous payment, the month, date of payment, number of voucher, etc. should also be stated.

* အကြောင်းအရာများကို ပြည့်စုံစွာရေးထည့်ရမည်။ အလျင်က ထုတ်ပေးထားသည့်ငွေအတွက်ဖြစ်လျှင်၊ ထိုသို့ ထုတ်ပေးသည့် ဘောက်ချာနံပါတ်၊ လနှင့် နေ့ရက် စသည်တို့ကို ရေးထည့်ရမည်။

SHWE TAUNG MINING CO.,LTD.
Olympic Tower(II), River View Garden Housing (3nd Floor), Strand Road,
Ahlone Township, Yangon, Myanmar.
Tel: 095-1-211430, Fax: 095-1-226979, 212217, E-mail: olympic@mptmail.net.mm

သို့

ဦးဆောင်ညွှန်ကြားရေးမှူး
အမှတ် (၁) သတ္တုတွင်းလုပ်ငန်း
သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန
နေပြည်တော်။

စာအမှတ် ။ ။ STM-MD-105-2020
ရက်စွဲ ။ ။ ၂၀၂၀ ပြည့်နှစ်၊ ဇူလိုင်လ ( )ရက်

အကြောင်းအရာ ။ ။ ထုံးကျောက်လုပ်ကွက်နှင့် ရွှံ့စေးလုပ်ကွက်အတွက် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးရန်ပုံငွေနှင့် သတ္တုတွင်းပိတ်သိမ်းမှုနှင့်ပြန်လည်ထူထောင်မှုရန်ပုံငွေ ဆောင်ရွက်ထားရှိပြီးကြောင်း တင်ပြခြင်း။

ရည်ညွှန်းချက် ။ ။ အမှတ်(၁)သတ္တုတွင်းလုပ်ငန်း၏ (၂၅.၀၆.၂၀၂၀)ရက်စွဲပါ စာအမှတ်၊ ၃၆၂၉/၁၉၃၇/ ရွှေတောင်/ထလ-၂/၂၀၂၀

အထက်အကြောင်းအရာပါကိစ္စနှင့်ပတ်သက်၍ အမှတ်(၁)သတ္တုတွင်းလုပ်ငန်း၏ ရည်ညွှန်းချက်ပါ စာအရ ကျွန်တော်များ ရွှေတောင်သတ္တုတူးဖော်ထုတ်လုပ်ရေးကုမ္ပဏီလိမိတက်မှ ကိုယ်စားလှယ်(၁)ဦး၊ အမှတ်(၁) သတ္တုတွင်းလုပ်ငန်းမှ ကိုယ်စားလှယ်(၁)ဦးနှင့် သာစည်မြို့နယ်၊ အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာနမှ ကိုယ်စားလှယ်(၁)ဦး တို့ဖြင့် မန္တလေးတိုင်းဒေသကြီး၊ မိတ္ထီလာခရိုင်၊ သာစည်မြို့နယ်၊ ပြည်ညောင်ဒေသတွင် တည်ရှိသော ထုံးကျောက်လုပ်ကွက်နှင့် ရွှံ့စေးလုပ်ကွက်များအတွက် သာစည်မြို့၊ မြန်မာ့စီးပွားရေးဘဏ်တွင် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးရန်ပုံငွေ (Environmental Management Fund-EMF) နှင့် သတ္တုတွင်းပိတ်သိမ်းမှုနှင့် ပြန်လည်ထူထောင်မှုရန်ပုံငွေ (Mine Closure Fund-MCF) များအား ဆောင်ရွက်ထားရှိပြီးဖြစ်ပါကြောင်း အောက်ဖော်ပြပါ Bank Account များဖြင့် လေးစားစွာ တင်ပြအပ်ပါသည်။

စဉ်	လုပ်ကွက်	ဘဏ်စာရင်းအမည်	ဘဏ်စာရင်းအမှတ်
၁။	ထုံးကျောက်	Mine Closure Fund-MCF	CF 00220
၂။	ထုံးကျောက်	Environmental Management Fund-EMF	CF 00221
၃။	ရွှံ့စေး	Mine Closure Fund-MCF	CF 00218
၄။	ရွှံ့စေး	Environmental Management Fund-EMF	CF 00219

လေးစားစွာဖြင့်

(ကျော်နိုင်စိုး)
ဒုတိယအုပ်ချုပ်မှုဒါရိုက်တာ
ရွှေတောင်သတ္တုတူးဖော်ထုတ်လုပ်ရေးကုမ္ပဏီ

မိတ္တူကို
- ရုံးလက်ခံ။

မြန်မာ့စီးပွားရေးဘဏ်

ငွေသား

၂၀   ခု၊ ၉.၇.၂၀၂၀

cf. ၀၀220

___ ၏ စာရင်းသို့

ငွေပေါင်း ကျပ် ___

ပေးသွင်းပါကြောင်း။

9 JUL 2020

	ကျပ်	ပြား
ငွေစက္ကူများ		
အကြွေများ		
ငွေပေါင်းကျပ်		

ငွေကိုင် ___ ငွေကိုင်ချုပ် ___

တာဝန်ခံအရာရှိ ___

အေ – ၁၁ (က)

(ငွေပေးသွင်းသူလက်မှတ်)

အမည် ___

မြန်မာ့စီးပွားရေးဘဏ်

ငွေသား

၂၀   ခု၊ ၉.၇.၂၀၂၀.

cf. ၀၀221

___ ၏ စာရင်းသို့

ငွေပေါင်း ကျပ် ___

ပေးသွင်းပါကြောင်း။

9 JUL 2020

	ကျပ်	ပြား
ငွေစက္ကူများ		
အကြွေများ		
ငွေပေါင်းကျပ်	30000000	–

ငွေကိုင် ___ ငွေကိုင်ချုပ် ___

တာဝန်ခံအရာရှိ ___

အေ – ၁၁ (က)

(ငွေပေးသွင်းသူလက်မှတ်)

အမည် ___

Annex - N:
Stakeholder Engagement Plan

STAKEHOLDER ENGAGEMENT PLAN

April 2020

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

1.1 Purpose

This document describes the Stakeholder Engagement Plan (SEP) for Shwe Taung Cement Co. Ltd (STC).[1] Stakeholder engagement refers to the process of sharing information and knowledge, seeking to understand and respond to the concerns of individuals potentially impacted or affected by the activities relating to cement production, and building relationships based on trust. As such, stakeholder engagement is essential for the successful ongoing operation of the cement plant as well as any future expansion or related projects.

Stakeholder engagement is undertaken by STC throughout all its planning, construction, operational and decommissioning activities. This SEP builds on previous consultation held with affected stakeholders during the Supplementary Environmental & Social Impact Assessment (ESIA) process, construction activities and early operaional phases of the project and focuses on stakeholder engagement activities to be undertaken in an ongoing manner during operations and any proposed expansions to the plant.

This Plan is used by STC as a 'live' document which is updated regularly to track and record progress against the Stakeholder Engagement Action Plan (refer Section 7) and is periodically reviewed by STC management.

1.2 Objectives

The objectives of this SEP include:

- Ensure understanding of the needs of affected stakeholders through an open, inclusive and transparent process of culturally appropriate engagement and communication.
- Promote inclusiveness of stakeholders in the scoping of issues, the assessment of impacts and the development of mitigation and management measures in relation to STC operations.
- Develop relationships with affected communities so they may express their views on potential impacts and mitigation measures related to STC operations.
- Engage vulnerable persons via an open and inclusive approach to consultation and provide where necessary special measures for vulnerable stakeholder types such as elderly people, the ill or infirm, children and single-parent households.
- Manage the expectations of stakeholders through the dissemination of accurate information in an accessible and timely manner.
- Provide a useable, transparent and functional grievance process via a dedicated stakeholder grievance mechanism.
- Ensure compliance with local regulatory requirements and international standards.

1.3 Scope

The scope of the SEP includes the following:

- Existing cement plant (including 'second line' expansion);
- Associated quarries (limestone and mudstone);
- Transmission lines (located in or adjacent to Pyi Nyaung and Thazi Townships);
- Shwe Taung Mining Company (STM) coal mine in Paluzawa including coal staging areas along the Chindwin river; and
- Transport corridors for the supply of fuel to the cement kilns in Mandalay Region.

[1] STC cement trades under the 'Apache Cement' brand which was launched in 2014. STC falls under the Shwe Taung Building Materials (STBM) division of Shwe Taung Group (STG).

This SEP applies to all main and associated facilities operated and/or use by STC.

1.4 Background to this SEP

A Supplementary ESIA was prepared for the project in 2017 to meet international requirements and fill gaps in the previous local environmental assessments conducted. As part of the Supplementary ESIA, a Stakeholder Engagement Plan (SEP) was developed by STC for internal use to identify and manage stakeholder engagement and concerns relating to the cement plant, the coal mine and associated facilities. This SEP (i.e. this document) has been developed as the operational version and will be made available for public disclosure.

This document contains some background information about past consultation that has helped inform the current stakeholder engagement program at STC, but is predominantly focused on the ongoing operations phase of the project including any current and future activities.[2]

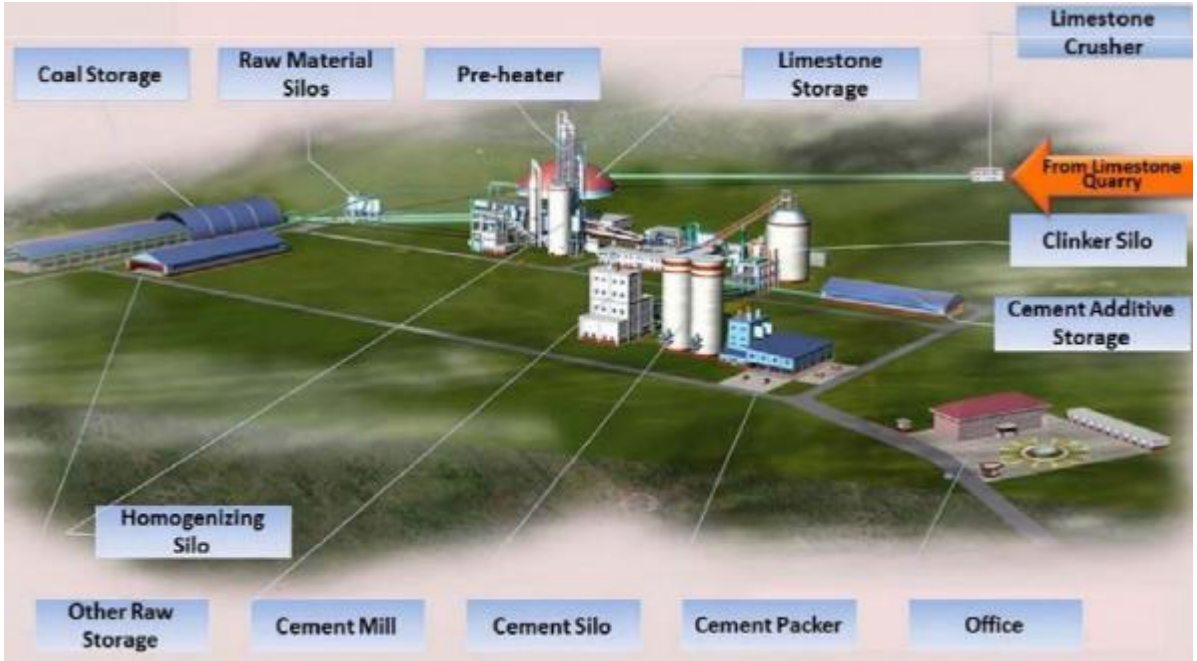
2 OPERATIONAL OVERVIEW

2.1 Cement plant

The existing STC cement plant and ancillary facilities (refer Figure 2.1) are located in a brownfield area of approximately 184 hectares in Thazi township within the Mandalay Region. It is situated in a valley which includes the STC mudstone quarry to the west and the STC limestone quarry to the east, both are situated within the Tha Pyae mountain range (refer Figure 2.3). A dry process is used for the cement production. Cement production comprises five key steps:

1. Raw material crushing;
2. Materials handling;
3. Clinker production;
4. Cement grinding; and
5. Cement packing and dispatch.

Figure 2.1. Illustration of the cement plant and layout



Source: Supplementary ESIA for STC Cement Plant and Associated Facilities in Myanmar, ERM, (April 2017)

[2] It is noted that as this SEP was being finalised the COVID-19 pandemic occurred. The content and timelines in this document should be considered in the context of this evolving global situation; which will impact STC operations and related activities.

Initially the clinker production was approximately 1,500 tonnes per day whilst the cement grinding capacity produced up to 2,800 tonnes per day. A brownfield expansion of the cement plant to a clinker capacity of 5,500 tpd and cement grinding capacity of 7,200 tpd was completed in 2018. The expansion also involved construction of a Waste Heat Recovery System ('WHRS') and improvement in emission control systems. Other facilities located at the cement plant include limestone storage and crusher, clinker silo, cement additive storage, coal storage sheds, packing facilities and office and adminstration facilities. In 2019 approximately 700 workers are employed at the cement plant and ancillary facilities including quarries (refer Section 2.2 below). There are around 1,000-1,200 family members resident in worker housing. Additionally there are around 200 truck drivers coming to and from the site on a regular basis who stay for one or two days at a time (and around 400 when Line 2 is fully operational).

2.2 Quarries

A limestone quarry is located approximately 800 metres east of the cement plant, on a concession of approximately 240 hectares (refer Figure 2.1). Limestone extraction is undertaken using a drill and blast method and is transported by conveyor to the limestone crusher where it is crushed and stored prior to use. Approximately 715,000 tonnes of limestone per year is currently required for current cement production rates cement plant.

A mudstone quarry of a total size of 67 hectares is located west of the cement plant. Mudstone excavation is currently undertaken by open excavation and is transported by truck to the cement plant. Approximately 97,500 tonnes of mudstone per annum to meet current cement production capacity.

Figure 2.2. Limestone Quarry

Source: STC ECD Presentation (2017)

2.3 Coal mining

The coal mine which is operated by Shwe Taung Mining (STM) is located on the western side of the Chindwin River in the Kalaywa township of Sagaing region Annual production is currently approximately 100,000 tonnes with an increase around 150,000 tonnes per annum proposed. The coal mining area is approximately 1,376 hectares over an area approximately 15 kilometres long and 900 metres wide, however mining is restricted to a significantly smaller area at any one time (refer Figure 2.5). Coal extraction is opencast. Coal mining occurs during the dry season only (i.e. December to May each year). Approximately 60 workers are employed at the coal mine during this mining period.

The extracted coal is transported to Paluzawa Village, via a 15 kilometre access road to a coal staging area and barging point on the bank of the Chindwin River. Coal is stockpiled at the staging area, from where it is taken to the barging point and loaded onto barges for transport to Mandalay and Nyaung U. At Mandalay and Nyaung U, the coal is transported to the STC Plant by road.

Coal is delivered to Mandalay region using barges all year around. However, in the dry season, only small barges are able to travel up the Chindwin River.

2.4 Associated facilities

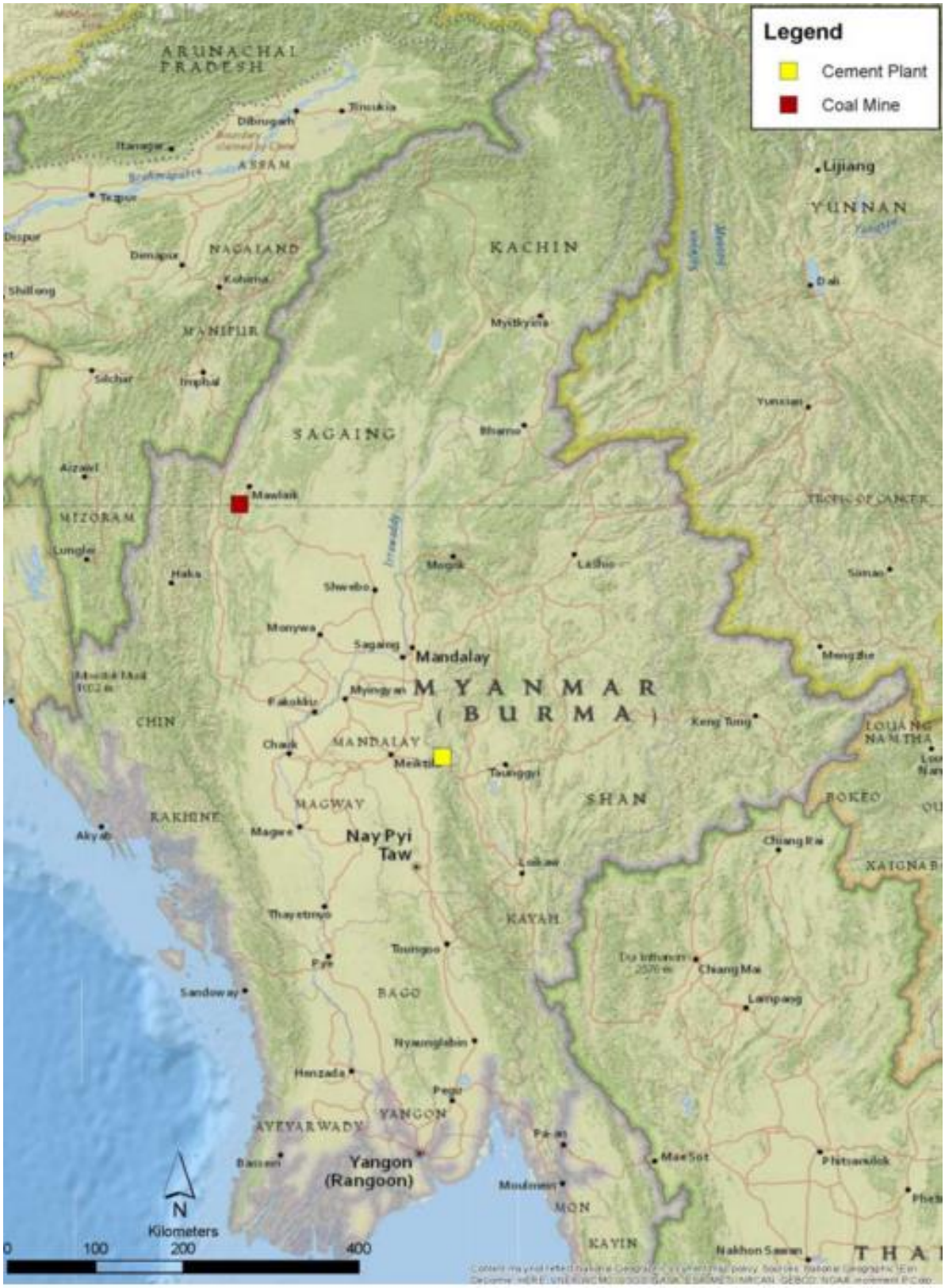
A concrete access road has been constructed by STC from Pyi Nyaung Village to the cement plant, and is considered a public road with unrestricted access. Electricity to the plant is provided by the Yay Paung Sone Power Station which is located approximately eleven kilometres from the plant. The cement plant currently requires 11 megawatts (MW) which is provided via a high voltage transmission line. In addition to this line the company constructed a new 66kV transmission line (10 km) to supply the cement plant and thus the increased supply to STC will be 36 MW in total for both production lines.

Water is currently sourced from two reservoirs situated within the plant area, with capacities of 6 million US gallons (equivalent to approximately 22,712 m3) and 45 million US gallons (equivalent to approximately 170,343 m3), respectively. Water is pumped to the reservoirs from Kubyin Stream at Kubyin Village, situated approximately four kilometres north of the cement plant during the dry seasons of 2014, 2015, and 2016. Since the 2017 dry season, water was not pumped from the Kubyin Stream as there was sufficient capacity in the reservoirs. During the wet season, the reservoirs are replenished by rain water and pumping from Kubyin Stream is not required.

2.5 Proposed facilities

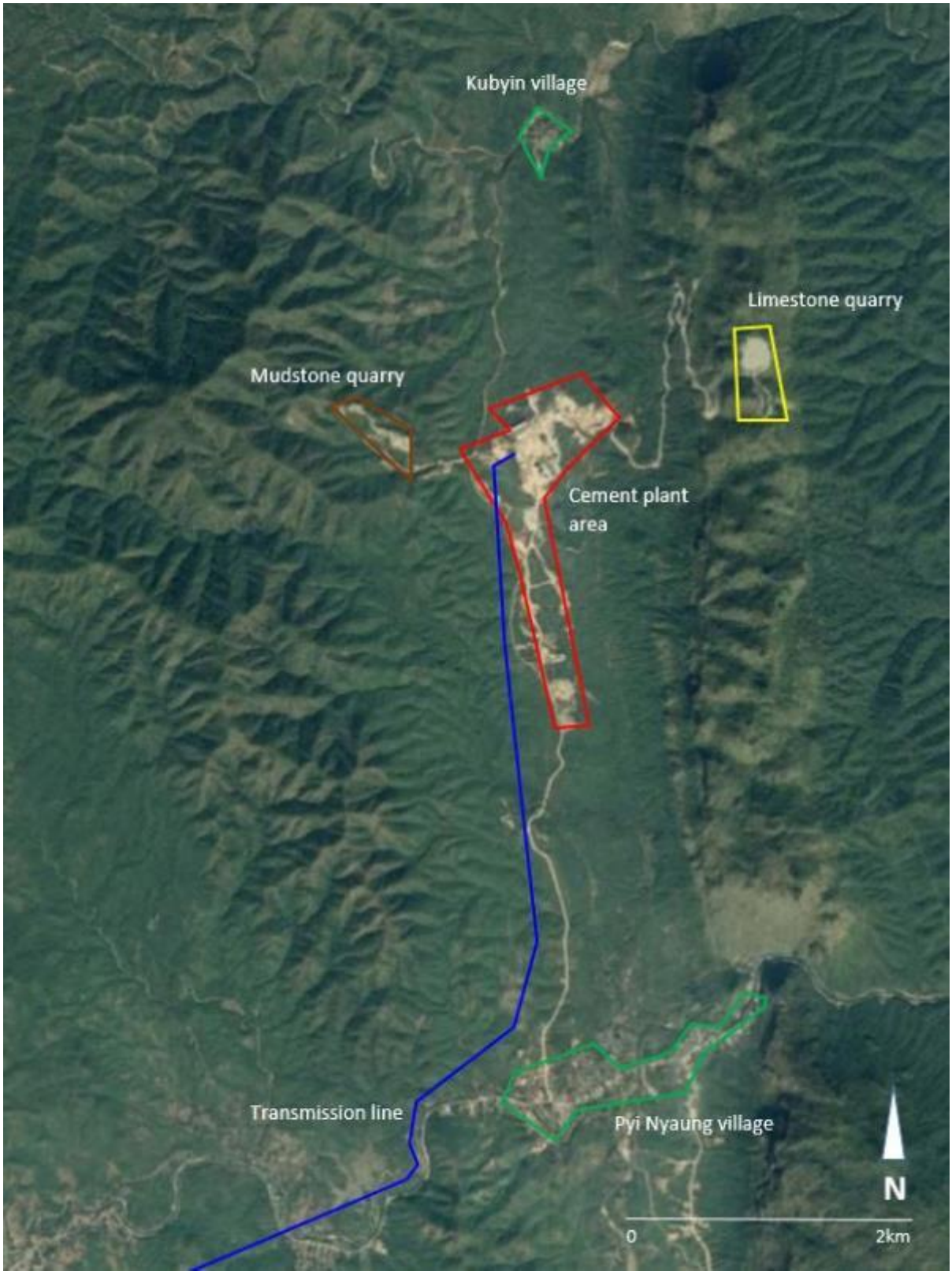
As part of the second expansion line, the Project also involves construction of a Waste Heat Recovery System (WHRS) and improvement in Emission Controls. Meanwhile, two waste heat recovery (WHR) units with a total installed capacity of 8.8 MW, are being constructed respectively in both the first line and second line of the STC cement plant. There is no additional land requirement for the installation of WHR units which will be installed within the existing brownfield area of the cement plant. There will not be any direct loss of natural terrestrial habitat. For the WHRS project, STC submitted an Initial Environmental Examination (IEE) Report to the Environmental Conservation Department (ECD). A main contractor, Shanghai Conch Kawasaki Engineering Co., Ltd, is managing the construction of WHRS project. The Project started in May 2019 and will finish around June 2020.

Figure 2.3. Location of STC cement facilities and STM coal mine



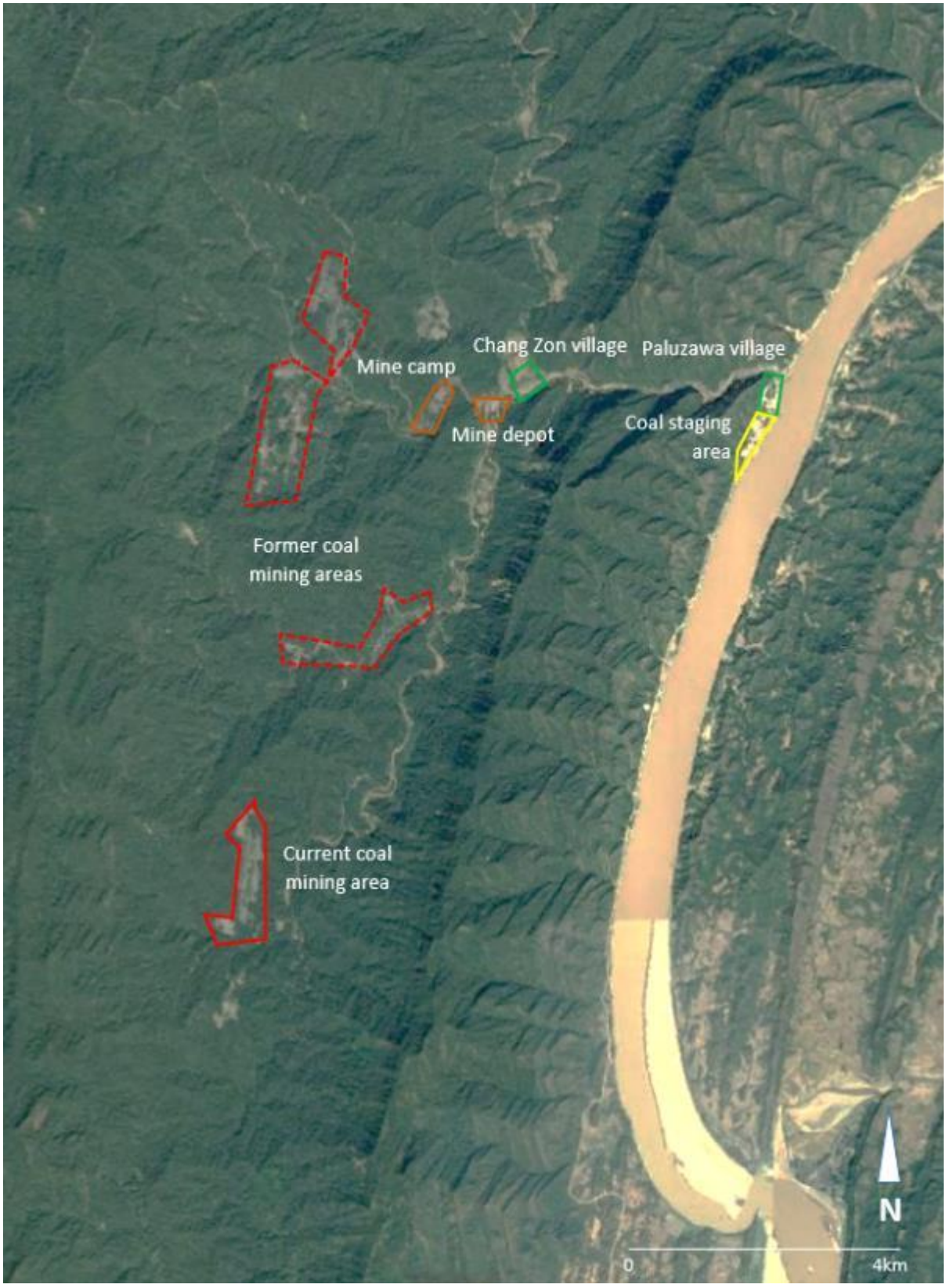
Source: Supplementary ESIA for STC Cement Plan and Associated Facilities in Myanmar, Environmental Resources management, (April 2017)

Figure 2.4. Location of STC plant, quarries and ancillary facilities



Source: Image courtesy of Google Earth, prepared by STC (November 2019)

Figure 2.5. Location of STM coal mine, camp/depot and staging area



Source: Image courtesy of Google Earth, prepared by STC (November 2019)

The Area of Influence (AOI) of the STC operation, quarries, coal mine and associated facilities is summarised in Section 4 of this document and detailed further in Attachment A.

3 REGULATORY REQUIREMENTS

3.1 Myanmar requirements

This SEP is designed to ensure that STC fulfils all of the relevant legal and regulatory commitments in Myanmar. The key regularly requirements related to stakeholder engagement for the ongoing operation of STC are: **Myanmar EIA Procedures (2015);** and **Public Participation Guidelines (Draft in 2017).** The ECD approves all EIA and IEE submissions.

Other regulatory requirements would need to be considered for any future expansion and ancillary projects at STC, including the Myanmar Investment Law (2016) and new Land Acquisition Act (2019), and potentially others (e.g., Vacant Fallow Virgin Land Law).

The key agencies involved in ongoing operations including any potential new biomass and solar power facilities include the Ministry of Electricity and Energy (MOEE), Ministry of Planning, Finance and Industry (MOPFI), Ministry of Natural Resources and Environmental Conservation (MONREC) and the Myanmar Investment Commission (MIC).

The management of land falls under the mandates of Ministry of Agriculture, Livestock and Irrigation (MOALI), MONREC, and the Ministry of Home Affairs (MOHA), with varying degrees of coordination at the union, region, and district and township levels. The Forest Department of MONREC is a key agency as all land areas for STC are leased from them.

The Regional Government and the relevant Township Governments (including the General Administrative Departments (GAD)) are also involved in overseeing different aspects of day-to-day operations and managing relationships with key stakeholders including affected communities.

3.2 International Standards

The International Finance Corporation (IFC) is a lender to STC for its expansion project and as such their Performance Standards on Social and Environmental Sustainability apply to all activities including stakeholder engagement.

The IFC Sustainability Framework includes eight Performance Standards on Environmental and Social Sustainability. The key Standard of importance is *Performance Standard 1 (PS1) - Assessment and Management of Environmental and Social Risks and Impacts,* which prescribes: an integrated assessment approach to identify the environmental and social impacts, risks, and opportunities of projects; effective community engagement through disclosure of information and consultation with local communities; and, the management of environmental and social performance throughout the life of the project/operation.

Development and implementation of a Stakeholder Engagement Plan commensurate to the project aspects and impacts is a specific requirement of IFC PS1. The SEP must be tailored to the characteristics and interests of the affected communities.

In addition, the IFC has developed a series of good practice documents that are designed to help practitioners with environmental and social issues. These include: *Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007);* and *Addressing Grievances from Project-Affected Communities: Guidance for Projects and Companies on Designing Grievance Mechanisms (Good Practice Note 2009).*

4 AREA OF INFLUENCE

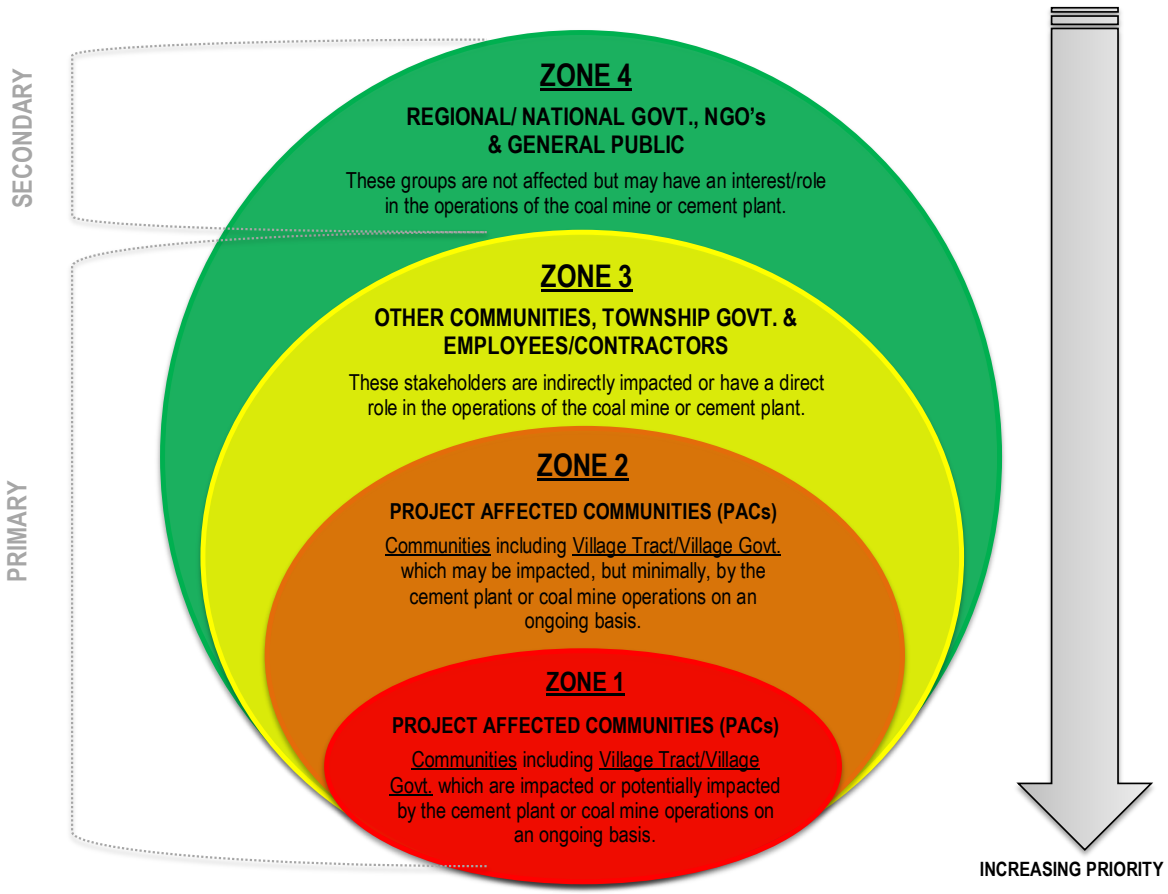
4.1 Overview

The STC Area of Influence (AOI) for stakeholder engagement has been defined using different 'zones' to categorise primary and secondary stakeholders for each of the main operating sites (Figure 4.1). The 'Zone 1' and 'Zone 2' priority stakeholders are the Project Affected Communities (PACs). These are as follows:

- Cement Plant and Quarries: **Pyi Nyaung** and **Kubyin Villages**;
- Cement Plant Transmission Line: **Kyauk Saung Gyi Kwae**, **Oak Kyin**, **Mon Pin, Yay Paung Sone** and **Poper Kone Villages**; and
- Coal Mine, Coal Staging and Transit Areas: **Chuang zon**, **Paluzawa, Nanmawke** and **Shwe Pyi Thar Villages**.

As the level of priority increases, so will the level of effort and resources required by STC to effectively manage stakeholder engagement and concerns. In addition to those PACs within the primary AOI, this Plan will also be used to guide and facilitate engagement with other stakeholders in 'Zone 3' (Other Communities, Township Government and Employees/Contractors and their families) and 'Zone 4' (Regional/National Government, NGOs and the General Public).

Figure 4.1. Stakeholder Groups within the Area of Influence (AOI)



Zone 1 - Project Affected Communities in Zone 1 are those villages which are impacted or potentially impacted by the cement plant or coal mine operations in an ongoing manner. Zone 1 PACs are in close proximity to the operating sites.

Zone 2 - Project Affected Communities in Zone 2 are those villages which may be impacted, but minimally, by the cement plant or coal mine operations on an ongoing basis. This includes communities affected by land acquisition for the high voltage transmission line to the cement plant and a community adjacent to the coal transit point where coal is transferred from barge to trucks. Zone 2 PACs are in proximity to the operating sites but not very close to them (e.g., more than around 5 kms).

Zone 3 – Other Communities in Zone 3 may be indirectly impacted such as along a transport corridor or have an interest in job; business; or community development opportunities with the coal mine or cement plant. Other stakeholders in this group may have a direct role in the STC operations. Zone 3 communities are not within proximity to the operating sites.

The Township Governments in Zone 3 have an ongoing host government role in overseeing the day to day operations of the different facilities and helping to maintain a sound relationship between the operations and their host communities.

Employees and Contractors have direct interaction with the operations often on a daily basis and in the case of many employees and some contractors they are resident at the facilities with their families.

Zone 4 – Stakeholder in Zone 4 including Regional/National Government, Non-Government Organisation (NGOs) and the General Public are not affected by the operations but have either an interest and/or an indirect role to play in the operations.

A detailed description and maps of the different stakeholder groups in the AOI for the cement plant and the coal mine are provided as Attachment A.

5 STAKEHOLDERS AND ANALYSIS

5.1 Stakeholder Identification

Stakeholders are any and all individuals, groups, organizations, and institutions interested in and potentially affected by the STC operation and related activities, or having the ability to influence the project. STC has identified a wide variety of stakeholders through the initial development of the plant, the Supplementary ESIA phase and the expansion works to develop the stakeholder list for engagement during ongoing operations.

The key stakeholder groups most relevant to the STC operation are shown below in Table 5.1. These are grouped by ‘Zone’ in alignment with the AOI and a description is provided as to why they are a key stakeholder group.

Table 5.1. Key stakeholder groups for STC operations

Stakeholder group	Type	Description
ZONE 1: Potentially Affected Communities (PACs)		
Pyin Nyaung Village	Community – Thazi township	Located in the vicinity of the access road to the cement plant.
Kubyin Village	Community – Thazi township	Located in the vicinity of the mud stone quarry and the cement plant.
Paluzawa Village	Community - Kalaywa township	Located in the vicinity of the 1st coal staging area of the coal mine.
Chaungzon Village	Community – Kalaywa township	Located near the base camp of the coal mine.
ZONE 2: Potentially Affected Communities (PACs)		
Kyauk Saung Kwae Village	Community – Thazi township	Located in the vicinity of the existing 1st power line to the cement plant. Some PAPs were affected by land acquisition from this village.
Oak Kyin Village	Community – Thazi township	Located in the vicinity of the existing 1st and 2nd power line to be constructed to the cement plant. Some PAPs were affected by land acquisition from this village.
Mon Pin Village	Community – Thazi township	Located in the vicinity of the existing 1st line to be constructed to the cement plant. Some PAPs were affected by land acquisition from this village.
Yay Paung Sone Village	Community – Thazi township	Located adjacent to the power substation and in the vicinity of the existing 1st and the power substation, and 2nd power line to be constructed to the cement plant. Some PAPs were affected by land acquisition from this village.
Poper Kone Village	Community – Thazi township	Located in the vicinity of the existing 1st line, and 2nd power line to be constructed to the cement plant. Some PAPs were affected by land acquisition from this village.
Nanmawke Village	Community – Kalaywa township	This community is located in the vicinity of the 2nd coal staging area of the coal mine.
Shwe Pyi Thar	Community – Nyaung U township	This community is located along the Irrawaddy river and is adjacent to the transit point where coal is loaded from barge to truck to go to the cement plant.
ZONE 3: Other Communities, Township Government and Employees & Contractors		
Ywar Thar Village	Community - Kalaywa township	These communities are located on the Chindwin River where coal barging occurs. Interested in community development opportunities. Some residents from these communities are workers at some of the STM operations.
Ma Sein Village	Community - Kalaywa township	
Nan Za Lin Village	Community - Kalaywa township	
Wal Daunt Village	Community - Kalaywa township	
Tha Bu Chaung Village	Community - Kalaywa township	
Wai Lon Village	Community - Kalaywa township	
Township General Administration Department (GAD) at Thazi	Government	Supports STC's engagement process to date at township and village levels of Thazi. Oversees relationship with host communities.
Township General Administration Department (GAD) at Kalaywa	Government	Supports STC's engagement process to date at township and village levels of Kalaywa. Oversees relationship with host communities.

Stakeholder group	Type	Description
ZONE 4: Regional/National Government, NGOs and General Public		
Ministry of Natural Resources and Environmental Conservation (MONREC) through its Environmental Conservation Department (ECD) - National	Government	Responsible for the administration of EIA Procedures (2015), approval of STC's Supplementary ESIA, and ongoing monitoring of STC operations. Responsible for monitoring the implementation of the biodiversity offset for the cement plant expansion project and rehabilitation of the coal mine/quarries.
Department of Mining under Ministry of Natural Resources and Environmental Conservation (MONREC)	Government	Oversees the development of new and existing mines/quarries in Myanmar. Communicates and coordinates with different government agencies for HSE-related issues at mines and quarries.
Forest Department - National	Government	Leaseholder of STC's cement plant area (quarries and mine). Monitors the replantation programme and implementation of the biodiversity action plan (BAP).
District General Administration Department (GAD) at Meikhtila - Regional	Government	Supports STC's engagement process to date via arrangement of meetings with stakeholders at District level of Meikhtila.
District General Administration Department (GAD) at Kale - Regional	Government	Supports STC's engagement process to date via arrangement of meetings with stakeholders at District level of Kale.
Myanmar Alliance for Transparency and Accountability (MATA) – National	National NGO	Concerns include the land / crop compensation for the cement plant expansion and other impacts. Participated in Supplementary ESIA consultation.
Myanmar Centre of Responsible Business (MCRB) – National	National NGO	Concerns include disclosure of project information, community engagement as well as ESIA related to the cement plant expansion. Participated in Supplementary ESIA consultation.
Upper Chindwin Youth Network (UCYN)	National NGO	Concerns include the coal mining process, transportation and BAP.
Earth Rights International (ERI) – National	International NGO	Concerns include coal use, land / crop compensation for the cement plant expansion and the Supplementary ESIA process including consultation. Participated in Supplementary ESIA consultation.
Fauna and Flora International (FFI) – International	International NGO	Performed the biodiversity survey for the Supplementary ESIA of the cement plant expansion project and was consulted for the development of the Biodiversity Action Plan (BAP).
Wildlife Conservation Society - International	International NGO	Consulted during Supplementary ESIA of the cement plant expansion and development of the BAP.
STC Employees	Workers	Engaged in overseeing the Project operational and other activities of STC. A number of workers are resident at the cement plant site and seasonally at the coal mine including with their families. STC staff
Contractors and subcontractors	Contractors	A number of contractors such as truck drivers periodically visit the cement plant, coal mine and other sites including sometimes with families. STC contractors need to be kept informed of key project activities and requirements.
General Public	Individual/ families/ businesses/ other organisations	Different members of the public may interact with the STC operations due to employment or business opportunities or through areas of interest, e.g., the Media may a stakeholder in this group.

5.2 Key Issues for Stakeholders

Stakeholder engagement undertaken to date has identified a number of key issues and concerns relevant to specific stakeholder groups. These are summarised in Table 5.2 along with the key stakeholder groups concerned and how STC is managing and will continue to manage these issues.

Table 5.2. Key Issues Management

Issue topic	Key stakeholder groups	Description of issue	Operational Controls and Other Measures
Air quality (including dust/coal dust)	Pyi Nyaung, Kubyin, Chuang zon, Paluzawa and Namwake villages	Residents of all villages near the cement plant, coal mine and coal staging areas are concerned about air/dust pollution on their health and crops.	• Environmental and Social Management Plan (ESMP) including air quality management. • Ambient Air quality monitoring plan • Monthly and Continuous Monitoring System of Stack emission of both kiln systems • Planned Participatory Environmental Monitoring (PEM) Program with communities.
Water quality (including sedimentation and related potential health issues)	Pyi Nyaung, Kubyin, Chuang zon, Paluzawa and Namwake villages	Some residents are concerned about pollution from the cement plant and coal mine on river and other water sources and potential health/skin issues including in children (e.g., at Ku Pyin River).	• Environmental and Social Management Plan (ESMP) including water quality management. • Surface Water quality management plan • Sanitary Wastewater quality management plan
In-flux / in-migration	Pyi Nyaung, Kubyin, Chuang zon, Paluzawa and Namwake villages	All communities are concerned about influx of outsiders due to construction and maintenance activities, as well as improved roads. Locals worry there will be pressure on local livelihoods and local social dynamics.	• Policy for giving preference to locals for employment. • Job fairs held locally to encourage local employment. • Liaise with the local government to discourage informal settlements on the road from Pyi Nyaung to the cement plant. Guards at the plant guardhouse shall discourage the setting up of settlements or businesses within the vicinity of the guardhouse.
Landslides and land clearance	Pyi Nyaung, Kubyin, Chuang zon, Paluzawa and Namwake villages	Landslides are a concern for some residents particularly in Chaung Zon	• Land clearance procedure of Biodiversity Action Plan • Mine Closure and Rehabilitation Plan • Stormwater Management Plan • Road Maintenance
Biodiversity management	MONREC Forest Department, MONREC Myanmar Centre of Responsible Business (MCRB) Upper Chindwin Youth Network Friends of Wildlife (FOW)	Loss of habitats due to clearing of areas for mud stone quarries (42ha); quarrying activities in limestone concession (244ha); Clearing of 1041ha for coal mining activities; illegal logging; Disturbance or displacement of flora/fauna due to operation of machinery and plant;	• Biodiversity Action Plan (October 2018) • Signing of Letter of Intent for Biodiversity Offset Project with MONREC (December 2018) • Consultation with Myanmar Government officials and NGOs (e.g. Fauna & Flora International, Wildlife Conservation Society, Friends of Wildlife, and etc).

Issue topic	Key stakeholder groups	Description of issue	Operational Controls and Other Measures
	Fauna and Flora International (FFI) Wildlife Conservation Society (WCS)	induced clearing/access to forested areas by local people (hunting and poaching);	
Noise	Pyi Nyaung, Kubyin, Chuang zon, Paluzawa and Namwake villages	Some residents have concerns over noise and increased noise due to expansion at the cement plant.	• E.g., Noise contours and monitoring program • Communication of results of program to stakeholders
Land/crop compensation	Households affected by construction of transmission lines to cement plant Myanmar Alliance for Transparency and Accountability (MATA) – National EarthRights International (ERI)	Affected households and other stakeholders are interested in ensuring that any families whose land or assets are affected are properly engaged, adequately compensated and offered relevant livelihood restoration measures where required.	• Compensation plan • Resolution of grievance related to land/crop compensation including formal introduction of Stakeholder Grievance Mechanism (SGM) rom March 2019.
Disclosure of information / community engagement	Residents in Project Affected Communities (PACs) District General Administration Department (GAD) (all) Myanmar Centre of Responsible Business (MCRB) – National	A range of stakeholders should be kept informed on a regular basis about the operations and also engaged on specific topics/issues that could affect them or are of interest to them.	• This SEP including the 'Action Plan' (refer Section 7). • Community Liaison Officers based locally at the cement plant and coal mine. • Community Information centers in Pyi Yaung and Paluzawa • Formal introduction of SGM from March 2019. • Information Boards and Suggestion Boxes in all nearby communities of both cement plant and coal mine
Employment opportunities for local residents	Residents in Project Affected Communities (PACs)	Many residents regularly express interest in employment opportunities at the cement plant, coal mine or ancillary facilities.	• Policy for giving preference to locals for employment. • Creation of new jobs through cement plant expansion. • Public meetings on job opportunities at STC/STM. • Job fairs in Pyi Yaung and Yin Mar Pin (May 2018) and other upcoming job fairs. • Registration of interested local workers in job-seeker database.

6 STAKEHOLDER ENGAGEMENT TO DATE

6.1 Previous Stakeholder Engagement by STC

STC has undertaken a range of consultation and stakeholder engagement activities over the past few year since the expansion project for the cement plant was initiated. Consultation activities undertaken by STC can be organized into the following three main phases:

- **Phase 1:** Initial consultations that fed into the scoping and preparation of the Supplementary ESIA.[3] Consultations were undertaken between October 2016 and January 2017.
- **Phase 2:** Stakeholder engagement during finalisation of the Supplementary ESIA and its public disclosure between January and November 2017. This phase included a series of specific stakeholder engagement activities relating to biodiversity management during July to November 2017
- **Phase 3:** Specific consultation initiatives and actions related to the expansion works and ongoing operations from 2018 onwards. This SEP focuses on ongoing Phase 3 stakeholder engagement activities which are described in the Stakeholder Engagement 'Action Plan' (SEAP) (refer Section 7).

A summary of the key formal engagement activities conducted to date are provided in Table 6.1 below. Some photos of recent past consultation and disclosure activities are shown in Attachment B. Lessons learned from past consultations have been used to develop the ongoing (Phase 3) stakeholder engagement program.

Table 6.1. Engagement activities undertaken to date

Activities	Period	Components
Phase 1 – Initial Supplementary ESIA scoping consultations		
Supplementary ESIA scoping consultations	October 2016 to January 2017	▪ Consultation with Village Tract Leaders in five villages near to cement plant and coal mine (Kyu Pin, Pyi Nyaung, Paluzawa, Nanmawke, Chaungzon). ▪ Public briefings in the five villages. ▪ 100 Household surveys in the five villages. ▪ A total of 15 focus group discussions with women and farmers in the five villages.
	January 2017	▪ Consultation with Flora and Fauna International (FFI) and Wildlife Conservation Society (WCS) on biodiversity assessment and offsets.
Phase 2 – Supplementary ESIA preparation and disclosure consultations		
Disclosure of Draft Supplementary ESIA	April 2017	▪ The Supplementary ESIA was disclosed on the Shwe Taung website and in key locations locally and nationally.
Consultations on Supplementary ESIA[4]	July and September 2017	▪ Public forum on 18 July 2017 in Yangon for Government, public, NGOs, businesses, others. ▪ Township meeting at Thazi held on 21 July 2017. ▪ Village meeting at Pyin Naung held on 22 July 2017. ▪ Township meeting at Kalaywa on 5 September 2017. ▪ Village meeting at Paluzawa held on 6 September 2017.
Land acquisition planning and implementation for transmission lines	July 2017	▪ Consultation and negotiations with potentially affected land users and owners including verification of affected assets, appraisal of land and asset values, negotiations on compensation, and payment of compensation.

[3] Further details on consultations for the Supplementary ESIA can be found at: http://www.shwetaunggroup.com/wp-content/uploads/2017/04/Supplementary-ESIA-Report.pdf

[4] Further details and minutes of meetings can be found at: https://www.apachecement.com/category/news/

Activities	Period	Components
Biodiversity offset and biodiversity management	June to November 2017	▪ Consultation with WCS Myanmar, FFI Myanmar, MCRB, Nature and Wildlife Conservation Division (NWCD) of MONREC, Township Forest Officers of Ywangan and Kalaywa, and others government authorities. ▪ Initial offset plans and biodiversity management were key topics during these consultations.
Phase 3 – Expansion works consultations and ongoing operational engagement		
Job fair in Pyi Yaung and Yin Mar Pin	May 2018	▪ A 2-day job fair was held by STC in Pyi Yaung and Yin Mar Pin villages and around 80 applications were received and 22 persons appointed from local areas.
Update to villages near cement plant and transmission line	September 2017 to November 2019	▪ Meetings held at Pyi Nyaung, Oakkyin, Mon Pin, Ku Pyin Pyi and Nyaung villages. ▪ Provided update on company activities and how to access opportunities for employment at STC.
Independent Livelihood Survey for transmission lines (BUSODEV)	December 2018	▪ Survey held in Mon Pin, Yay Paung Sone, Kyauk Saung Kwae, South-Pyi Nyaung and Pyi Nyaung villages. ▪ Covered a range of livelihood parameters and indicators of standard of living (e.g., education, access to water, etc)
Mine blasting information session	December 2018	▪ Knowledge sharing on rock blasting for mining/quarrying and information on safety concerns and requirements.
Biodiversity offset and biodiversity management	January 2018 to November 2019	▪ Meetings with NWCD, FFI and others. ▪ Signing of Letter of Intent between MONREC and STC for Biodiversity Offset Project, Nay Pyi Taw. ▪ Updating of the Biodiversity Action Plan (BAP) with stakeholders'' concerns ▪ Preparation of Letter of Agreement between MONREC and STC
Consultation with Shwe Pyi Thar	September 2018 To November 2019	▪ Consultation with Shwe Pyi Thar community to provide an update and listen to concerns. ▪ Regular monthly meeting with Shwe Pyi Thar community to provide health care service and listen to concerns
Electricity supply information session	February 2019	▪ Information session for Ku Pyin villagers on electricity charges and accessibility (to change from STC provided diesel generators to electricity grid).
Community health information sharing	February 2019	▪ Meeting about community health issues and aligning STC programs with Public Health Department of Thazi (using recognized pamphlets for reproductive health, contraceptive knowledge, hygiene, TB and flu.)
Public information on Line 2 expansion	February 2019	▪ Public Forum in Pyi Nyaung Monastery to provide a company/operational update and introduce SGM. ▪ Provided more detail on Line 2 expansion and more employment opportunities.
SGM Roll-out and Awareness Raising Campaign	March to October 2019	▪ A formal SGM awareness campaign started on 13 March. ▪ Meetings were held in Pyi Nyaung, Ku Pyin, Oak Kyin, Poppa Kone, and Yay Paung Zone villages and with students at Pyi Yaung Primary School. ▪ SGM presentations, leaflets, information boards, vinyl sheets, and contact information cards were disseminated in 7 villages around the cement plant. ▪ Household visits were made in Kyu Pyin and Pyi Nyaung to explain SGM directly to families. ▪ A survey was conducted to assess effectiveness and make ongoing improvements to the SGM.

Note: Many consultations to implement a range of Community Development Program (CDP) activities by STC have been implemented since 2010 in Zone 1 and 2 communities.

7 STAKEHOLDER ENGAGEMENT ACTION PLAN

The STC Stakeholder Engagement Action Plan (refer Table 7.1) focuses on the engagement about ongoing operations of STC cement plant and coal mine, and related environmental management, community health and safety, community development and other initiatives, including the effective resolution of community grievances through the Stakeholder Grievance Mechanism (refer to Attachment C).

Table 7.1. STC Stakeholder Engagement Action Plan

Purpose / Action	No.	Tasks/Methods	Schedule or Frequency	Responsibility
Project Affected Communities (Zones 1 and 2)				
1. Provide periodic updates to communities	1a	▪ Hold public forum/meeting to update communities and listen to their feedback and concerns at Cement Plant and Coal Mine.	▪ Bi-annual (cement) ▪ Yearly (coal mine)	Implement: Social Manager Monitor: HSSE Head
2. Maintain regular engagement with communities	2a	▪ Maintain Information Centers and regularly update disclosure materials e.g., maps, newsletters, flyers and photos, etc.	▪ Every three months	Implementation: CLO/ HSSE Officer/Information Center Exec. Monitor: Social Manager
	2b	▪ Open Information Center at Coal Mine site near Paluzawa	▪ By Q1 2020	
	2c	▪ Publish Community Newsletters that provides updates on: ➢ Operation of the plant/site ➢ Community engagement schedule ➢ Answers to Frequently Asked Questions (FAQs) ➢ Summary of complaints received and resolved ➢ Summary of CDP, CHP, SGM and other activities undertaken ➢ Upcoming events ➢ Employment & business opportunities ➢ Other relevant issues	▪ Quarterly	Implement: CLO/ HSSE Officer Monitor: Social Manager
	2d	▪ Hold semi-regular meetings with communities on key environmental & social (E&S) topics or other of interest to them, e.g., ➢ Transport/traffic ➢ Noise ➢ Water quality ➢ Air quality and dust ➢ Others as required	▪ As required (but at least once per year)	Implement: Social Manager Monitor: HSSE Head

Purpose / Action	No.	Tasks/Methods	Schedule or Frequency	Responsibility
3. Implement Stakeholder Grievance Mechanism (SGM)	3a	▪ Engage community leaders and selected members on development of complaints management.	▪ By Sept 2019	Implement: CLO / HSSE Officer Monitor: Social Manager
	3b	▪ Distribute "Leaflet" on the SGM to all PAC households of Cement Plant and Coal Mine (including 1st T-Line and 2nd T-Line households of Cement Plant).	▪ By end 2019	
	3c	▪ Establish Suggestion Boxes to receive complaints at multiple locations in PACs and at other locations near Cement Plant and Coal Mine.	▪ By Sept 2019	
	3d	▪ Implement roll-out of the SGM to PACs by: ➢ Obtaining feedback on SGM procedure ➢ Providing training in the use of SGM ➢ Providing SGM contact persons' information (e.g. noticeboards, newsletters, etc) ➢ Piloting the SGM by collecting and resolving current grievances.	▪ By end Jan 2020 ▪ Then annual refresher training	
	3e	▪ Conduct survey on SGM roll-out process to at least 20% of households of PACs to evaluate early understanding and use of SGM during pilot phase.	▪ By end 2019	
	3f	▪ Disclose SGM results regularly to communities and other stakeholders (e.g., grievance no., type, resolutions, etc) in Community Newsletter or equivalent and on website.	▪ By end 2019 ▪ Then annually	Implement: Social Manager Monitor: HSSE Head
4. Maximise local employment opportunities for PAC residents	4a	▪ Implement Job Seeker Program, and provide PACs with information about job registration services, e.g., flyers, newsletter, etc.	▪ As required when new employment opportunities arise	Implement: CSR Executive Monitor: Social Manager
	4b	▪ Regular communications to PACs on employment opportunities at Information Centers.	▪ As required	
	4c	▪ Provide CV template at Information Center and send received CVs to STC HR Department	▪ Ongoing	Implement: Info. Center Executive Monitor: Social Manager
	4d	▪ Provision of jobseeker database (with PACs as priority) to company departments and contractors	▪ Quarterly	Implement: CSR Executive Monitor: Social Manager
	4e	▪ Announce recruited PAC and existing ratio of PAC vs Total Workforce at Information Centers.	▪ At least annually	
	5a	▪ Prepare and distribute CHP leaflets on relevant topics	▪ As required	

Purpose / Action	No.	Tasks/Methods	Schedule or Frequency	Responsibility
5. Implement Community Health (& Safety) Program (CHP)	5b	▪ Conduct a series of workshops or similar in each PAC to raise awareness on CHP risks from the operation (including road traffic safety, heavy machinery, equipment, communicable diseases and others as relevant)	▪ At least quarterly, but more as required	Implement: Medical Officer/Doctor Monitoring: Social Manager
	5c	▪ Conduct community health & safety awareness activities with children, e.g., at schools during summer training camp.	▪ Annually	Implement: CSR Executive/ CLO Monitoring: Social Manager
	5d	▪ Conduct emergency preparedness and response training in Zone 1 PACs (and others if required).	▪ By mid-2020 ▪ Then annually	Implement: CLO/Safety Manager Monitor: Social Manager
6. Establish Participatory Environmental Monitor (PEM) program	6a	▪ Invite selected community members to participate in regular PEM activities, e.g., water and air quality sample collection and testing, etc. Explain PEM concept and request feedback.	▪ By Q2 2020	Implement: Enviro/Social Managers Monitor: HSSE Head
	6b	▪ Provide training to PEM group members in monitoring techniques and analysis, and interpreting and reporting results	▪ By Q2 2020	Implement: Enviro. Manager Monitor: HSSE Head
	6c	▪ Prepare regular PEM reports and disclose in PACs and other relevant locations (e.g., Information Center, website).	▪ Quarterly	Implement: Administrative and Communication Executive, and CLO Monitor: Social Manager
Project Affected Communities (Zone 2 households affected by past land acquisition for the T-Line to Cement Plant)				
7. Maintain regular engagement and monitoring of economically displaced households (status of livelihoods)	7a	▪ Publish disclosure materials (e.g. flyers) on livelihood restoration opportunities (including job opportunities, small business development, other)	▪ Every three months	Implement: CLO/Social Team Monitor: Social Manager
	7b	▪ Follow-up the Supplementary Land acquisition and Involuntary Resettlement assessment of households after the compensation process to assess impacts on income impacts and permanent land loss impacts (if any)	▪ December 2018	Implement: Independent consultant
	7c	▪ Conduct follow-up survey to evaluate of households approximately one year after supplementary land acquisition.	▪ October 2020	Implement: CLO/Social Team Monitor: Social Manager
8. Monitor and support vulnerable displaced households	8a	▪ Follow-up survey of Vulnerable households to assess livelihood status following two years of compensation	▪ August 2020	Implement: CLO/Safety Manager Monitor: Social Manager
	8b	▪ Engage and implement additional support measures if needed for vulnerable households based on survey results (8a above)	▪ October 2020	Implement: CLO/Safety Manager Monitor: Social Manager

Purpose / Action	No.	Tasks/Methods	Schedule or Frequency	Responsibility
Employees & Contractors				
9. Raise company and contractor awareness on community engagement	9a	▪ Raise awareness on PACs by sharing Project Area of Influence (AOI) definition and maps at induction and refresher training sessions.	▪ As per training plan	Implement: CLO/LLO/Social Manager Monitor: HSSE Head
	9b	▪ Circulate community newsletters to STC employees and to contractors at noticeboards, and other locations.	▪ Every three months	Implement: CLO / HSSE Officer Monitor: Social Manager
	9c	▪ Prepare community profiles including environmental and social risks due to operation of cement plant and coal mine. ▪ Circulate to employees and contractors including expectations on behaviour in communities.	▪ End 2019	Implement: Social Manager and Environmental Manager Monitor: HSSE Head
Township/ District Government (Thazi and Kalaywa Townships)				
10. Maintain regular engagement with Township/District Government	10a	▪ Arrange regular meetings with Township/District Government officials (GAD and others as relevant).	▪ Every six months	Implement: Social Manager Monitor: HSSE Head
	10b	▪ Distribute Community Newsletters to Government Offices.	▪ Every two months	Implement: CLO / HSSE Officer Monitor: Social Manager
	10c	▪ Engage Township/District Government in community development launch and completion events and other activities as relevant (e.g., SGM, SEP, CHP, etc).	▪ As required	Implement: Social Manager Monitor: HSSE Head
	10d	▪ Conduct site tours for Township/District Level Government representatives.	▪ Propose once yearly	
	10e	▪ Distribute STG Sustainability Report to Government Offices.	▪ Annually	
Regional/ National Government				
11. Maintain regular engagement with Regional/National Government	11a	▪ Arrange regular meeting to Regional Government officials (GAD and others as relevant).	▪ At least annually	Implement: Social Manager Monitor: HSSE Head
	11b	▪ Engage Regional Government in community development launch and completion events and other activities as relevant (e.g., SGM, SEP, CHP, etc).	▪ As needed	
	11c	▪ Distribute Community Newsletters to Regional Government Office.	▪ Once/three months	
	11d	▪ Conduct site tours for Regional Government representatives.	▪ Propose once yearly	
	11e	▪ Distribute STG Sustainability Report to Government Offices.	▪ Annually	

Purpose / Action	No.	Tasks/Methods	Schedule or Frequency	Responsibility
12. Engagement with Government on biodiversity management and offset management	12a	▪ Consultation on implementation of the Biodiversity Offset Management Plan (BMOP), Biodiversity Management Plan (BMP) and related activities as per the Biodiversity Action Plan (BAP). ▪ Specific engagement with the Forestry Department and Wildlife Conservation Department at regional and other levels.	▪ As per the BAP.	Implement: Environmental Manager and Social Manager Monitor: HSSE Head
Environmental Conservation Department (ECD) (Regional and National Level)				
13. Maintain regular engagement and EMP reporting with ECD	13a	▪ Facilitate regular meetings for Regional/National ECD officers.	▪ Every six months	Implement: Environmental Manager and Social Manager Monitor: HSSE Head
	13b	▪ Involve Regional ECD in any significant complaint investigations.	▪ As required	
	13c	▪ Distribute Community Newsletter to Regional ECD Office.	▪ Every two months	
	13d	▪ Conduct site tours for ECD representatives.	▪ Propose once yearly	
	13e	▪ Submit EMP report to Regional ECD Office	▪ As needed	
	13f	▪ Distribute annual STG Sustainability Report to ECD.	▪ Annually	
Non-Governmental Organisations (NGOs) (Local, national and international)				
14. Maintain a positive and open dialogue with NGOs and respond to information requests	14a	▪ Respond to NGO information requests in a timely manner.	▪ As required	Implement: Social Manager Monitor: HSSE Head
	14b	▪ Provide a regular update to key NGOs interested in the STC operations	▪ At least annually	
	14c	▪ Engage NGOs in community development launch and completion events (where appropriate)	▪ As required	
	14d	▪ Engage specific NGOs as needed to address their information requests or concerns (e.g., biodiversity, land, grievances, etc)	▪ As required	
15. Engagement on biodiversity offset management plan (e.g., with the Contracted Conservation NGO)	15a	▪ Implementation of BOMP, BMP and related activities as per the BAP. ▪ Relevant disclosure activities on the BOMP and BMP implementation, progress and outcomes to interested NGOs (and other key stakeholders) as per the BAP.	▪ As per the BAP.	Implement: Environment Manager and Social Manager Monitor: HSSE Head

Purpose / Action	No.	Tasks/Methods	Schedule or Frequency	Responsibility
General Public				
16. General engagement on key environmental & social matters	16a	▪ Complete regular website updates. ▪ Provide information as relevant on operations progress; New project progress (e.g., Waste Heat Recovery); ECCs and ESIAs progress; Community engagement activities; Stakeholder engagement activities; CSR/CDP and CHP activities; Environmental & social monitoring reports, as relevant.; Other activities.	▪ Regular updates at least every six months ▪ Public reporting on key topics annually	Implement: Social Manager, Environmental Manager and Admin & Communication Executive, HSSE Officer and CLO Monitor: HSSE Head
Media (Local, regional, national)				
17. Leverage Media interest and support for the project and mitigate adverse media as required	17a	▪ Provide regular press releases on key project progress/ topics on company website.	▪ Every three months (or upon major news event)	Implement: Admin & Communication Executive and Social Manager Monitor: HSSE Head
	17b	▪ Respond to media information requests in a timely manner.	▪ As required	
	17c	▪ Engage media in community development launch and completion events (where appropriate).	▪ As required	

8 STAKEHOLDER GRIEVANCE MECHANISM (SGM)

STC has developed and implemented a Stakeholder Grievance Mechanism (SGM) to resolve stakeholder grievances that may arise as a result of their operations and related activities. The SGM operates in tandem with an effective stakeholder engagement program that allows key stakeholders to regularly discuss and address issues of concern with the company.

The SGM has been developed in accordance with international E&S standards and in keeping with good corporate policy, as well as Myanmar legal requirements.

This SGM is applicable to all concerns, complaints and grievances received by STC either directly or indirectly from external stakeholders. The SGM is open to all stakeholders who consider themselves affected by the Project's activities, but has a specific focus on PAC's and other stakeholders in 'Zone 1'and 'Zone 2' of the AOI (see Section 4). A separate Worker Grievance Mechanism (WGM) has been implemented for employees and contractors/sub-contractors. The SGM has the following six key steps:

- **STEP 1**: Complaint Lodged;
- **STEP 2**: Complaint Registered;
- **STEP 3**: Complaint Assessed;
- **STEP 4**: First Level Resolution (MINOR);
- **STEP 5**: Second Level Resolution; and
- **STEP 6**: Third Level Resolution.

The SGM procedure (flowchart) is shown in Attachment B. A detailed procedure sets out the full SGM and is managed by the HSSE Department. The detailed procedure covers the following aspects:

- Responsibilities and resources;
- Publicizing and raising awareness of the SGM;
- Monitoring and reporting including regular public reporting on SGM implementation to communities and other stakeholders;
- Periodic review of the SGM; and
- Confidentiality and Protections.

The SGM is managed by the HSSE Department. The CLO and HSSE Officer have responsibility for the day-to-day operation of the SGM with supervision of Social Manager. A Stakeholder Grievance Log and all Stakeholder Grievance Forms and other relevant records are maintained by the HSSE Department.

The investigation from HSSE Department will consider if the complaint is legitimate and/or related to the operation/project. In cases where it is found not to be legitimate/or unrelated to the operation, then the resolution will be to explain this with reasonable evidence to the complainant. Regardless of the acceptance from the complainant, a response shall be provided to all complainants from STC. STC will communicate the proposed resolution, and ask for the complainants' agreement. If the complaint is resolved to the satisfaction of the complainants, STC will get a confirmation and file it along with the case documentation. If complainants do not agree to a resolution, there is provision in the SGM for external mediation (Step 6 – Third Level Resolution) which includes community or other support for the complainant (at no cost to the complainant). At any step of the SGM process complainants are free to take their grievances to a dispute resolution mechanism outside of the STC grievance mechanism.

As described in Section 6.1, STC started rolling out and piloting the SGM with PAC's and other stakeholders in early 2019. Comprehensive awareness raising and other activities related to the SGM are ongoing. Public reporting on SGM results has commenced in early 2020.

9 SEP IMPLEMENTATION

9.1 Roles and Responsibilities

STC management has overall responsibility for effective stakeholder engagement. **The HSSE Department** has responsibility for leading the implementation of this SEP and its associated Stakeholder Grievance Mechanism (SGM), and other social plans, programmes and procedures, with actual implementation to be carried out by the **Social Division within the HSSE Department.** The key roles related to the SEP are as follows:

- **The CEO** of STBM authorises this SEP and the management team has overall responsibility for ensuring effective stakeholder engagement and resolution of stakeholder grievances.
- **The COO of Cement Business** oversees implementation of this SEP alongside the HSSE Head. The COO provides enabling conditions including budget and resources and senior management support for stakeholder engagement.
- **The HSSE Head** oversees implementation of this SEP alongside the HSSE Head. The HSSE Head also provides technical support and oversight of the Social Division including the Social Manager, CLO and HSSE Officer in the implementation of the SEP and the SGM. The HSSE Head is responsible for ensuring that any stakeholder engagement matters that require input from the CEO are raised at the management meetings and tracked until closed out.
- **Head of Mining (Coal Mine) and Plant Manager (Cement Plant)** support implementation of the SEP at the respective sites and associated facilities and ensure the HSSE Officer/CLO and other relevant staff have sufficient budget and resources to implement community engagement.
- **The Social Manager with support from the Community Liaison Officers (CLOs) and HSSE Officer (Coal Mine)** carry out the day-to-day activities related to stakeholder engagement at the community level and are responsible for grievance management.
- **Other department heads, employees, contractors** are required to provide accurate, timely and relevant information to support stakeholder engagement and to be involved in implementation of this SEP and resolution of grievances as required. This coordination across departments mainly transpires through the HSSE Committee.

Specific position descriptions with responsibilities and key performance indicators (KPIs) relevant to the implementation of the SEP are detailed in Attachment D.

9.2 Monitoring and Reporting

STC has established a stakeholder engagement management system and database that contains the following elements:

- The Stakeholder Engagement Action Plan;
- A 12 month ‘look ahead’ including detailed schedule;
- A Stakeholder Engagement Log; and
- Reporting framework.

The Stakeholder Engagement ‘Action Plan’ (refer Section 7) is reviewed and updated annually together with this SEP. The 12 month ‘look ahead’ is the detailed schedule that sets out the different stakeholder engagement activities planned by STC; per period in different locations and with different stakeholder groups. The 12 month ‘look ahead’ is reviewed at least quarterly. The key stakeholder engagement reporting undertaken by STC is shown in Table 9.1.

Table 9.1. SEP Reporting Framework

Reporting	Internal or External	Frequency	Responsible
Stakeholder Engagement Log	Internal	Monthly	CLO / HSSE Officer Report to: Social Manager
SGM Logs	Internal	Monthly	CLO / HSSE Officer Report to: Social Manager
SGM Report	Internal	Annually	CLO / HSSE Officer Report to: Social Manager
Social Report (including stakeholder engagement)	Internal	Monthly	Social Manager Report to: HSSE Head and HSSE Committee
HSSE Report (including any outstanding/important stakeholder matters)	Internal	Monthly	HSSE Head Report to: CEO of STBM and Senior management meeting
Community Newsletter (incl. update on community engagement)	External	Quarterly	CLO / HSSE Officer / HSSE Department Report to: PACs and other key stakeholders
SGM Report	External	At least annually	CLO / HSSE Officer / HSSE Department Report to: PACs and other key stakeholders
Annual E&S Report (including summary of key activities and outcomes)	External	Annually	HSSE Department Report to: key external stakeholders (e.g., PACs, Govt., NGOs, public)

9.3 Training

In order to ensure effective implementation and monitoring of the SEP, relevant staff must be trained in stakeholder engagement and grievance management, while all employees and contractors should have an appreciation of stakeholder engagement principles, and the key elements of the SEP and SGM.

The HSSE Head and the Social Manager are responsible for training in the SEP and SGM within the STC operations. Training requirements will be reviewed on an annual basis by the HSSE Head and Social Manager.

Training on key aspects of the SEP and SGM for external stakeholders (e.g. PACs) will be undertaken as part of general planned engagements, as shown in Table 7.1 above. Training to employees for 2020 is shown at Table 9.2.

Table 9.2. SEP Training (2020)

Group	Forum	Frequency
Social Division and STC management team	• Meeting – review and identify additional training needs with HSSE Head and CEO	Annual
Employees (STC and permanent contractors)	• Employee Induction • Employee Noticeboards • Toolbox briefings	Semi – annual and as required
Part-time Contractors / Subcontractors / Site Visitors	• Visitor induction	As required

10 ATTACHMENTS

- **ATTACHMENT A – Areas of Influence (AOI)**
- **ATTACHMENT B – Previous stakeholder engagement activities**
- **ATTACHMENT C – Stakeholder grievance mechanism flowchart**
- **ATTACHMENT D – STC Accountabilities, Roles and Responsibilities**

ATTACHMENT A – AREAS OF INFLUENCE (AOI)

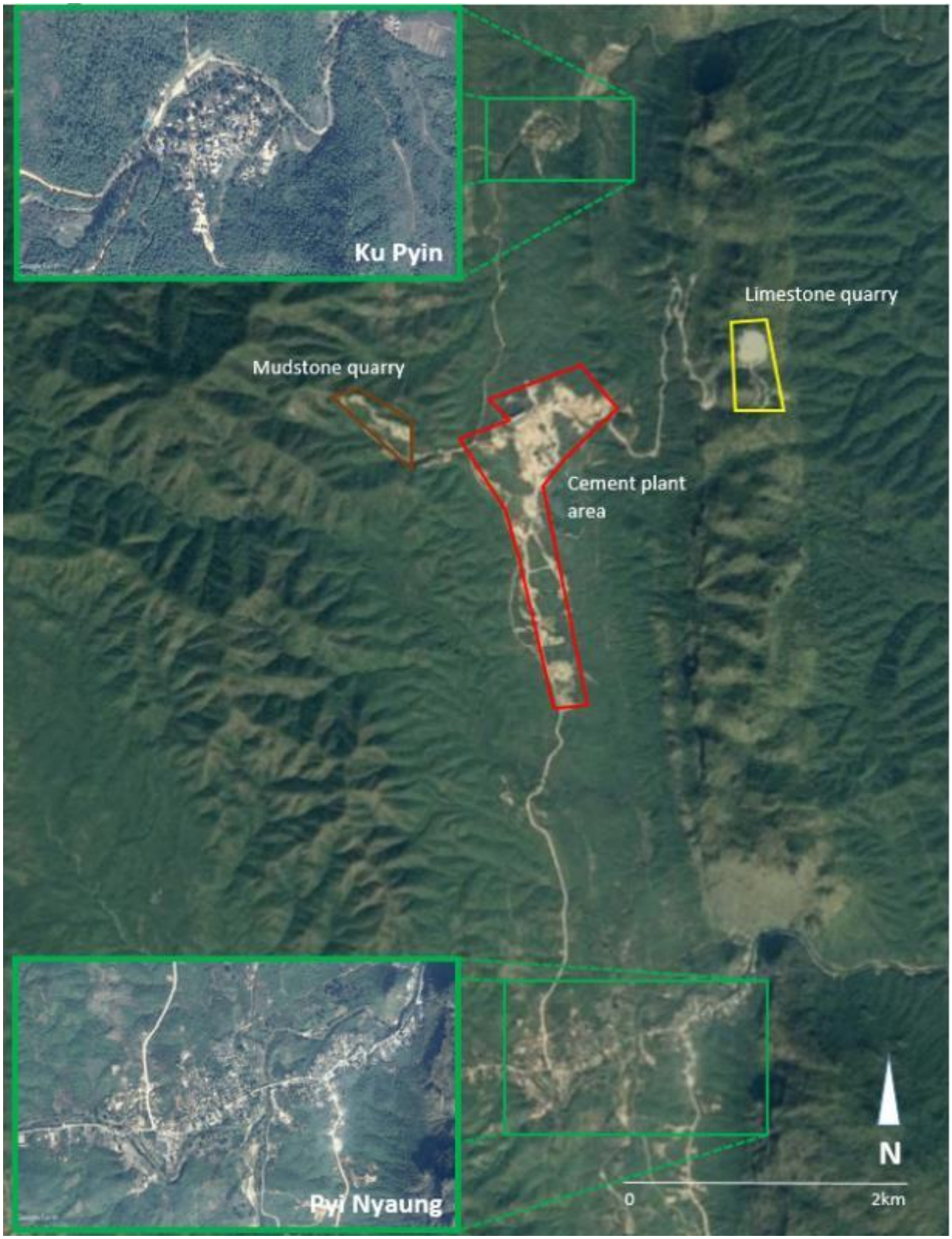
AOI 1: Shwe Taung Cement (STC)

Definition	Stakeholders
ZONE 1	
Defined as the **1st priority** area as they are the most affected communities by STC operations.	• Ku Pyin village • Pyi Nyaung village
ZONE 2	
Defined as the **2nd priority** stakeholder group as they have been affected by the project but minimally by ongoing STC operations.	• Oakkyin village • Mon Pin village • Kyauk Saung Kwae village • Popa Kone village • Yay Paung Sone village • Shwe Pyi Thar village[5]
ZONE 3	
Defined as the **3rd priority** stakeholder group as they have an interest and/or direct role in STC operations.	• STC employees • STC contractors/ indirect employees • Township Govt.
ZONE 4	
Defined as the **4th priority** stakeholder group as they are not directly affected but may have an interest/role in STC operations.	• Regional/National Govt. • NGOs (local, national, international) • General Public

[5] Shwe Pyi Thar village is in the AOI for both the cement plant and coal mine because it is near to the ancillary facility where coal is loaded from barges to trucks.

Zone 1 Project Affected Communities - STC

Village	Population	No. of Households
Pyi Nyaung	2,293	668
Ku Pyin	260	70

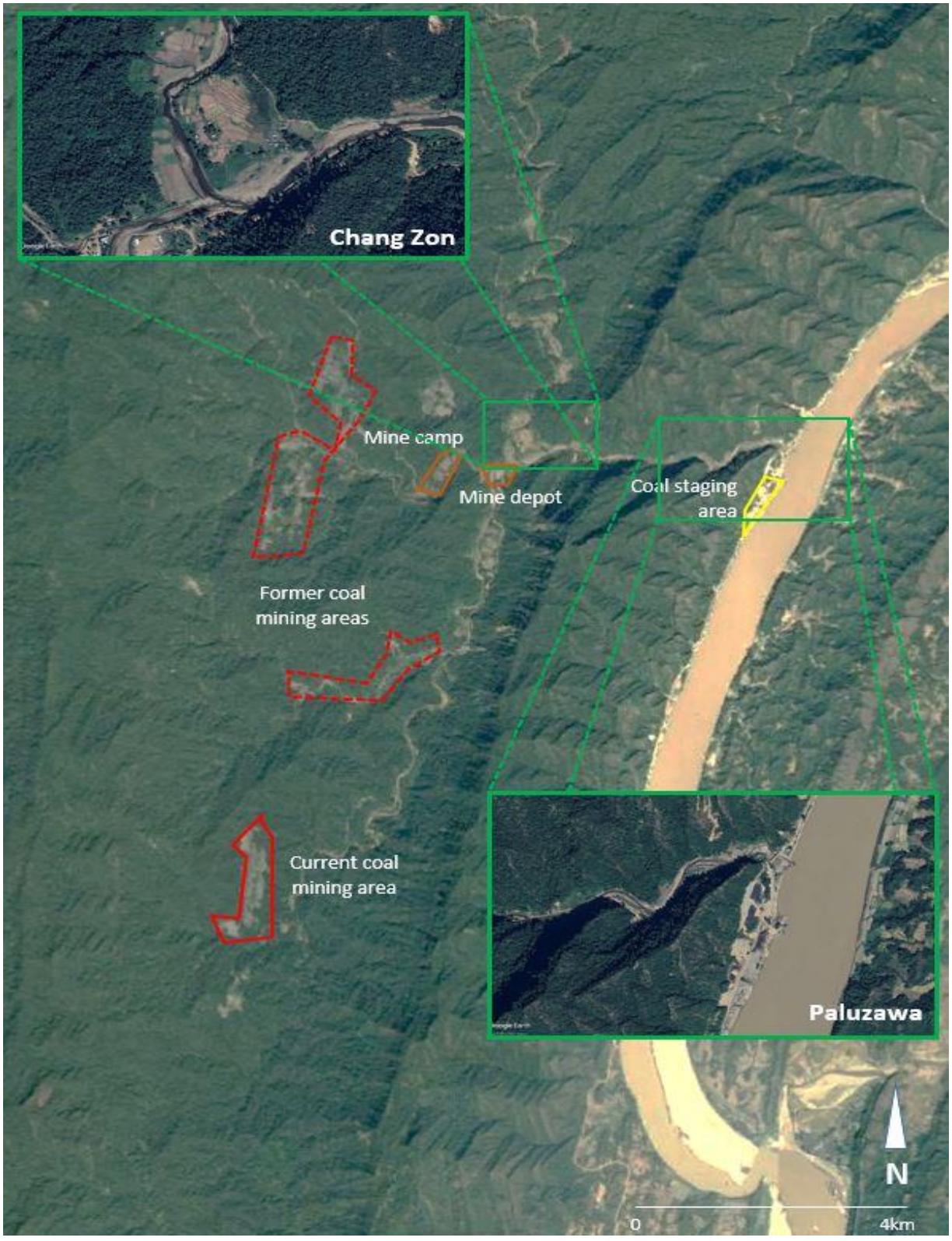


AOI 2: Shwe Taung Mining (STM)

Definition	Stakeholders
ZONE 1	
Defined as the **1st priority** area as they are the most affected communities by STM operations.	• Paluzawa village • Chaung Zon village
ZONE 2	
Defined as the **2nd priority** stakeholder group as they have been affected by the project but minimally by ongoing STM operations.	• Nanmawke village
ZONE 3	
Defined as the **3rd priority** stakeholder group as they have an interest and/or direct role in STM operations.	• Tha Bu Chaung village • Wal Daunt village • Wai Lon village • Man Phar Lay village • Nan Za Lin village • Ywar Thar village • Ma Sein village • Other communities, as relevant • STM employees • STM contractors/ indirect employees • Township Govt.
ZONE 4	
Defined as the **4th priority** stakeholder group as they are not directly affected but may have an interest/role in STM operations.	• Regional/National Govt. • NGOs (local, national, international) • General Public

Zone 1 Project Affected Communities - STM

Village	Population	No. of Households
Chang Zon	140	27
Paluzawa	125	25



ATTACHMENT B – Photos of previous stakeholder engagement

Figure B.1. SGM Awareness Raising Campaign (2019)

At Pyi Nyaung

At Ku Pyin

At Oakkyin

At Poppa Kone

Figure B.2. SGM Awareness Raising Campaign (2019)

Information Center and Library

Drinking water facility

Figure B.3. SGM pamphlet distribution at Pyi Nyaung and Ku Pyin (2019)


Figure B.4. Mine Blasting Information Sessions (2018)

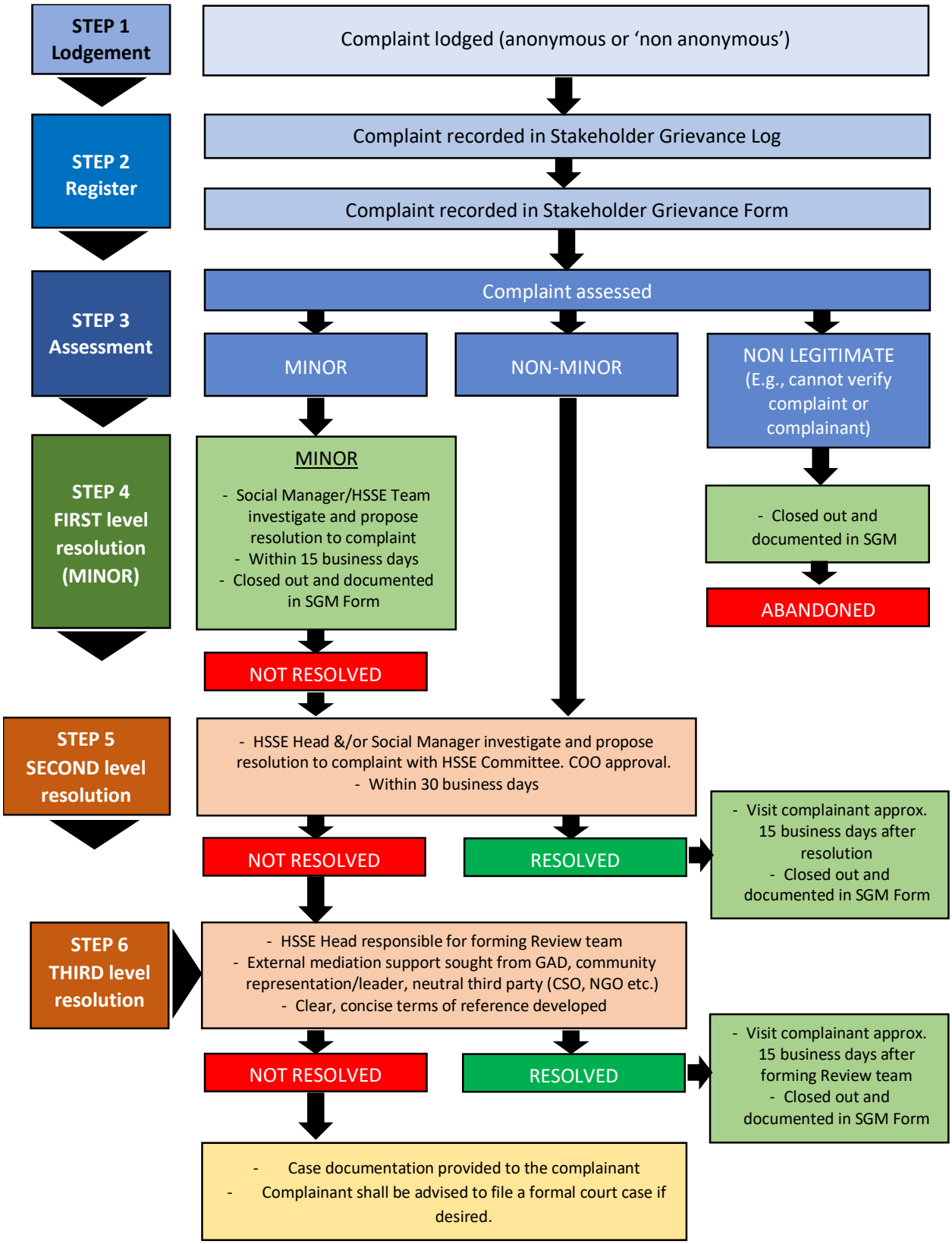

At Pyi Nyaung, Oak Kyin, Yay Paung Sone and Mon Pin

Figure B.5. CSR Activities (2019)

English Language & Soft Skill Training Program (April 2019)

World Environment Day Plantation Program (June 2019)

ATTACHMENT C – Stakeholder Grievance Mechanism – Flowchart



ATTACHMENT D – STC Accountabilities, Roles and Responsibilities

Position	Responsibilities	KPIs	Verification
CEO STBM	▪ Authorise the SEP. ▪ Provide senior management support to the COO/HSSE Head to achieve effective stakeholder engagement.	▪ 100% review of monthly management meeting minutes ▪ 100% follow-up on any stakeholder engagement concerns, grievances or requests requiring a senior management decision.	▪ Minutes of monthly management meeting
COO Cement Business	▪ Oversee the implementation of this SEP. ▪ Provide enabling conditions to ensure effective stakeholder engagement (including financial and manpower support and full senior management support from the STBM CEO). ▪ Review summary reports and statistics to ensure effective implementation of this SEP including the associated Stakeholder Grievance Mechanism (SGM).	▪ 100% attendance at biannual community meetings at Cement Plant. ▪ 75% attendance at monthly management meeting[6] ▪ 100% follow-up on any stakeholder engagement concerns, grievances, or requests requiring a senior management decision.	▪ Minutes of monthly management meeting ▪ Community meeting minutes
HSSE Head	▪ Oversee the implementation of this SEP. ▪ Ensure the SEP aligns with the other plans/procedures developed by STC. ▪ Facilitate communication between the various STC employees, Departments, managers, and officers in support of implementation of this SEP. ▪ Oversee stakeholder engagement activities undertaken by the CLO, HSSE Officer, Social Manager and others as relevant. ▪ Provide updates on SEP implementation at monthly management meetings ▪ Ensure all employees and contractors are familiar with stakeholder engagement requirements through induction sessions and ongoing training. ▪ Identify and report stakeholder issues to be addressed before they become a significant risk to STC operations, and capture/share lessons learned. ▪ Work with HR Department to recruit and manage required staff for the SEP.	▪ 100% attendance at biannual community meetings at Cement Plant & annual meetings at Coal Mine ▪ 75% attendance at monthly management meetings ▪ 100% review of Monthly Social Report including stakeholder engagement and grievances ▪ 100% follow-up on any stakeholder engagement concerns, grievances, or requests requiring a senior management decision.	▪ Minutes of monthly management meeting ▪ Monthly HSSE Report to CEO of STBM ▪ Community meeting minutes ▪ Monthly Social Report
Head of Mining (Coal Mine)	▪ Support the implementation of this SEP at Coal Mine. ▪ Ensure HSSE Officer and other relevant staff have sufficient budget and resources to implement community engagement. ▪ Provide senior management input into SGM resolutions as required.	▪ 100% attendance at annual community meeting at Coal Mine.	▪ Monthly Report to COO of Cement Business ▪ Community meeting minutes
Plant Manager (Cement Plant)	▪ Support the implementation of this SEP at Cement Plant. ▪ Ensure HSSE Officer and other relevant staff have sufficient budget and resources to implement community engagement. ▪ Provide senior management input into SGM resolutions as required.	▪ 100% attendance at biannual community meetings at Cement Plant ▪ 90% attendance at monthly HSSE Committee meetings at Cement Plant	▪ Monthly Report to COO of Cement Business ▪ Community meeting minutes

[6] Monthly management meeting covers all HSSE topics including stakeholder engagement and grievance management.

Position	Responsibilities	KPIs	Verification
Social Manager	▪ Overall responsibility for implementation of the SEP and the associated SGM. ▪ Ensure contractor organizations communicate the SEP to their employees and sub-contractors and ensure it is adhered to. ▪ Lead the CLO at the cement plant and the HSSE Officer at the coal mine in managing stakeholder relations. ▪ Oversee monitoring and reporting requirements under this SEP which are the responsibility of the CLO at the cement plant and HSSE Officer at the coal mine.	▪ 100% attendance at biannual community meetings at Cement Plant & annual meetings at Coal Mine. ▪ 100% attendance at Township and District Govt. biannual meetings. ▪ 75% attendance at monthly HSSE Committee meetings. ▪ 100% attendance at information center visits every two months at Cement Plant. ▪ 100% attendance at information center visit every year at Coal Mine. ▪ 100% provision of the Monthly Social Report and presentation to HSSE Committee.	▪ Monthly Social Report ▪ HSSE Committee meeting minutes ▪ Community meeting minutes
Community Liaison Officers (CLO) (Cement Plant)	▪ Support the Social Manager to ensure the SEP is implemented. ▪ Record engagement activities (incl. grievances received) at the Cement Plant and report these in accordance with the SEP. ▪ Engage with communities and other external stakeholders in accordance with the SEP. ▪ Coordinate the management and tracking of the SGM. ▪ Prepare monitoring and evaluation reports at the frequency defined in this SEP.	▪ 100% achievement of monthly updates to the SEP and SGM Logs for each Monthly HSSE Committee meeting. ▪ 100% attendance at quarterly visits to communities at the Cement Plant. ▪ 100% achievement of preparation of quarterly Community Newsletter. ▪ 100% achievement of at least one annual awareness campaign with communities (on relevant topic, e.g., health, safety, etc).	▪ Monthly Social Report ▪ HSSE Committee meeting minutes ▪ Community meeting minutes ▪ Community newsletters ▪ SEP Log ▪ SGM Logs
HSSE Officer (Coal mine)	▪ Support the Social Manager to ensure the SEP is implemented. ▪ Record engagement activities (incl. grievances received) at the Coal Mine and report these in accordance with the SEP. ▪ Engage regularly with communities and other external stakeholders in accordance with the SEP. ▪ Coordinate the management and tracking of the SGM. ▪ Prepare monitoring and evaluation reports at the frequency defined in this SEP. ▪ Manage the Information Center.	▪ 100% achievement of monthly updates to the SEP and SGM Logs for each Monthly HSSE Committee meeting. ▪ 100% attendance at two visits per year to communities at Coal Mine. ▪ 100% achievement of preparation of Community Newsletter twice per year. ▪ 100% achievement of at least one annual awareness campaign with communities (on relevant topic, e.g., health, safety, etc).	▪ Monthly Social Report ▪ HSSE Committee meeting minutes ▪ Community meeting minutes ▪ Community newsletters ▪ SEP Log ▪ SGM Logs
Information Center Executive	▪ Manage the information Center at the Cement Plant. ▪ Manage day-to-day engagement activities with communities and other key stakeholders at the Cement Plant. ▪ Receive suggestions, queries and complaints.	▪ 100% achievement of quarterly update of materials at Information Center. ▪ 100% provision of received CVs to HR Department each month.	▪ Spot checks at Information Center by Social Manager. ▪ Community meeting minutes

Position	Responsibilities	KPIs	Verification
	▪ Regularly update information materials at the Information Center and noticeboards.	▪ 75% Opening of Information Center on weekdays (except public holidays). ▪ 100% reporting of stakeholder grievances to CLO weekly.	▪ SGM Logs ▪ HR CV database
Environmental Manager	▪ Support the Social Manager and HSSE Head to engage on environmental matters including biodiversity in accordance with this SEP. ▪ Provide subject matter expertise on environmental and biodiversity matters as required for stakeholder engagement activities, disclosure materials and grievance resolutions.	▪ 100% attendance at biannual community meetings at Cement Plant and Coal Mine. ▪ 100% attendance at Monthly HSSE Committee meetings. ▪ 100% provision of the Monthly Environmental Report and presentation to HSSE Committee.	▪ Monthly Environment Report ▪ HSSE Committee meeting minutes ▪ Community meeting minutes
Occupational Health & Safety (OHS) Manager	▪ Support the Social Manager and HSSE Head to engage effectively on OHS matters in accordance with this SEP. ▪ Provide subject matter expertise on OHS matters as required for stakeholder engagement activities, disclosure materials and grievance resolutions. ▪ Act as Secretary of the HSSE Committee of the Cement Plant.	▪ 100% attendance at biannual community meetings at Cement Plant and Coal Mine. ▪ 100% attendance at Monthly HSSE Committee meetings. ▪ 100% provision of the Monthly OHS Report and presentation to HSSE Committee.	▪ Monthly OHS Report ▪ HSSE Committee meeting minutes ▪ Community meeting minutes
HSSE Committee	▪ [Involves the HS Manager, Environmental Manager, Social Manager, CLO, HSSE Officer, STC Plant Manager and other mangers of Cement Plant]. ▪ Discuss important stakeholder feedback including any grievances from communities, and propose actions as needed. ▪ Review documentation provided at the Monthly HSSE Committee meetings, including regular SEP reports and statistics. ▪ Provide a monthly 'look ahead' of operational activities that need to be communicated to stakeholders, e.g., blasting, planned emissions, maintenance, etc.	▪ 100% circulation of HSSE Committee meeting minutes. ▪ 100% follow-up on stakeholder engagement actions proposed at monthly committee meetings.	▪ HSSE Committee meeting minutes
Contractors (and Sub-Contractors)	▪ Responsible for being aware of this SEP and communicating any relevant requirements to their employees. ▪ Adhere to rules of engagement with local communities and stakeholders. These rules are set out in contracts, environmental and social (E&S) management plans, or other documentation as relevant. ▪ Communicate and work with their staff and sub-contractors, to implement corrective actions and address stakeholder questions and grievances that are relevant to them	▪ 100% provision of quarterly HSSE progress reports to STC Social Manager including any stakeholder engagement. ▪ 100% reporting of any stakeholder grievances received to CLS/HSSE Officer/ or other HSSE staff member.	▪ Biannual 'spot-checks' of contractor documentation by the Social Manager ▪ SGM Logs

Annex O
Worker Grievance Mechanism

SHWE TAUNG CEMENT CO.,LTD.	Worker Grievance Mechanism		STBM-IMS-P-003-00
	Revision	Effective Date	HR Department
	1-12-2020	18-04-2018	

Change History		
Rev #	**Description of Change**	**Paragraph**
01	Initial Release	All

Prepared by		
Name	**Designation**	**Signature**
U San Myaing	HR Manager	
Verified by		
Name	**Designation**	**Signature**
U San Myaing	HR Head	
Approved by		
Name	**Designation**	**Signature**
U Aung Zaw Naing	CEO	

1 Purpose

This Worker Grievance Mechanism (WGM) has been prepared to assist Shwe Taung Group (STG), in particular Shwe Taung Building Materials' entities (ST), comply with the requirements of the International Finance Corporation (IFC) Performance Standard (PS) 2 Labour and Working Conditions and the associated Environmental and Social Action Plan (ESAP) prepared for STG's operations which requires an anonymous reporting mechanism to be developed and implemented for workers associated with the cement plant, quarry, mine of Shwe Taung Cement (STC), Shwe Taung Mining Company (STM) under STC and High Tech Concrete Co. Limited (HTC).

In accordance with IFC PS 2, the purpose of this document is to provide a grievance mechanism easily acccessible by workers (including those employed by third party labor intermediaries if any, contractors, and sub-contractors, in the case that those third parties do not have their own effective WGM's in place) through which ST workers (and any of their organisations or unions, described in this document as "worker") may raise workplace concerns and matters that can be brought to Managers and Executives' attention and addressed expeditiously ("complaint" or "grievance" lodged by a "complainant"). The worker grievance mechanism is designed to direct complaints through an appropriate process in order to protect the confidentiality of the worker, and ensure that workers can raise concerns other than to immediate supervisors in a process free of any pressure, and that verified concerns are acknowledged, addressed, and resolved within stated response times publicised to workers as part of ST company policy. This procedure should ensure that a fair, equitable, transparent and consistent process to manage workers' grievances during ST operations is undertaken and that such process fulfils all of the relevant legal and regulatory commitments as well as international good practices. It is also intended to encourage the provision of feedback to ST in relation to workplace's concerns and thus to improve ST's overall performance.

The worker Grievance Mechanism does not replace existing legal and administrative processes in Myanmar. The Procedure seeks to resolve worker grievance directly as a first preferable step and, if possible, quickly.

2 Key Principles of the Worker Grievance Mechanism

In accordance with good international practices, the key principles of this grievance mechanism are that:

- Workers are informed about the grievance mechanism at the time of hiring (for instance during the induction session).
- Management representatives (at an appropriate level) are involved in grievance's investigations and responses.
- Investigations and responses are conducted promptly and transparently.
- There is no retribution for aggrieved parties, and access to external remedies (e.g. judicial or administrative processes) is not impeded.

- The worker grievance mechanism is available to all workers, including the employees of contractors and sub-contractors (which should also have a worker grievance mechanism, leaving the choice to workers between two non-mutually exclusive mechanisms).
- Grievances are documented by severity, theme, and location, and records are maintained and reported.
- The worker grievance mechanism, and information about the worker grievance mechanism, is communicated in a culturally appropriate manner and with consideration of workers' language (e.g. Myanmar language, English, Chinese) and literacy levels (e.g. through simplified posters, using images).

3 Scope[1]

This Worker Grievance Mechanism covers all types of concerns, actual or perceived, that workers may have or feel they have in relation to their work at ST.

This Worker Grievance Mechanism will cover direct workers and contracted workers of ST. Specifically, these include, but are not limited to, the following personnel:

- Permanent staff / workers employed by STC at the cement plant, quarries, mine of STC and HTC;
- Short-term (daily paid) workers hired at STC cement plant for cleaning and packing;
- Short-term (daily paid) workers hired at STC coal mine, mainly for coal handling at the staging area; and
- Workers engaged by third parties, and in short-term the construction workers hired by the EPC contractor for the construction of the cement plant expansion project.

ST employees, contractors and visitors to ST's premises shall be aware of, comply with and support the requirements of this document.

It should be noted that the specific list of direct and contracted workers provided above should be regularly reviewed and updated to cater for any changes in circumstances, for example, use of short-term labour by HTC in future operations or hiring of third parties for plant maintenance etc.

4 Definitions and Abbreviations

CEO	The Chief Executive Officer of Shwe Taung Building Materials' entities
CLO	Community Liaison Officer or on-site person-in-charge of social aspects with the communities, reporting to the Social Manager
FOM	Form
Environmental Manager	Person-in-charge of environmental aspects

[1] As at 7 December 2017, this V01 Worker Grievance Mechanism will be discussed, reviewed and agreed with ST's workers unions.

EPC Contractor	Engineering, Procurement and Construction company responsible for the design, procurement, construction, commissioning and handover of the expansion project (second clinker and cement line) at STC; the EPC Contractor must appoint a health and safety manager (HS EPC Manager) and a manager responsible for the expansion project (Project EPC Manager)
Head of Cement Business	Person-in-charge of STC and STM
Head of Concrete Business	Person-in-charge of HTC
EHSS	Environmental, Health, Safety and Social
EHSS Head	Environmental, Health, Safety and Social Department Head
HR Head	Human Resources Department Head
HR Manager	Human Resources Manager or person-in-charge of Human Resources matters
HS Manager	Health and Safety Manager or person-in-charge of Health and Safety matters
HTC	High Tech Concrete Company
LLO	Labour Liaison Officer within the HR Department
OHS	Occupational, Health and Safety
Social Manager	Person-in-charge of social aspects or social accountability manager
SOP	Standard Operating Procedure
ST	Shwe Taung Building Materials' entities i.e. STC, STM and HTC and their associated facilities and assets
STC	Shwe Tang Cement Co., Ltd.
STC Plant Operation Manager	Person-in-charge of the operations at STC (first clinker and cement line) and of the expansion project at STC (second clinker and cement line) until it is commissioned and incorporated in the operations at STC
STG	Shwe Taung Group
STM	Shwe Taung Mining
WIS	Working Instruction
Grievance	An issue, concern, problem, or claim (perceived or actual) that an individual or community group wants a company or contractor to address and resolve.
Grievance Mechanism	A locally based, formalised way to receive, assess, and resolve stakeholder complaints about the performance or behavior of project/ company , including its contractors or employees.
Direct Workers	Any personnel for whom ST has a clear employment relationship and complete control over the working conditions and treatment.

Contracted Workers	Workers engaged through third parties (for example contractors, brokers, agents, or intermediaries) who are performing work or providing services directly related to core business processes of the STC / HTC for a substantial duration.

5 Responsibility and Authority

5.1 **CEO**

CEO shall be responsible in overseeing that this Worker Grievance Mechanism is implemented throughout ST operations. CEO shall endorse this Grievance Mechanism Procedure and have overall accountability for grievance management.

CEO shall enable and regularly check that this Procedure is implemented and regularly reviewed, including through the ongoing work of ST's audit function unit.

5.2 **Head of Cement Business (STC) / Head of Concrete Business (HTC)**

Head of Cement (STC) / Head of Concrete (HTC) shall be responsible in overseeing that this Worker Grievance Mechanism is implemented throughout STC and HTC operations, respectively.

Head of Cement (STC) / Head of Concrete (HTC) shall enable and regularly check that this Mechanism is implemented and maintained within STC/HTC.

5.3 **HR Manager**

HR Manager, within HR Department, shall oversee that this Procedure is implemented as required. HR Manager should manage and plan the staffing responsibilities for the execution of this Procedure. HR Manager shall also ensure that the Worker Grievance Mechanism aligns with the other plans and procedures developed by ST. HR Manager shall facilitate communication between the various ST departments, the Labour Liaison Officer, the Contractors and the workers.

HR Manager shall be responsible for managing and ensuring that the Managers and Executives of ST help resolve the grievances that are addressed to their area of activities in accordance with this Procedure.

The HR Manager is also responsible for ensuring this Procedure is communicated to all direct workers of ST.

5.4 **Labour Liaison Officer**

The Labour Liaison Officer (LLO), under the Head of HR Department, is the interface between ST and its workers. The LLO is:

- Responsible for documenting, investigating, and resolving issues and complaints raised through the grievance mechanism, with the involvement of other managers, EHSS

Department and Head of Cement (STC) / Head of Concrete (HTC) as required depending on the nature and severity of the grievance.

- With the Procurement Department and relevant contract owner, in particuarly for the EPC contractor engaged for the expansion of the cement plant, the LLO must ensure that the contractor workers (i.e. contracted workers) also have access to an appropriate grievance mechanism, and/or provides access to this Worker Grievance Mechanism.

5.5 **Labour Union Representative**

The Labour Union Representative represents ST's workers, including the employees of contractors and sub-contractors and is tasked with defending the interests of these workers.

5.6 **Employer Representative**

The Employer Representative represents ST and is tasked with defending the interests of ST.

5.7 **Worker Grievance Committee**

Worker Grievance Committee gathers the Head of Cement / Head of Concrete, HR Head, HR Manager, LLO, STC Plant Operation Manager (who is also in charge of the expansion project), EHSS Head and representatives from the EPC Contractor (the HS EPC Manager and the Project EPC Manager), Labour Union Representative, Employer Representative, is chaired by the Head of HR and is managed by a secretary (the HR Manager).

Worker Grievance Committee shall follow, enable and check during the monthly Worker Grievance Committee meetings that the Worker Grievance Mechanism is used and followed and that for any incident/ accident that occurs, corrective actions are taken and lessons shared.

5.8 **EHSS Head**

EHSS Head shall support LLO and HR Department in grievance responses under this Worker Grievance Mechanism and contribute to facilitating communication between the various ST departments, the Labour Liaison Officer, the Contractors and the workers, as required.

5.9 **Environmental, Health, Safety and Social (EHSS) Department**

EHSS Department gathers ST employees involved in EHSS matters and is managed by the EHSS Head.

EHSS Department shall support grievance responses where relevant.

5.10 **EHSS Committee**

EHSS Committee gathers the EHSS Head, HS Manager, Environmental Manager, Social Manager, CLO, Head of Cement / Head of Concrete, STC Plant Operation Manager (who is also in charge of the expansion project), representatives from the EPC Contractor (the HS EPC Manager and the Project EPC Manager), is chaired by the Head of Cement / Head of Concrete and is managed by a secretary (the HS Manager).

EHSS Committee shall support the Worker Grievance Committee and HR Department in implementing this Worker Grievance Mechanism.

5.11 Procurement Department

The Procurement Department is responsible for:

- Communicating the requirements of this Worker Grievance Mechanism to contractors, engaging them to communicate the requirements to their sub-contractors.
- Ensuring all workers hired by contractors and third-parties are informed of their rights in relation to the Worker Grievance Mechanism, in particular through the Contractor EHSS Management Procedure.

5.12 Managers and Executives

Managers and Executives, who are responsible for certain lines of business or are at the frontline shall enable that this document is implemented by responding to grievances that may be assigned to them. They should manage and plan the staffing responsibilities for the execution of this document.

Managers and Executives shall be responsible for grievances that are addressed to their area of activities are responded to in accordance with this document.

5.13 EPC Contractor and other Contractors (Contractors)

STC's EPC Contractor and ST's other Contractors, including their subcontractors, are responsible for ensuring this document and its requirements are communicated to their staff and for ensuring their staff follow the associated processes and procedures devised under this document as relevant.

For instance, where relevant, ST shall communicate and work with its EPC Contractor or other Contractors to implement corrective actions and address grievances that are relevant to them. The EPC Contractor or other Contractors must participate.

5.14 All Persons

All persons employed by ST, directly or indirectly, have a responsibility to be familiar with the requirements of this document.

5.15 Audit Function Unit

ST's audit function unit, under ST's CEO, is responsible for, on a regular basis, auditing that this document is implemented and for providing post-audit recommendations to be communicated to the Worker Grievance Committee.

6 Grievance Procedure

6.1 Establishment of the Grievance Mechanism

The establishment of the Worker Grievance Mechanism consists of:

- Appointing and retaining the department / committee / personnel as detailed in Section 5.1-5.6 above;

- Informing ST employees and EPC contractor and other Contractors of their obligations with respect to confidentiality and treatment of complaints (through the communication of this Procedure to new employee and EPC contractor and other Contractors, reminders at regular internal meetings, as well as through ensuring this Procedure is kept accessible to anyone working at ST's premises, for instance in canteens, main office, medical centre, and also on the internal website/ intranet);
- Publicising the Worker Grievance Mechanism to direct workers and contracted workers under ST operations, including:
    - making provisions for those who may be unable to read;
    - explaining the worker grievance mechanism and its purpose, who can raise complaints and what sort of complaints, where, when and how through the use of a clear poster or leaflet and clear oral explanations;
    - identifying who is responsible for receiving and responding to complaints by sharing the contact details (work mobile phone number, email address) of the LLO;
    - describing what sort of response can be expected; and
    - mentioning any other rights and protections that are guaranteed.

The Worker Grievance Mechanism Procedure should be introduced to all direct and contracted workers of ST during their induction training which should be conducted soon after the time of hiring (or in case for contracted worker when they visit the work site of ST for the first time), and can also be regularly advertised via face-to-face meetings (individual or in group), printed materials, displays (e.g. on stand, wall mounts, billboards), company representative (e.g. LLO, Human Resources & Admin Manager), third parties, online (website), refreshment training sessions for workers, etc.

6.2 **Receipt of Grievance**

Worker Grievance can be received the same way as they are advertised, verbally or in writing through the internal suggestion boxes or by email / app. Verbal complaints can be reported directly to the LLO, or via worker's supervisor to the LLO. All the worker grievances should be transmitted to the LLO.

Channels to lodge written grievances include the following:

- Shwe Taung Connect, which is a mobile application established by Shwe Taung Group for its direct employees / workers (see screenshot appended to this Procedure). It should be noted that since the Shwe Taung Connect requires a user name and password to login as shown in Figure 1, the worker, who would like to complaint, can choose between "Anonymous Report" and "Normal Report" when submitting the complain (and this option should retain anonymity).
- Shwe Taung Group Website (see screenshot appended to this Procedure) - http://www.shwetaunggroup.com/commitment/
- Apache Cement Website (see screenshot appended to this Procedure) - http://www.apachecement.com/compliance-form/

- Letter deposited at the suggestion boxes to be placed at the Messing, 2 Storey Plant Gate (Main Gate), 603 (CCR and LQC Office) and Site Office of STC cement plant and Information Centre at Pyi Nyaung (at a location where the privacy of the complainant can be protected);
- Letter deposited at the suggestion box to be placed at the base camp and coal staging area of the coal mine at Paluzawa (at location where privacy of the complainant can be protected);
- Letter deposited at the suggestion box to be placed at the main HTC premises (at location where privacy of the complainant can be protected); and
- Letter deposited at the suggestion box to be placed at STC and HTC Offices in Yangon and Mandalay (at location where privacy of the complainant can be protected).

The suggestion boxes should be emptied once a week each by a representative from the HR or Administration Department or other ST representative, as relevant.

Written grievances can be addressed directly, or not, to the Labour Liaison Officer. All grievances should be forwarded to the LLO by the ST representative who receives the grievance.

All these written grievance receipt channels can be anonymous in nature and are accessible by both ST employees directly and by contracted workers.

6.3 **Keeping track of cases**

As soon as a grievance is received by the LLO, the LLO is then in charge of transcripting the grievance or concern on one (internal) worker grievance form, compiling each grievance file and logging each grievance's details in a Worker Grievance Log (in parallel to a Worker Grievance Confidentiality Log that retains the match between the name, address and place or community of residence of the complainant, if known, its brief description and a given worker grievance identification number on a secured spreadsheet). The standard worker grievance form will include:

- Brief (anonymous) description of the person lodging the complaint;
- Date, time, place where the complaint was received; and
- Description of the complaint.

The LLO is in charge of ensuring confidentiality of complainants, as requested by the complainant, by keeping these two separate logs, the Worker Grievance Log, accessible to the HR team, and the Worker Grievance Confidentiality Log, accessible to the LLO and the HR Head only.

Keeping good records through the ongoing use of the Worker Grievance Log will help ST track cases, respond to grievances in a timely manner, check the status of complaints and track progress, measure effectiveness and report on results.

The LLO will prepare a monthly report to the HR Head and assist the HR Head in aggregating data from the cement plant, the coal mine and HTC and reporting to the Worker Grievance Committee on a monthly basis.

ST will use the grievance log template for HR Head and LLO to keep track of grievance cases: check the records and updated process (including registered closeouts), liaise with the relevant departments / areas, produce aggregated monthly reports to Worker Grievance Committee (or, where relevant, to CEO), report on the incident management and corrective actions, disseminate lessons learnt.

6.4 **Reviewing and investigating grievances**

When a grievance is received, the nature must be established to determine its legitimacy and the measures needed for review and investigation: minor or less minor[2].

If the grievance is minor, the LLO, after discussion with the HR Manager where relevant, should attempt to settle the grievance through discussion and negotiation directly with the complainant. If the discussion is successful, then the LLO and, if applicable, the complainant will undertake preventive or corrective measures directly following the discussion and in accordance with the decisions agreed upon during the discussion.

If the grievance is not minor or if the minor grievance could not be settled through direct discussion, then the LLO should discussed with the HR Department and the Worker Grievance Committee and agree on initiating a grievance investigation. This must be documented throughout.

Investigations should be conducted following good international practices:

- Senior management (including via the HR, Worker Grievance Committee, EHSS Committee, for instance) is involved and fully informed;
- An appropriate, relevant and neutral investigation team is appointed and a sufficient budget allocated to the task;
- Tasks and responsibilities are clearly developed (investigation plan, assessment of needs for safety and confidentiality, collection of evidence, investigation report);
- Meetings are conducted with complainants and site visited and inspected;
- Facts are assessed, records documenting current conditions (e.g. photographs of worker accommodations / PPEs / malpractice) are kept onsite, clear communication to compliant (on what is reasonable and can be expected) is encouraged;
- The process is duly documented.

[2] As at 7 December 2017, this V01 Worker Grievance Mechanism does not define minor or less minor grievances. The identification and classification of minor or less minor worker grievances will be addressed by the HR Department, Worker Grievance Committee and, if relevant, the support of the EHSS Committee at the next audit round.

It is important to gather a complete and documented picture of a grievance, especially when it is not straightforward, to try to address only legitimate issue, to have sufficient basis to protect both the complainants and ST and to reach an equitable outcome. In cases of sensitive grievances, for instance involving multiple interests and a large number of affected people, an extensive investigation by third parties may be required.

6.5 Response to Grievance for which Complainant Identity is Provided

This section details the procedure to respond and address a grievance when the complainant has provided his / her identify on a voluntary basis and agreed to remain non-anonymous.

Whichever channel is used all complaints received should be directed to the LLO. As soon as grievance is received by the LLO, the grievance should be acknowledged and a dialogue with the complainants initiated. This will assure the complainant that ST is responding properly and this will help STC register, report and keep track of the grievance in the worker grievance log, identifying the associated likely timeline (receipt, tracking, closeout), roles and responsibilities for addressing the grievance. The LLO will work with the HR Manager, in particular, and the HR Department, in general, to discuss the grievances and their appropriate corresponding response.

A formal response detailing how the worker grievance will be resolved should be provided to each complainant within 30 days where possible.

If the grievance is complex, the complainant should be regularly updated on the process of the response development.

If the grievance is outside the scope of this Worker Grievance Mechanism, the complainant should be informed as soon as possible and ST should advise on the alternative avenues of complaint. This may be the case when the complaint is not clearly related to ST / Contractor operations, constitutes criminal activity, or is a commercial dispute, or for issues related to governmental policy and government institutions.

If the complainant has given his/her identify but wishes to remain anonymous, the LLO should develop the grievance response so as to protect the complainant's identity at all times.

6.6 Developing resolution options and preparing a response for non-anonymous worker grievance

Resolution options are developed by the LLO after discussions with the HR Department and the Worker Grievance Committee and once a grievance is well understood. Resolution options should be commensurate with the nature of the grievance and may include:

- A unilateral solution proposed by ST;
- A bilateral solution discussed and agreed between ST and the complainant;

- A solution reached through third party (formally or informally or through mediation);
- A solution reached through traditional and customary practices.

This grievance mechanism is a structure that enables such flexible resolution options.

The following *Figure 1* illustrates ST grievance response approach for cases where complainant has provided his / her identify on a voluntary basis.

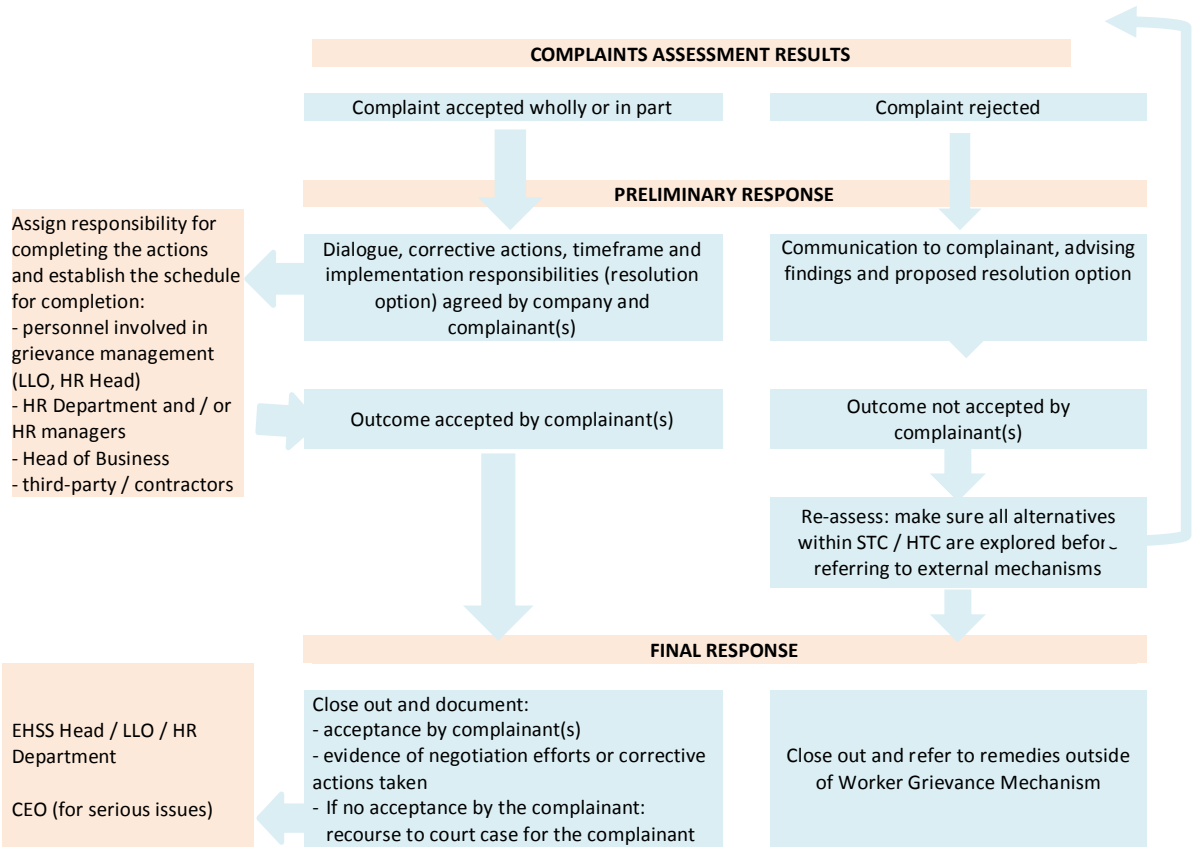
The response will be clearly prepared and communicated preferably through the same communication channels it was received, as soon as possible by the LLO, and all communication documented by the LLO on an ongoing basis. If the claim / grievance is accepted, a preliminary response will be provided and when the resolution is accepted by the complainant, the final response will be communicated. If the claim / grievance is rejected, because ST assesses that it is ineligible or has no basis, then ST (LLO) will diplomatically share this outcome with the complainant and will provide a detailed and respectful explanation to the complainant.

The complainant has the right to reject the resolution proposed in which case the LLO should discuss the complainant's expectations and review and update the proposed resolution on the basis of these discussions. If resolution cannot be agreed, then the grievance should be escalated to the HR Head or escalated to the Head of Cement (STC) / Head of Concrete (HTC). A revised formal response detailing how the grievance will be resolved should be provided to each complainant within 30 days where possible.

If all else fails, the final recourse as part of the worker grievance mechanism is for the complainant to file a court case and enter into litigation.

Cases are closed out when an agreement with the complainant is reached. It is good practice to collect and retain proof that the agreed corrective actions have been taken (photos, documentary evidence, keep internal record with time and date, etc.) and have a closeout meeting with the complainant (within two to three weeks) to ensure that the complainant is satisfied and to gather feedback on the grievance resolution process. The follow up visits should be registered on the worker grievance log.

Figure 1 Worker Grievance Response Approach for which Complainant Identity is provided



6.7 Response to Anonymous Grievance

This section details the procedure to respond and address grievance raised in an anonymous manner.

Whichever channel is used all complaints received should be directed to the LLO.

A formal response detailing how the grievance will be resolved should be discussed by the LLO with the Worker Grievance Committee to ensure the complainant cannot be recognised and announced within 30 days where possible:

- On Shwe Taung Connect;
- On Shwe Taung Group Website;
- On Apache Cement Website;
- On notice board to be placed at the STC staff accommodation and Information Centre at Pyi Nyaung;
- On notice board to be placed at the base camp and coal staging area of the coal mine at Paluzawa;
- On notice board near the suggestion box to be placed at the main HTC premises (at location where privacy of the complainant can be protected); and
- On notice board at STC and HTC Head Offices in Yangon.

The announcement should include details of the grievance to ensure that the complainant can identify his / her cases but in the meantime that s/he cannot be identified.

If the grievance is complex, announcement should be regularly provided to update on the grievance response process.

If the grievance is outside the scope of this Worker Grievance Mechanism, ST should respond via announcement by the above means with advice on the alternative avenues of complaint. This may be the case when the complaint is not clearly related to ST / Contractor operations, constitutes criminal activity, or is a commercial dispute, or for issues related to governmental policy and government institutions.

6.8 Developing resolution options and preparing a response for anonymous worker grievance

Resolution options are developed by the LLO after discussions with the HR Department and the Worker Grievance Committee and once a grievance is well understood. Resolution options should be commensurate with the nature of the grievance and may include:

- A unilateral solution proposed by ST;
- A solution reached through third party (formally or informally or through mediation); and
- A solution reached through traditional and customary practices.

This grievance mechanism is a structure that enables such flexible resolution options.

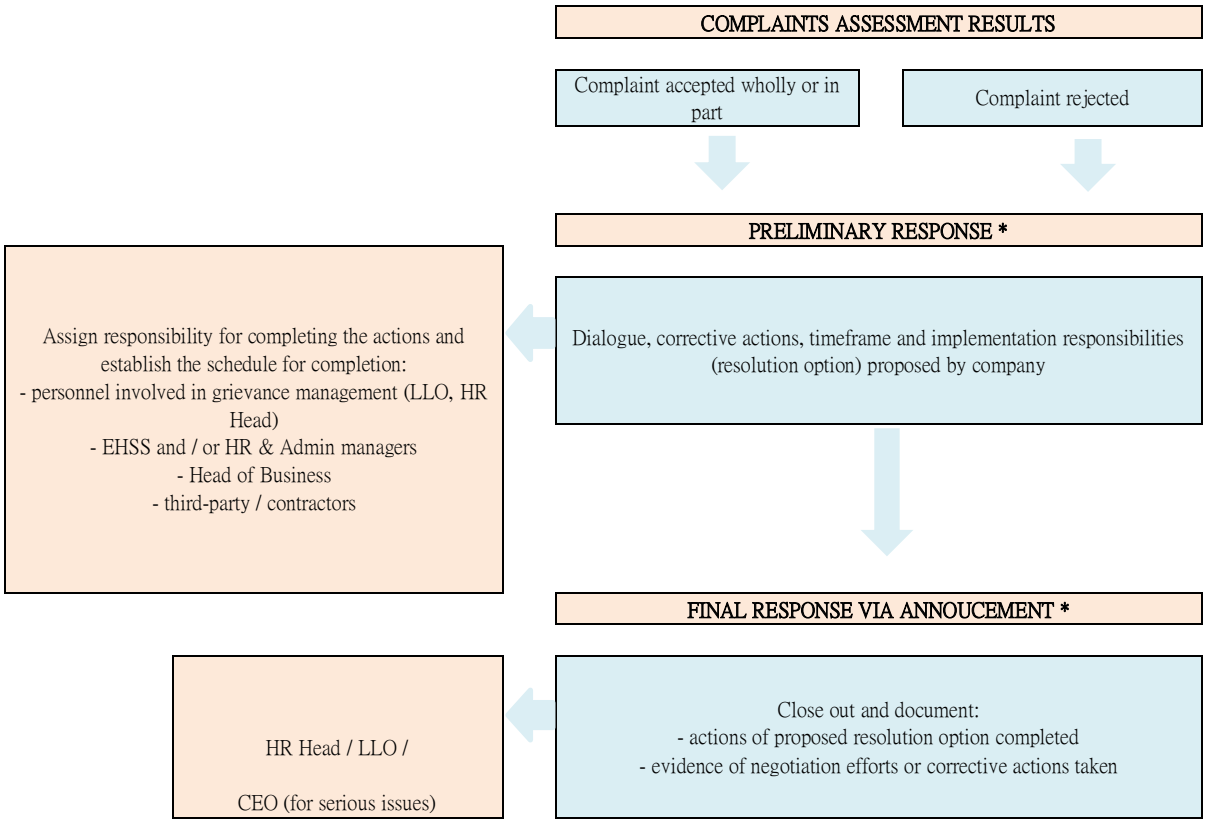
The following *Figure 2* illustrates ST grievance response approach for cases with anonymous complainant.

The response will be clearly prepared and communicated through announcement at public places and web-based platforms as presented above, and all communication documented by the LLO on an ongoing basis. If the claim / grievance is accepted or rejected, a preliminary response will be provided and when the resolution is confirmed by the company, the final response will be communicated. If the claim / grievance is rejected, because ST assesses that it is ineligible or has no basis, then ST (LLO) will be tactful in advertising so and will provide a detailed and respectful explanation.

If all else fails, the complainant can file a court case and enter into litigation.

Cases are closed out when the proposed resolution is completed. It is good practice to collect and retain proof that the agreed corrective actions have been taken (photos, documentary evidence, keep internal record with time and date, etc.)

Figure 2 Grievance Response Approach for which Complainant Identity is Anonymous



* VIA ANNOUNCEMENT AT PUBLIC PLACES / WEB-BASED PLATFORM

7. **Transparency and Confidentiality of Complaints**

While the worker grievance mechanism must be conducted in a transparent manner that is open and accessible to all the workers, a complainant must also have the option to purse his/ her grievance in a confidential manner in accordance with ST Code of Conduct and in particular its Whistleblowing Policy.

LLO will ensure that the complaint form does not identify the complainant and that the grievance investigation and related inquiries are carried out in a manner that does not identify the complainant.

If LLO becomes aware that confidentiality cannot maintained, s/he must inform the complainant immediately.

Any complainant may withdraw his/ her grievance / complaint at any time.

ST will provide all reasonable assistance at all times and to all its workers to participate in this Worker Grievance Mechanism, with special care for vulnerable complainants. Such assistance

will include helping worker understand and use this Procedure, identifying and retaining support and logistical assistance to pursue the grievance.

Where criminal conduct is alleged or LLO identifies criminal conduct on the part of any persons or entities through a grievance investigation, LLO will liaise with HR Head, HR Department and Head of Cement (STC) / Head of Concrete (HTC) to engage local criminal law enforcement bodies, and this process will be duly documented.

8. Resources

ST will allocate sufficient and adequate resources to the Worker Grievance Mechanism, in terms of people, processes and associate financial resources.

The Grievance Mechanism will be managed by LLO, HR Head and HR Department, while the Head of Cement (STC) / Head of Concrete (HTC) will have overall accountability for grievance management. Grievances will be reported to the Worker Grievance Committee, copy the Head of Cement (STC) / Head of Concrete (HTC) in aggregate on a monthly basis and on an ad-hoc basis for significant grievances. Head of Cement (STC) / Head of Concrete (HTC) and the CEO will remain available to intervene should the need arises.

9. Performance Monitoring and Reporting

The following performance indicators have been designed for the Worker Grievance Mechanism:

- Participation - Percentage of worker grievances channeled through the Worker Grievance Mechanism. The target is to channel 90% of grievances through the Worker Grievance Mechanism, before complaints reach the media or the courts.
- Effectiveness - Percentage of complaints receiving effective and timely responses. The target is 100%.
- Resolution - Percentage of complaints resolved in the first and second rounds of proposed resolution options. The target is to resolve at least 80% of complaints.
- Recurrence reduction - the intention is to learn from grievances and respond to them qualitatively in a manner that, over time, reduces their rate of occurrence.

The HR Head and Labour Liaison Office should be responsible for the performance monitoring and documenting lessons learned. An annual report on monitoring results should be prepared and this report should also identify areas of non-compliance with national laws and international standards, and identifies measures that will be undertaken to improve performance.

10. Audit and Review Policy

This Mechanism will be reviewed annually by the Worker Grievance Committee to ascertain the progress it has made in achieving the set aim and on an ad-hoc basis by ST's Audit Function Unit.

Any significant changes made to the procedure, in particular to capture lessons learned and updated policies and other procedures, will be announced to all staff, and training provided to ensure relevant staff are made aware of updates.

11. **Related Documents and References**

a. External Documents

i. ILO Convention 87 on Freedom of Association and Protection of the Right to Organize
ii. ILO Convention 98 on the Right to Organize and Collective Bargaining
iii. ILO Convention 29 on Forced Labor
iv. ILO Convention 105 on the Abolition of Forced Labor
v. ILO Convention 138 on Minimum Age (of Employment)
vi. ILO Convention 182 on the Worst Forms of Child Labor
vii. ILO Convention 100 on Equal Remuneration
viii. ILO Convention 111 on Discrimination (Employment and Occupation)
ix. United Nations Convention on the Rights of the Child, Article 32.1
x. IFC PS 2 Labour and Working Conditions

b. Internal documents

i. STG Code of Conduct, including its Whistleblowing Policy
ii. [Communication, Participation and Consultation Procedure]
iii. [Incoming and Outgoing Document Procedure]
iv. [Legal Compliance Procedure]
v. Stakeholder Engagement Plan
vi. Contractor EHSS Management Procedure

c. Attachments

i. Worker Grievance Form
ii. Worker Grievance Log Template
iii. Worker Grievance Confidentiality Log Template
iv. Shwe Taung Connect (Mobile Application)
v. Shwe Taung Group Website for Grievance Reporting - http://www.shwetaunggroup.com/commitment/
vi. Apache Cement Website for Grievance Reporting - http://www.apachecement.com/compliance-form/

Attachment 11.3.1 Worker Grievance Form

Name of staff completing grievance form:		Date (and time) of Grievance Form (dd/mm/yyyy)):
Concerned Department / Area Name:		
Assigned to (Department and name of staff):		
To complete before (dd/mm/yyyy):		
Date completed (dd/mm/yyyy)		

Type of Grievance:

	Unsafe Working Conditions		Forced Labour
	PPE		Child Labour
	Environmental Nuisance		Other
	Accommodation Services		
	Payment of Wages		
	Terms of Employment		
	Discrimination		
	Termination of Contract		

Grievance description and timing:

_____
_____
_____
_____

Brief description of complainant (and whether the complaint is anonymous or not) and channel of complaint (how was the grievance received?):

_____
_____
_____
_____

Grievance resolution plan and timing:

_____
_____
_____
_____

LLO

Approval
Head of Cement (STC) or
Head of Concrete (HTC)

HR Head

Close-out and timing:

_____
_____
_____
_____

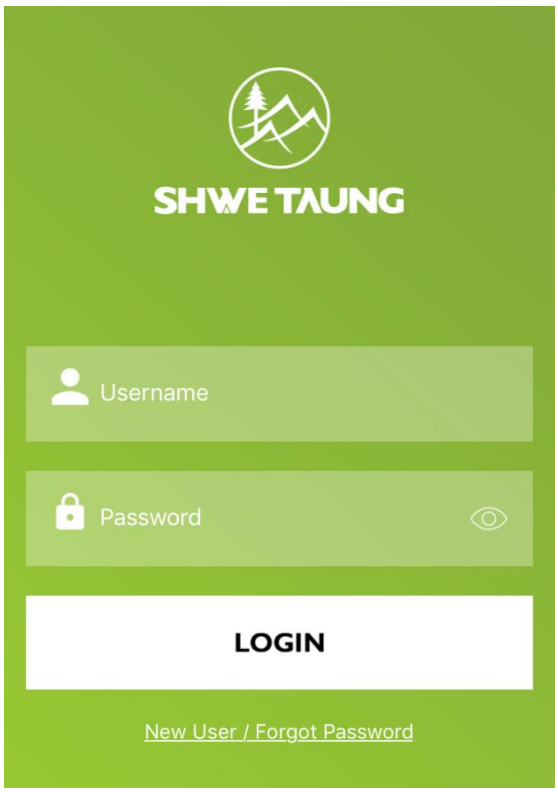
Attachment 11.3.2 Worker Grievance Log Template

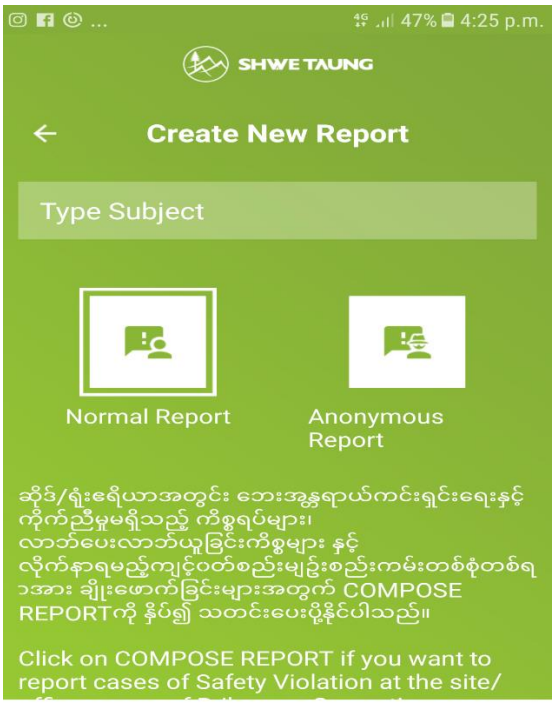
No.	Date Received (dd/mm/yy)	Received by (name of ST representative and channel of reception)	Brief description of (likely) complainant (occupation, residence))	Brief description of grievance / concern	Type/ category (if applicable)	Assigned to (name, entity)	Proposed resolution, feedback, recommendation	Response target date (dd/mm/yy)	Status / Resolution brief description (including date)

Attachment iii Worker Grievance Confidentiality Log Template

No.	Date Received (dd/mm/yy)	Received by (name of ST representative and channel of reception)	Name of complainant (if known)	Brief description of (likely) complainant (occupation, residence)	Confidentiality of complaint specifically requested by the complainant?

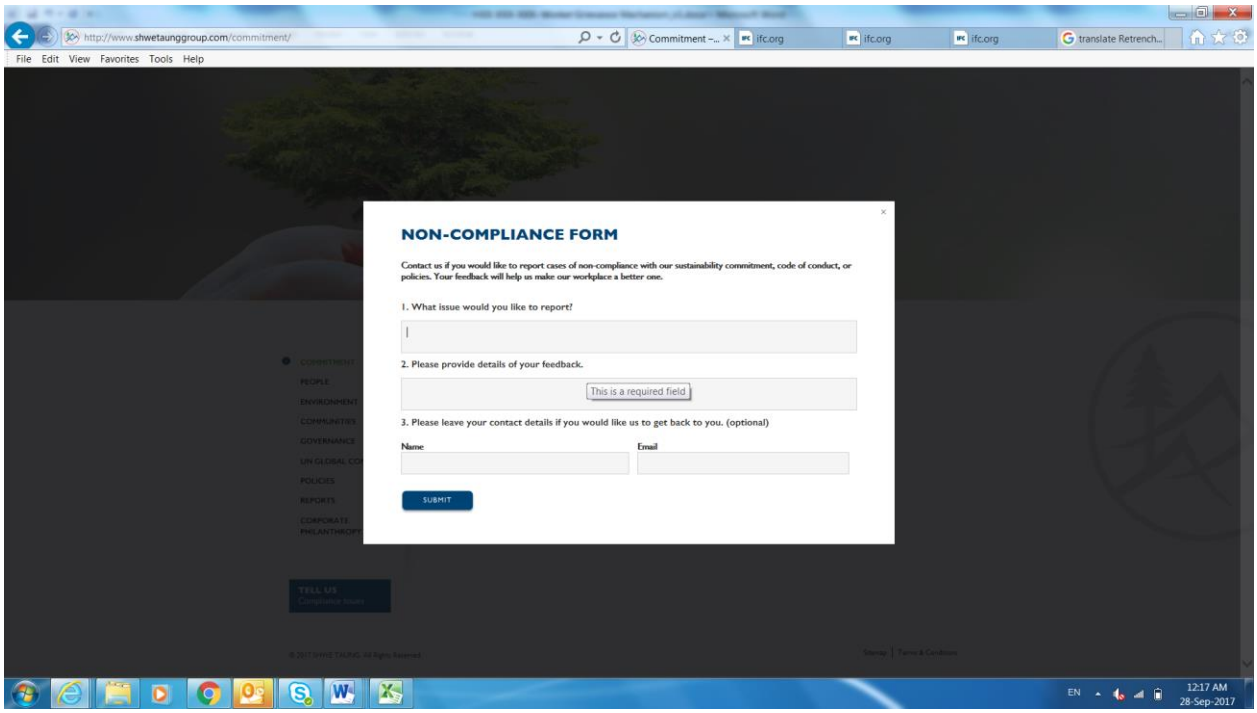
Attachment 11.3.4 Login Page of Shwe Taung Connect Mobile Application



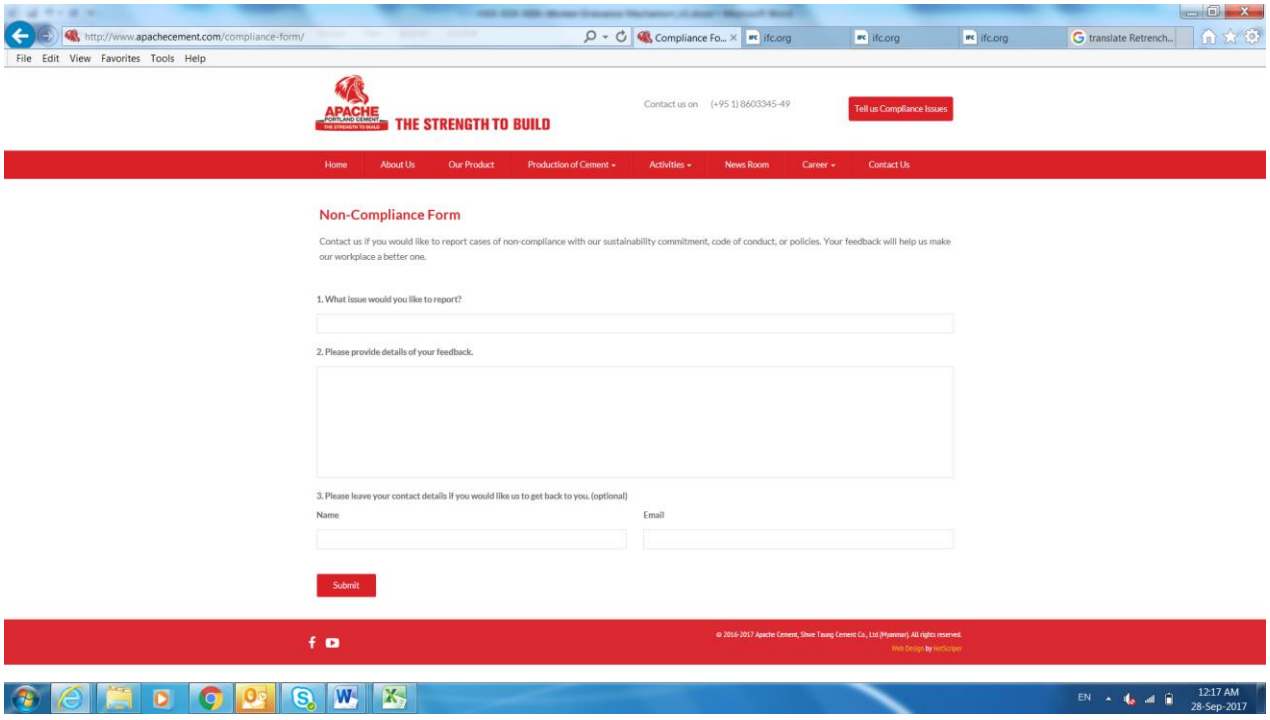


COMPOSE REPORT

Attachment 11.3.4 Shwe Taung Group Website for Grievance Reporting - http://www.shwetaunggroup.com/commitment/



Attachment 11.3.5 Apache Cement Website for Grievance Reporting - http://www.apachecement.com/compliance-form/



Annex P
Community Development Plan

SHWE TAUNG
CEMENT CO.,LTD.

STM Community Development Plan

1. Our Commitment

STC and STM believe that community development is a key aspect of sustainability. Our aim is to go beyond contribute and be actively involved in projects that have positive impact for the community and the society.

We are committed to being a good Corporate Citizen, contributing to the development of Myanmar. Our aim is to create value for stakeholders, while conducting sustainable business practices, caring for our community, and protecting our environment. Through our wide ranging corporate social responsibility (CSR) engagement, we aim to become a catalyst of positive change that will enhance the lives of Myanmar citizens. Our objective is to achieve sustainable outcomes through private public ventures and shared value initiatives. Shwe Taung Cement (STC) and Shwe Taung Mining (STM), part of Shwe Taung Group, is invested in the communities we work beside, our consumers are our key stakeholders and we strive to support the communities we serve.

STC and STM committed to focus on creating long-term value, for both the company and stakeholders, through the achievement of goals relating to profitability and growth, efficiency, operational excellence and preventing of business risks.

Figure - CSR & Sustainability Development

2. Objectives

Sustainability is at the core of our strategy. We aim to create value for stakeholders while pursuing business practices that meet the wider social, environmental and economic needs of our society. We hope to become a catalyst for positive change in Myanmar through our expansive corporate social responsibility programmes.

Growing together with our stakeholders, with a proactive approach to development, first and foremost requires considerable effort – both our own and that of the private sector. A company's responsibility does not end with combating climate change. To reduce current and prospective risks, close attention must be paid to integrity, safety and protection of people, asset integrity and respect for the environment. As our country is developing country, we work in difficult surroundings, where access to water, energy and health care services cannot be taken for granted and these areas also have poor education. Our commitment to these territories is realized through action plans for the communities and by involving the population and local stakeholders in the creation of new opportunities.

We have constructed and established Information Center, which included clinic, library and contact point in Pyi Nyaung village closed to cement plant, and an Information Center at Paluzawa village near coal mine, in order to more engage with local communities as the part of stakeholder engagement plan.

The objectives of our company which related with community development program for the affected area of our operation are -

- To support and construct village schools to promote education which is require to develop our country and local content
- To promote Health awareness among local people and provide health care service for local people
- To create more job opportunities and improve the local communities from unskilled labour to skilled labour
- To implement sustainable agriculture like organic farming in the operation affected area especially in Pyi Nyaung, Kupyin, Oak Kyin village, Mone Pyin and Ye Paung Sone village.
- To encourage local development

3. CSR Contribution to Local Communities (From 2010 – 2023)

STC and STM started community development program since 2010 before the construction started of Cement Plant Line 1, Coal Mine, Limestone Quarry and Mudstone Quarry. Since 2010, STM spent 1,475,769,598 kyats on social investment, especially in the areas of

Education and Health for the communities around the sites and the whole country of Myanmar where we operate.

STC and STM has also developed an annual "Stationary Donation Program", supplying stationery items to all students attending the schools in the vicinity of cement plant and coal mine operation area.

Monsoon tree planting activity was organized and developed resoundingly at the surrounding area of cement plant and coal mine.

STC and STM cooperates with Shwe Taung Group of Companies' activities to support and donate necessary stuffs, cement and other necessary support as "Disaster Relief Program" every year since 2014.

"Apache Scholarship program" has been implemented in Thazi Township since 2014. The scholarship program making things it possible for a large number of students to live their dreams about education and carrier aspiration. Moreover, Apache also donated stationaries and other learning support accessories during the school opening period once every year since 2013 to encourage the improvement of basic education system.

Access to clean drinking water is a basic Human Right and an important step in improving the standard of living. In March 2017, STC and STM constructed and donated a RO Machine that was capable of purifying 1,500 gallons of water a day to Ku Pyin village in Thazi. Ku Pyin's 320 villagers now have better access to safe and affordable drinking water.

In August 2017, STC and STM built and donated a bigger capacity RO machine to Pyi Nyaung Village. The machine purifies 3,000 gallons of water a day. We also donated a 9,000-Gallon concrete tank and purified water bottles that can hold 20-litres of water to Pyi Nyaung village who has over 2,600 residents.

During recent years, the number of vehicles rapidly increase in Myanmar. So, we frequently heard a lot of accident and incident from newspapers and social media. Therefore, STC and STM realize that local people must be provided awareness and knew about Road Safety.

STC and STM are organized Traffic Awareness Program especially for the Youth in the Local Community, as part of the Community Health and Safety Plan. It was also observed among the youth groups using motor cycle that they travel too quickly and that may cause danger to the children who are walking to the school. Traffic Awareness Program is covered following topics:

- Traffic Rules
- Road Traffic Legislations
- Using Helmets while driving motor bike
- Offences and penalties

On 12th June 2018, STC and STM held Traffic Awareness Program at Pyi Nyaung High School and Road Transport Administration Department and Traffic Police were invited to the awareness seminar. STC planned to held more traffic awareness programme with Tharzi Township to reduce car and motor bikes accidents in that area.

SHWE TAUNG
CEMENT CO.,LTD.

Below is the summary table of STC and STM's contribution on different categories.

No	Sector	Donation
1	Education	570,233,383
2	Health Care	110,489,236
3	Water Supply	119,937,300
4	Electrification	236,550,343
5	Transportation	98,547,297
6	Social	97,137,189
7	Religion	57,323,770
8	Environmental	55,462,680
9	Natural Disaster	130,088,400
Total		**1,475,769,598**

5. Some photo of CSR Activities (From 2010 – 2023)

SHWE TAUNG
CEMENT CO.,LTD.

4. Monitoring Plan

Between 2009 and 2023 the Company implemented voluntary rural infrastructure and community development programmes (CDPs) as part of its social commitment. Since 2017 however, the Company has been working to make a distinction between voluntary rural infrastructure and community development and mandatory mitigation programmes needed to reduce negative impacts associated with the Project. Mandatory mitigation measures are described in more detail in the Project ESIA.

STC engages with all stakeholders for these CDPs, based on regular meetings, echoes the principles adopted within the Social Strategy and builds on it; it also elaborates how community development will be undertaken by STC and STM.

By viewing community members as development partners, STC and STM aim to integrate capacity building into its current and future community development efforts wherever possible. This will be done both at beneficiary level where all beneficiaries attend trainings and get continuous technical assistance; as well as at community level, where demonstration days are organized to teach new technologies and practical skills to groups of beneficiaries and other interested community members.

STC and STM intend to work directly with local communities, alongside their development partners, in order to deliver specific and targeted capacity building, education and awareness modules, such as training events, workshops, awareness campaigns and educational events for

schools. The flagship training programme will be designed to assist local residents to be "job ready" when operational roles commence.

Social programs seek to minimize, mitigate and compensate any adverse social impacts generated by its activities, and to enhance beneficial social impacts where possible and in accordance with internationally recognized business best practice. Specific measures have been identified through the ESIA and parallel studies (e.g., the supplementary livelihood survey) to manage and address adverse impacts and the budget for these activities is managed external to the social investment strategy. The social investment programs which are the topic of this summary focus on those programs which are designed to enhance beneficial social impacts.

Monitoring is a means of verifying the effectiveness of the management and mitigation measures contained within the management plans listed above.

STC and STM will continue monitoring individual operation periodically in order to evaluate the effectiveness of STC and STM's community development programmes. Monitoring will be performed by:

• STC and STM's internal staffs, led by the Social Manager, focus on accomplishments; community participation and contribution, impact, lessons learned.

• STC and STM's partner organizations would each have their monitoring and evaluation plans including regular site visits, progress and financial reports, end of project evaluations; and

Monitoring methods will include: entrance and exit surveys, structured interviews with key stakeholders, local and regional statistics and records of community events. Participatory monitoring may also be implemented in some cases (e.g. infrastructure projects, projects involving capacity buildings for community).

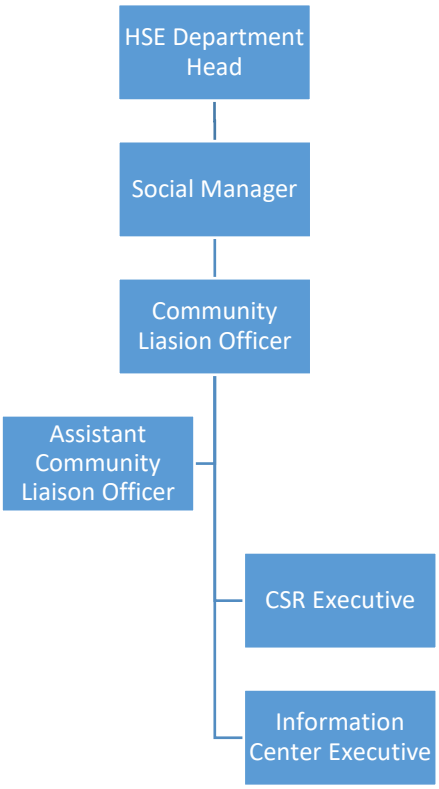


Figure – Social Section of Health, Safety, Social and Environment Department of Shwe Taung Cement and Shwe Taung Mining Organization Chart

The above organogram shows STC and STM's resourcing strategy for community development programmes and their oversight.

9. NEXT STEPS

This Community Development Plan (CDP) meets the needs identified at this stage of the project, and is capable of being developed into a long-term implementation guide and plan. The basic premise is that there would be a high level of community involvement in prioritizing needs, designing programmes, contributing to the projects and overseeing their implementation.

Annex Q

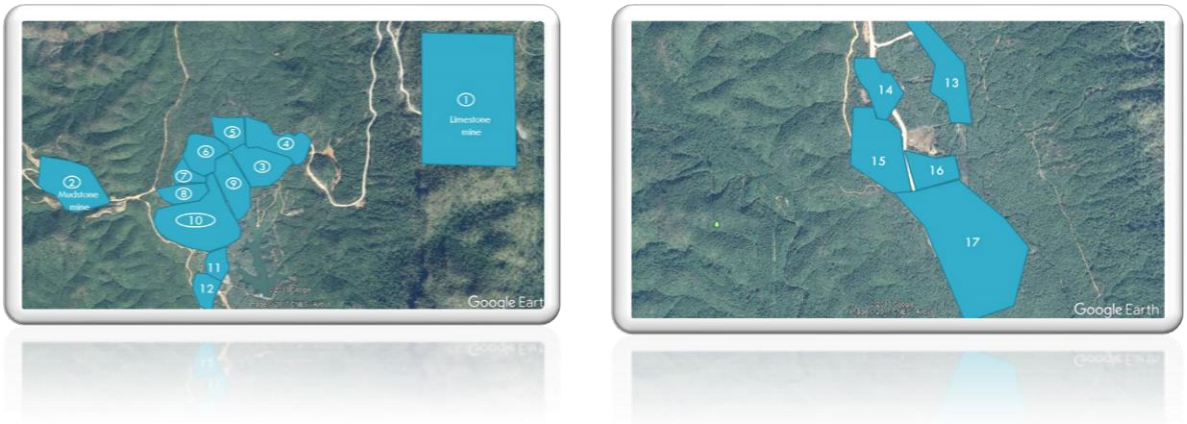
Stormwater Management Plan

SHWE TAUNG CEMENT COMPANY LIMITED

SHWE TAUNG CEMENT COMPANY LIMITED

STORM-WATER MANAGEMENT PLAN

CONCEPTUAL



DECEMBER 2017

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1. INTRODUCTION

Protecting water quality in local lakes, streams, rivers, and wetlands is an essential part of any stormwater management plan. Unchecked and untreated stormwater runoff results in accelerated and extended stream flows, destruction of aquatic habitat, modified natural hydrologic patterns, and elevated pollutant concentrations, all of which negatively impact the local drinking water sources, water recreation.

The purpose of this stormwater management plan is to identify stormwater drainages and pathways, identify potential pollution sources, and describe how potential impacts from sources are reduced or managed. This stormwater management plan has been prepared to provide an overview of site conditions, facilities, potential on-site sources of impact to natural drainages from stormwater migration, and best management practices (BMPs) to reduce potential impacts and control or mitigate stormwater migration.

1.1 OBJECTIVES

The objective of the Storm-water Management Plan (SWMP) is to guide storm-water management activities. The objectives are to:

- Protect private and public property from storm-water and groundwater related damage.
- Develop a storm-water management plan that will not adversely affect wetlands, creeks, streams and rivers, while meeting the needs of the Project.
- Develop a plan that uses natural features to retain and filter storm-water on site, supported by traditional conveyance systems when necessary.
- Develop a storm-water management plan that identifies specific required improvement and associated costs.
- Limit negative storm water related impacts to the community.
- Implement a storm-water management program that satisfies current and future regulatory requirements.
- Protect or enhance the quality of life in the area, including aesthetics.

1.2 SCOPE OF WORK

The report includes a baseline hydrology of the site and surroundings and delineation of clean and dirty stormwater catchments in and around the cement plant and the mines.

The SWMP presents conceptual designs for clean and dirty stormwater drainage infrastructure (berms/channels/containment facilities etc.)

This report is structured as follows:

- Section 3 presents a description of baseline information of the site and surrounding areas;
- Section 4 presents Best Management Practices in brief;
- Section 5 presents Potential Sources of Stormwater Pollution;
- Section 6 presents Stormwater Management Control
- Section 6 presents Conclusion

2. DESCRIPTION OF PROJECTS

Shwe Taung Cement Company Limited (STC) is part of the Shwe Taung Group (STG) which owns and operates a variety of businesses across various sectors in Myanmar. STC is running a cement plant, a limestone mine and a mudstone mine in Pyi Nyaung area, Thazi Township in the Mandalay region of Myanmar (the Project).

The Project consists of four main components, namely the cement plant (including ancillary facilities), a limestone mine and a mud stone mine located close to the cement plant as well as a coal mine located in the Kalewa township of the Sagaing region.

The Project aims to expand STC's clinker production capacity from 1,500 tonnes per day (tpd) to 5,500 tpd and cement capacity from 2,800 tpd to 7,200 tpd.

An overview of the Project location is shown in *Figure 2.1*.

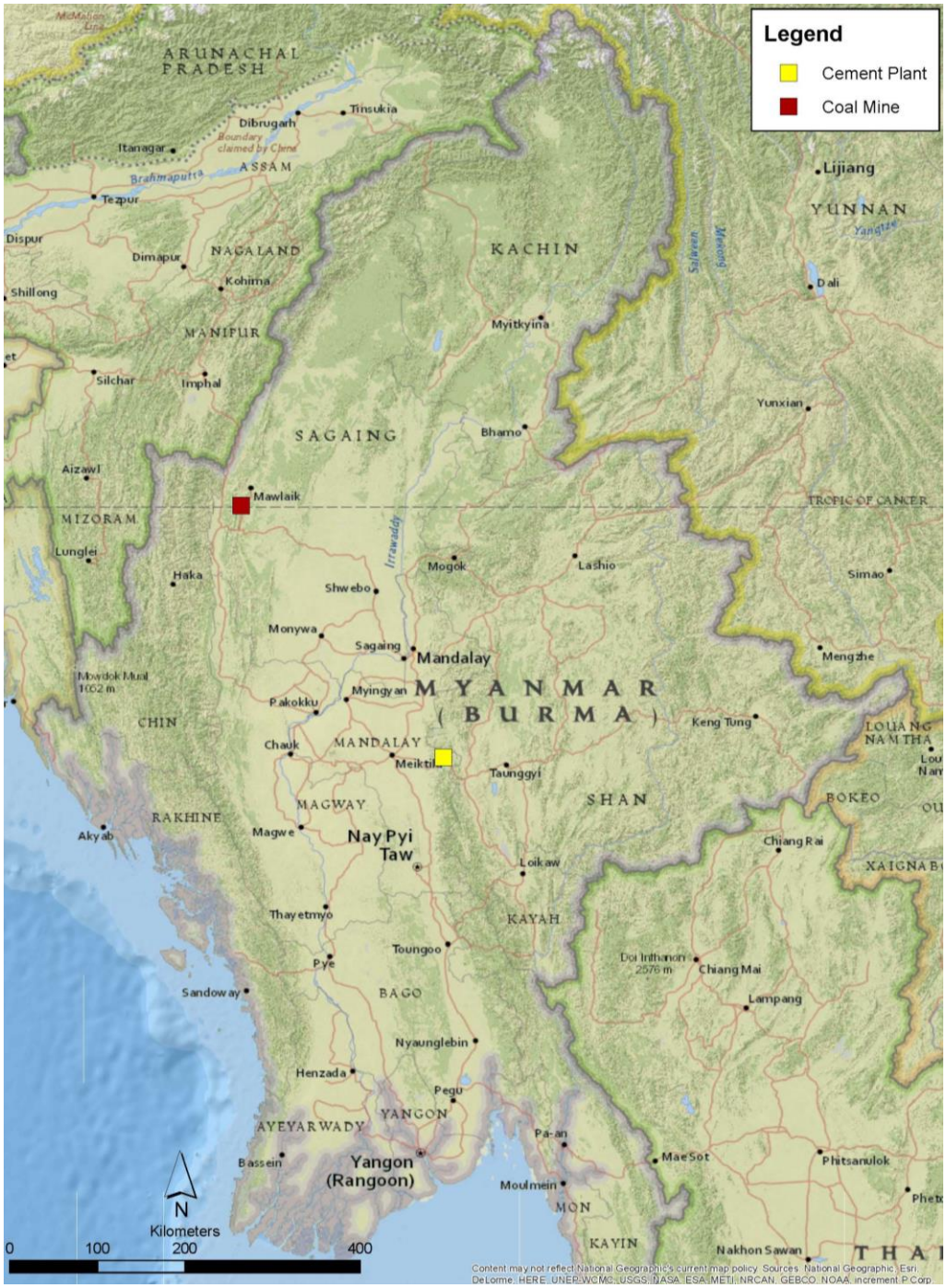


Figure 2.1 Locations of Cement Plant (with associated mines) and Coal Mine

Detailed descriptions of the above Project components are provided below.

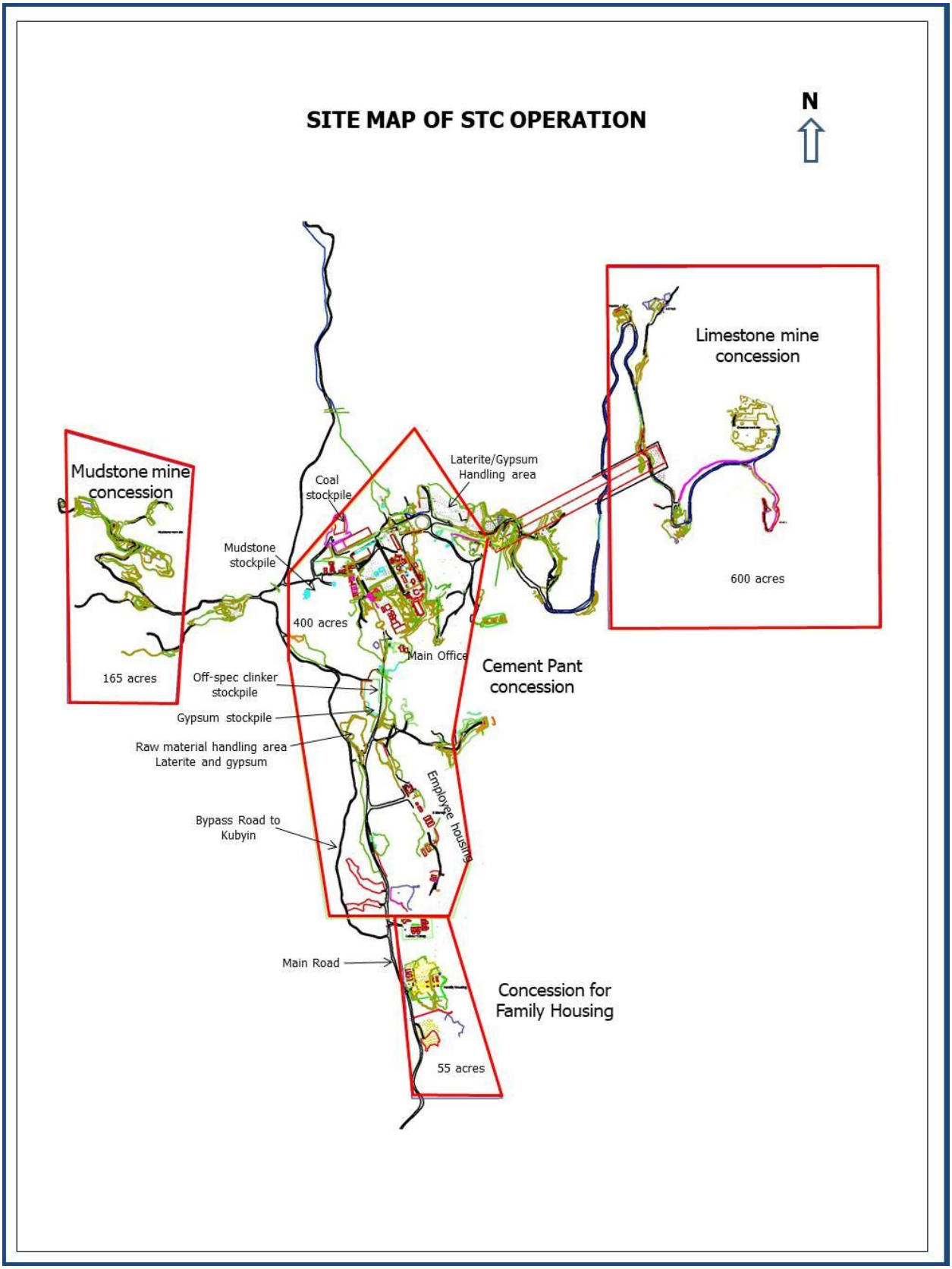


Figure 2.2 Location of Cement Plant (with associated mines)

2.1 CEMENT PLANT AND ANCILLARY FACILITIES

2.1.1 Cement Plant

The existing STC cement plant and ancillary facilities are located in a brownfield area of 455 acres in Thazi township within the Mandalay Region . It is situated in a valley surrounded by the mudstone mine to the west and the limestone mine to the east, which fall within the Tha Pyae mountain range.

The clinker production and cement grinding capacity of the existing plant are 1,500 tpd and 2,800 tpd, respectively. A dry process is used for the cement production. Cement production comprises five key steps including raw material crushing, materials handling, clinker production, cement grinding and cement packing and dispatch.

Figure 2.3 Overview of the Existing Cement Plant

2.1.2 Limestone Mine

A concession of 600 acres in size has been allocated to STC for limestone extraction. It is located approximately 5 km to the east (by road) of the cement plant within the forest area on the ridge of the Tha Pyae mountain range . Limestone extraction is undertaken using a drill and blast method. The extracted limestone is transported by truck to the limestone crusher where it is crushed and stored prior to use (*Figure 2.4*) . Approximately 715,000 tonnes of limestone per year is required for the current production of the cement plant.

For the Project expansion, a conveyor will be built to transport the limestone from the quarry to the limestone crusher in place of trucks. The new production line will require an additional ~1.6 million

tonnes of limestone per year. The concession, which has estimated limestone reserves of 110 million tonnes, is expected to be mined down from ~750 m to 550 m above sea level with further clearance of forest required. A detailed mining schedule to accommodate the expanded cement plant is not currently available.

Figure 2.4 Limestone Mining Operation

Figure 2.5: Limestone Mine Overview

2.1.3 Mudstone Mine

A mudstone mine with a size of 165 acres is located about 1 km west of the cement plant. Mudstone excavation is currently undertaken by open excavation at ~500 m above sea level to provide raw material for the existing plant. The extracted mudstone is transported by truck to the

cement plant which requires ~97,500 tonnes of mudstone per annum to meet the current production capacity.

The new kiln will require an additional ~262,260 tonnes of mudstone per year. It will be necessary to operate the second mudstone quarry to supply the new kiln and further habitat clearance will be required within the existing concessions.

2.1.4 Coal Mine

The coal mine is located on the western side of the Chindwin River in the Kalaywa township of Sagaing region (*Figure 2.6*). Annual production is currently 100,000 tonnes. The coal mine is approximately 3,378 acres, measuring 15 km long and 0.9 km wide. Coal extraction is open-cast. The extracted coal is transported down from the mine, past base camp to Paluzawa Village, via a 15 km access road built by STM, and then to the coal staging area and barging point on the bank of the Chindwin River. The access road is seasonal and is rebuilt each November. It followed the Paluzawa stream for much of its path with numerous stream crossings control. A new 10 km access road is currently being constructed by STC between the coal mine and the coal staging area. Coal is stockpiled at the staging area, from where it is taken to the barging point and loaded onto barges for transport to Mandalay. At Mandalay, the coal is transported to the STC Plant by road.

Mine preparation begins in November for coal production from December through to May during the dry season.

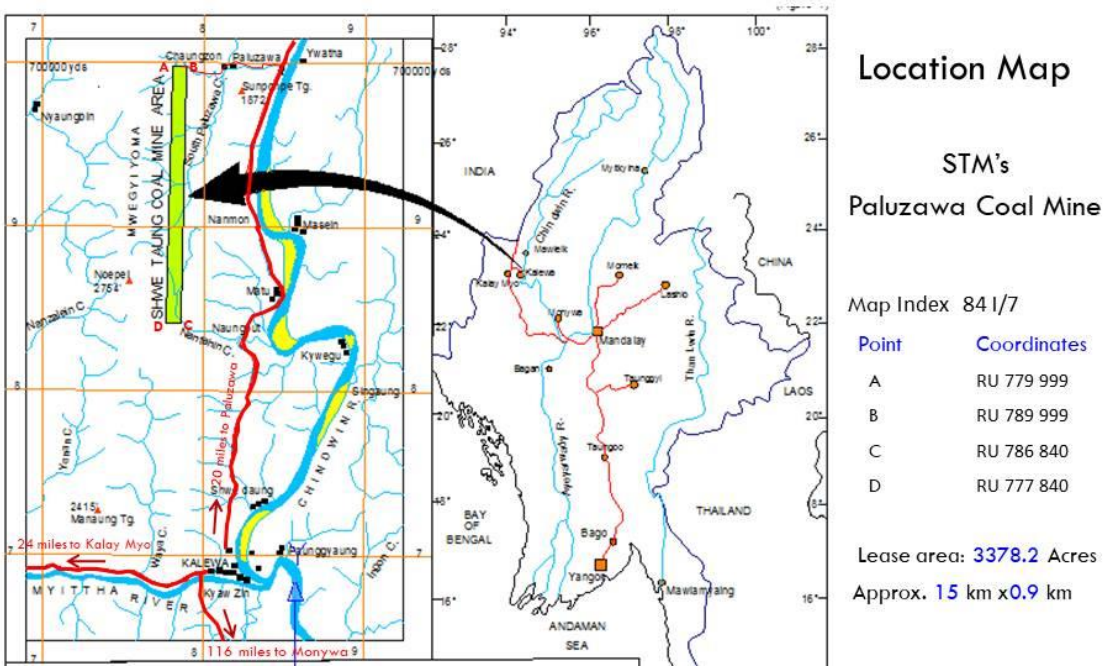


Figure 2.6 Location of Coal Mine

3. BASELINE INFORMATION

This section presents information relevant to the local topography, climate, rainfall, baseline hydrology, and includes a description of local watercourses, land cover, soil and sedimentation.

3.1 TOPOGAPHY

The topography in and around the cement plant area comprises considerably flat terrain with an average elevation of 350 m above MSL. The areas where the limestone and mudstone mines consist are mountainous. The limestone mine started from 775 m bench and the mudstone mine started from 775 m bench.

3.2 CLIMATE

The Climate at site can be described as a tropical monsoon climate with a hot and dry season (pre-monsoon), a rainy season with moderate rainfall (monsoon) and a cool season (post-monsoon). It is characterized by strong monsoon influences, has a considerable amount of sun, moderate rainfall, and high humidity. The hot dry season (summer) is from March to middle of June. The rainy season (monsoon season) starts from the middle of June to the end of September. The cool season (winter) starts from November to and continues till the end of February. The average temperatures ranging from 18 degrees C in winter to 29 degrees C in summer. The monthly maximum temperature was recorded at 41.6 °C in April. The monthly minimum temperature was recorded at 9.5 °C in January.

3.3 RAINFALL

STC has it own rainfall measuring station at site. The station has a record of daily rainfall measurements from 2012 to date. Monthly average rainfall and the largest recorded daily rainfall for each month are presented in Table 3.1. The largest daily rainfall event recorded in 6 years was 5 inches (125 mm) on 11 October 2017.

Total Monthly Rainfalls from 2012 to date are depicted in Table

RAINFALL (mm)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
2012	-	-	-	67.5	175.0	227.0	91.0	95.0	285.5	153.0	67.0	-	**1161.0**
2013	11.0	-	11.0	7.0	127.0	100.0	56.0	173.0	289.5	133.0	2.5	15.0	**925.0**
2014	-	-	-	43.5	93.0	170.0	74.5	103.0	82.5	142.5	5.5	1.0	**715.5**
2015	38.5	-	-	6.0	42.5	117.0	281.0	181.0	282.0	203.0	-	-	**1151.0**
2016	15.0	-	-	75.0	205.0	465.0	386.0	364.0	328.0	525.5	242	-	**2605.5**
2017	35	-	23	117.0	304.0	318.0	202.0	343.0	402.0	378.0	109		**2231.0**
6 yrs' mth avg	**24.9**	**0.0**	**17.0**	**52.7**	**157.8**	**232.8**	**181.8**	**209.8**	**278.3**	**255.8**	**85.2**	**8.0**	
6 yrs' month max	**35.56**	**0.00**	**23.37**	**76.20**	**121.92**	**121.92**	**76.20**	**91.44**	**106.68**	**127.00**	**101.09**	**8.128**	
										11-Oct-17			

Table 3.1: Total Monthly Rainfall at Cement Plant Complex

3.4 HYDROLOGY

The Project is located in the Kubyin Reserved Forest region within the Kubyin valley watershed. There is a small Kyauk tala creek at the north of the project. Clean storm water from the Thapyay taung flows into it and the creek merges with Kupaung Stream at Kubyin village. The water impoundment area east of the factory was transformed into two reservoirs. The two reservoirs have a combined capacity of 51 million gallons of water. There was no precedent of major flooding during the rainy season or wet months. The two reservoirs lie in a north south

direction. The upper reservoir acts as storm water pond to collect and settle dirty runoff from 102, CVE and 801 areas. Clean stormwater from Thepyay taung Limestone hill flows into the lower reservoir. It acts as clean stormwater pond. The water in it is clear water.

3.5 SURFACE WATER QUALITY

ERM's baseline study for ESI indicated that water quality impacts could be a potentially significant issue for the construction and operation of the cement plant, for example, in case of contaminated run-off from the coal storage area as well as sediment loaded run-off from the mudstone quarries. Potential contamination of stream water from the above sources may affect the Kubyin Village which is located downstream of the cement plant and mudstone mines. Therefore, four water samples from the places located in Figure 3.2 were collected and analyzed.

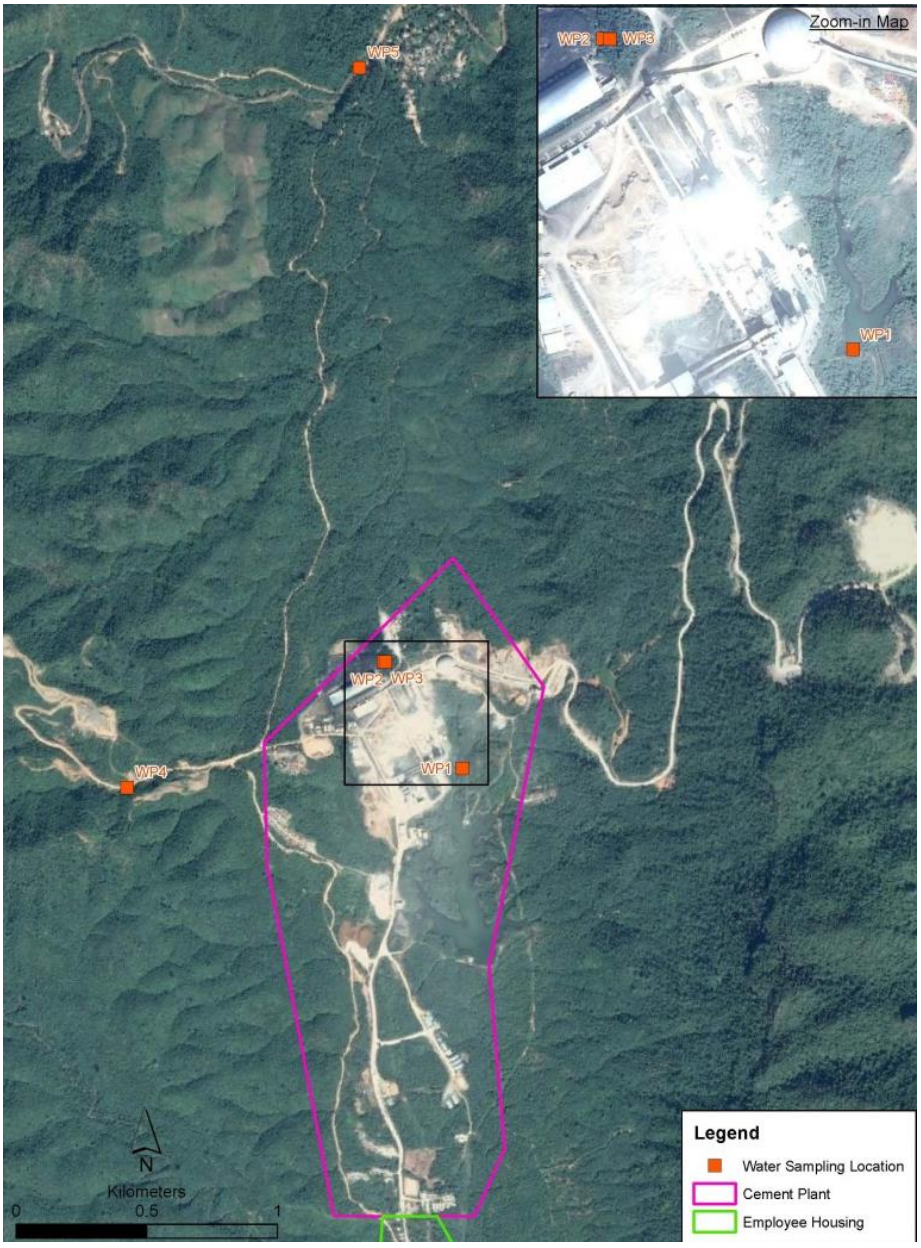


Figure 3.1 Water Sampling Locations Stations at the Cement Plant and Associated Mines

Parameter	Unit	Detection Limit	Analytical Method Reference	WP1 - Reservoir	WP2 – Coal Downstream Staging Area	WP3 – Coal Downstream Staging Area	WP4 – Downstream Mudstone Quarry	WP5 – Kubyin Village	WBG EHS Guidelines for Cement and Lime Manufacturing (2007)	WBG General EHS Guidelines (2007) for Treated Sanitary Sewage Discharge
TSS	mg/L	2.00	APHA 2540 D	11.00	118.00	215.50	9.00	23.00	50	50
TP	mg/L	0.01	APHA 4500P:J	0.01	0.03	0.06	0.01	0.06	-	2
TN	mg/L	0.10	APHA 4500P:J APHA 4500-NO3:I	0.40	1.25	1.70	0.30	0.30	-	10
Total Coliforms	CFU/100mL	1.00	DoE Sec 7.8 & 7.9	7.00	2,00.00	45.50	N.D.	14.50	-	400
BOD_5	mg/L	2.00	APHA 5210 B	1.00	5.50	6.50	1.00	1.00	-	30
COD	mg/L	5.00	APHA 5220 C	10.00	21.50	41.50	2.50	4.75	-	125
Oil & Grease	mg/L	5.00	APHA 5520 B	D.L.	D.L.	D.L.	D.L.	D.L.	-	10
pH	Standard Unit	n.a.		7.60	8.00	7.60	5.60	6.30	6-9	6-9
Temperature	°C	n.a.		24.50	24.00	24.00	20.50	24.00	Increase <3 °C	

Notes:
(1) D.L. = value detected below detection limit for all samples at the station.
(2) n.a. = not applicable
(3) N.D. = not detected
(4) To determine the average level at a station with one of the two samples reported to be below detection limit, value below detection limit is halved for the calculation.
(5) Exceedance of WBG Guidelines is shaded grey.

Table 3.2 Baseline Water Quality at the Cement Plant and Associated Mines

The baseline water quality data collected in January 2017 are presented in *Table 6.10*. At WP2 and WP3, which are discharge locations of the coal staging area, the level of TSS exceeded both the WBG *EHS Guidelines for Cement and Lime Manufacturing* (2007) and WBG *General EHS Guidelines* (2007) for treated sanitary sewage discharge. The *E. coli* level at WP2 also exceeded the WBG *General EHS Guidelines* (2007) for treated sanitary sewage discharge. These exceedances indicate contamination due to existing operations at the coal staging area through sediment loaded discharge and possibly sewage. In addition, higher COD levels were reported at the coal staging area when compared to other locations which indicated potential issues of contaminated run-off from the coal staging area. Other measurements were generally within the WBG EHS Guidelines with no specific concern identified.

3.6 WATERCOURSES

As presented in Figure 2.2, some parts of the cement plant complex are located in the headwaters of Kyauktala creek in the north and Pholaung Chaung in the south. the Kyauktala creek flows into Ku Paung stream (4 km north of the site) and The Pholaung Chaung creek flows into Myit Tha stream (6 km south of the site).

As the limestone mine is part of the north-south orienting mountain range made up of Kyauk khet taung, Thabyay taung, Nwalabo taung and Saing taung, water course splits down east and west. And the mudstone mine is part of the Modi taung and its water course leads to the east.

3.7 LAND COVER

The cement plant and mines areas fall in the Kubyin reserves forest, but the areas has been logged by the forest department and leased to STC for the project. The land is covered with common small trees, bamboo, shrubs and vegetation.

3.8 SOILS

The soil of the project area and its environs is red brown forest soil (Rhodic Ferralsol). This soil can be categorized into dark red brown forest soil, Podzolied red brown forest soil and Lateritic red brown forest soil. These are typical soils of tropical evergreen forest of Myanmar. They usually occur on the well-drained hill slopes at the elevation from 1000 to 4000 feet above sea level. Top soils contain up to 40% of clay and have moderate to low in situ permeability and poor to very poor infiltration rates.

3.9 SEDIMENTATION

Because the secondary forest is still in relatively good condition, the forest, especially the intricate root systems could retain the soil effectively. No visible case of sedimentation process such as erosion and sedimentation/deposition were found. However, there is no doubt that due to steep slope there will be erosion to a certain extent during the rainy season. This is evident in the present of residual soils in many places. When the forests are cleared either for construction work and for quarrying work there is no doubt that erosion process will become more prominent. The fast flowing mountain stream does not favour sedimentation; no sediment deposits were observed.

4. GENERAL BEST MANAGEMENT PRACTICES

STC will implement BMPs to manage the flow of stormwater, prevent uncontrolled migration, and minimize erosion and sediment transport from Project facilities and disturbed areas during construction, operations, and initial stages of reclamation. The general BMPs covered in this section include structural and non-structural controls:

4.1 STRUCTURAL CONTROL

Structural stormwater controls include stormwater diversion and erosion/sediment control. Structural controls minimize or mitigate the effects of stormwater velocity and pathway. Structural controls are either permanent as part of the overall stormwater management plan for the life of the Project and post-reclamation, or are temporary as part of stormwater management during construction and development of facilities and during operations.

Design of control structures (except for short-term construction projects) will be based on the required storm events. Some of these structures are permanent and will remain throughout the life of the Project and some are temporary and will remain for a limited number of years of operation. In general, stormwater diversion and erosion/sediment structural control BMPs include the following types.

- **Up-Gradient Control**: Diversion of stormwater that originates up-gradient of roads, disturbed areas, and other potential pollution sources will be accomplished by using a combination of berms, channels, culverts, and water bars. Erosion and sediment controls include rip-rap channel lining, synthetic channel lining, and sediment basins. These erosion and sediment controls will slow velocity and settle out sediment. Where diversion channels are narrow or at relatively steeper grades, rip-rap and/or synthetic lining will be installed if necessary to slow the velocity and scouring effect of the stormwater.
- **Down-Gradient Control:** Down-gradient diversion of stormwater that originates on potential pollution sources will be accomplished by using a combination of berms, channels, culverts, and water bars. Erosion and sediment controls include rip-rap channel lining, synthetic channel lining, and settling basins or ponds. Down-gradient structural controls will capture stormwater originating on waste rock disposal areas (WRDAs), stockpiles, growth medium stockpiles, and borrow areas and divert it to sediment basins to settle out sediment. Stormwater originating on roads will be captured in roadside diversion channels with integral engineered outlets that allow diversion to basins or ponds. Channels will have rip-rap and/or synthetic lining if necessary to slow the velocity and scouring.
- **Temporary Construction Controls:** Temporary construction structural controls would be implemented for short-term construction activities. For temporary construction controls, a combination of silt fences, straw bales, waddles, and/or temporary diversion channels will be installed. Temporary construction structural controls may be relocated as construction activities progress.

4.2 NON-STRUCTURAL CONTROL BMPS

Non-structural controls are procedures, management actions, and other policy activities that are employed to reduce the potential for pollutant loading in stormwater outfalls. Appropriate non-structural controls for the mine include:

- Good housekeeping measures;
- Routine inspections;
- Maintenance;
- Training; and
- Reclamation and vegetation.

4.2.1 Good Housekeeping

Good housekeeping measures include, but are not limited to:

- Storage of materials in areas that are not exposed to precipitation and do not drain to stormwater;
- Providing secondary containment for bulk storage tanks and other containers;
- Removal of non-essential products and waste materials from the site; and
- Removal of debris from stormwater drainage areas.

Good housekeeping and preventive maintenance are the most effective BMPs for controlling stormwater pollution from process areas and storage areas. Spills will be

cleaned up immediately and contaminated materials removed and disposed of in accordance with applicable regulations. A licensed firm would be responsible for characterizing the spent materials and either recycling or disposing in accordance with state and federal regulations. Used coolant and oil would not be mixed. Used containers would be disposed of or recycled according to federal, state, and local regulations. STC would institute a waste management plan that would identify the wastes generated at the site and their appropriate means of disposal.

4.2.2 Routine Inspections

Inspections of disturbed areas and stormwater structural controls such as stormwater diversion and conveyance systems will be conducted to identify erosion and to ensure that structural controls are functioning effectively.

Disturbed Areas Inspection

Inspections of disturbed areas will include observing erosion; gullies, pooling of water, collapsed embankments, or other types of erosion will be identified and documented.

Structural Controls Inspection

Structural stormwater controls will be inspected to determine:

- The functional integrity of the structures; and
- The amount of sediment accumulation if present, to plan for removal of sediment.

Breaches or other items requiring repair observed in berms, channels, or secondary containment will be recorded in writing and reported immediately to management. Following inspections, additional erosion controls or maintenance of existing BMPs will be implemented if required by the STC Stormwater Management team.

Storage Areas Inspection

Storage areas for chemicals, hazardous materials, solid and liquid waste, or other potential sources of stormwater pollution will be inspected to ensure that containment has not been adversely impacted by storm events.

Oil and Petroleum Storage Inspection

Primary containment (tanks, totes, drums, and other containers) and secondary containment structures for oil and petroleum products will be inspected on a regular basis.

Inspection Schedules

STC will observe stormwater structural controls, if feasible, during storm events to ensure that the integrity of the structures is maintained. In addition, STC will inspect disturbed areas, control structures, and storage areas exposed to precipitation or stormwater after any storm event that is equal to or greater than a 25-year, 24-hour event.

Annual Inspections

Inspection and evaluation of BMPs and disturbed areas will be conducted annually, preferably following the spring runoff period. Inspections of the BMPs and the disturbed areas may be conducted separately or concurrently. This evaluation will result in the preparation of a written report.

4.2.3 Maintenance

Maintenance is performed after inspections to repair structural controls or to supplement or enhance existing BMPs with additional controls, as required.

Maintenance can also be conducted as a result of non-routine observance of needed repairs, testing of facility stormwater equipment such as pumps. Examples of maintenance of stormwater controls include (but are not limited to):

- Removal of accumulated sediment from holding ponds or basins;
- Repair of deteriorated channel linings, pond linings, berms, or water bars;
- Routine maintenance of earth-moving equipment, pumps, and vehicles; and
- Repair of equipment.

4.2.4 Training

An employee awareness, orientation, and training program will be conducted annually for the plant and mine personnel responsible for implementation of stormwater management practices. The education program will inform personnel of the components and goals of the Project's stormwater management plan.

Table 4.1 identifies four modules that each annual training session addresses.

Module	Training Requirements
Housekeeping and source control measures	• Review routine housekeeping measures and issues; • Review procedures for minimizing pollutant sources
Mine inspection procedures and maintenance of structural BMPs	• Review mine inspection procedures and schedules • Completion of BMP inspection forms • Maintenance of BMPs • Review BMP plan
Annual periodic evaluation	• What to evaluate • Completing the forms
Spill prevention, response, and reporting	• Review mine spill contingency plan and spill response, containment, and cleanup measures • Review spill notification procedures

Table 4.1: Training Sessions

A form for documenting stormwater management training sessions will be completed and filed with the water pollution control permit records.
In addition to stormwater management training, other forms of training would indirectly benefit the stormwater management program, such as training for staff in proper unloading techniques, emergency procedures training, and training to inform employees of their responsibilities in proper waste disposal procedures (e.g., allowable wastes that can be placed in the landfill, management of used filters, oily rags, fluorescent light bulbs, aerosol cans, and other regulated substances).

5. POTENTIAL SOURCES OF STORMWATER POLLUTION

In general, the types of potential stormwater pollution sources that, depending on specific activities, could be present at the Project include:

- Sediment as total suspended solids (TSS);
- Geochemical constituents (GC) (e.g., metals, potentially acid-generating materials, anions);
- Petroleum hydrocarbons; and
- Reagents, process solutions, or other chemicals.

A facility is considered a potential stormwater pollution source if the location is exposed to precipitation or may come in contact with stormwater and has the potential to generate stormwater pollution.

5.1 AREA DIVISION OF POTENTIAL SOURCES

Within the Project, there are four major areas where potential sources of stormwater pollution could occur:

Area A: Limestone mine

Area B: Mudstone mine

Area C: Cement plant complex

Area D: Employee Accommodation area

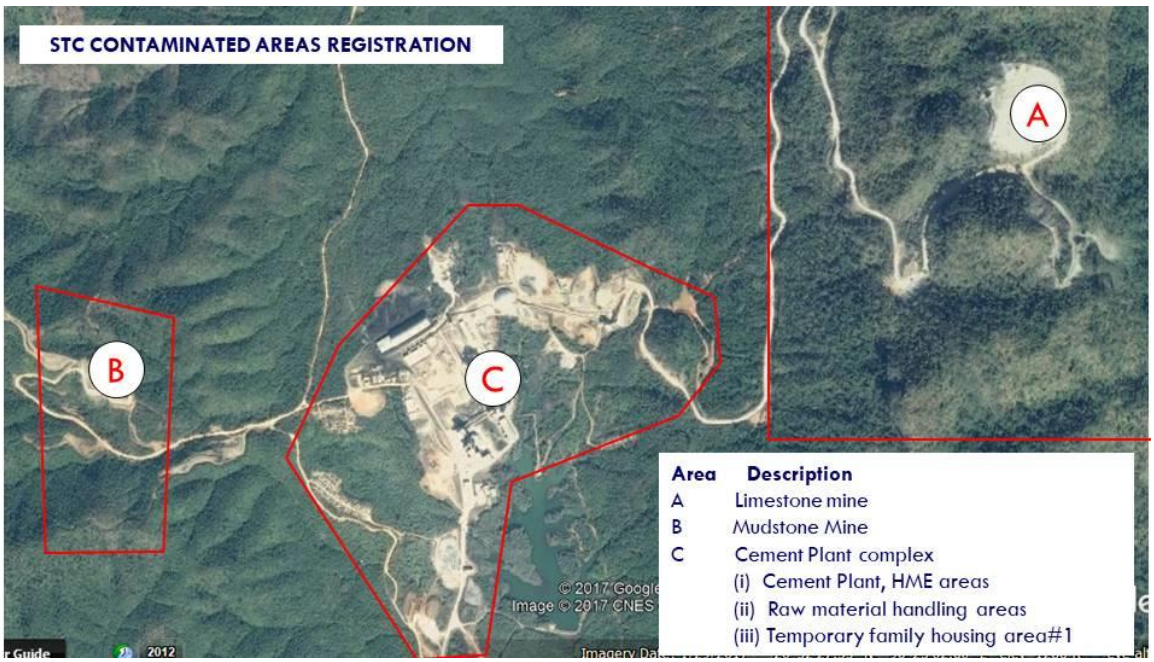


Figure 5.1 STC Contaminated Areas A, B, C

A) Limestone mine area

The potential pollutant sources in limestone mine include the exposed mining faces, a waste dumpsite, a topsoil stockpile and a main haul road. Pollutants from the limestone mine are broken sandy limestone particles, alkaline solution and washed out sediment particles from the surface of the road and minimal of hydrocarbon spillage from the heavy machinery.

B) Mudstone mine area

The same applies on the mudstone mine. The potential pollutants area includes the exposed mining faces and a main haul road. Pollutants from the mudstone mine are broken sandy / muddy particles, washed out sediment particles from the surface of the road and minimal of hydrocarbon spillage from the heavy machinery.

C) Cement plant complex area

The potential pollutants sources in the cement plant complex area are: crushing facilities, Heavy Machinery Workshop, gypsum stockpile, Laterite stockpile, mudstone stockpile, aggregate washing plant, concrete batching plant, coal staging area, cement plant, raw material grinding facility, Line2 construction site, weighbridge and temporary family housing area.

D) Employees settlement area

Area D comprises of messing, three-storey staff housing area, technical staff housing area, fuel farm area, weighbridge area, temporary family housing area, labour camp area and family housing complex.

Figure 5.2 STC Contaminated Area D

5.2 SITES OF STORMWATER POLLUTION SOURCES

The above four areas are sub-categorized into 17 sites of stormwater pollution sources depending on nature of terrain, type of pollutants and runoff flow directions:

Site ID	Description	Potential Pollutants
1	Limestone mine	TSS
2	Mudstone mine	TSS
3	102, CVE and 801 area	TSS: Limestone dust/cement dust/
4	101, 102, HME and Raw materials handling area	TSS, petroleum hydrocarbon: Limestone dust/mudstone /gypsum/laterite/ fuel & lube spills
5	HTC area	TSS: Cement dust/ concrete mix spills/ chemical/
6	Coal staging area	TSS: Coal dust/sediments/oxidized solution
7	Contractor Camp area	TSS: Kitchen waste/ waste water
8	Site Office and Warehouse area	TSS: Cement dust/sediments
9	Line#1 Cement Plant area	TSS, Petroleum hydrocarbon, chemical
10	Line#2 Plant and Temp. housing area	TSS: dust from excavation/ cement dust/sediments
11	Gypsum and Off-specs staging area	TSS, oxidized solutions:Sulphate solution from gypsum and washed out off specs dirt
12	Gypsum and Laterite staging area	TSS: Oxidized solutions from gypsum and laterite
13	Messing + 3-Storey + Technician Camp	TSS: Kitchen waste/domestic waste/dust
14	Fuel Farm area + Weigh bridge Canteen	TSS, Petroleum hydrocarbon: domestic waste
15	Main Gate + Temp. family housing	TSS: Kitchen waste/domestic waste/dust/
16	Kitchen + Labor Camp	TSS: Kitchen waste/domestic waste/dust/
17	55-acre Family Housing	TSS: Kitchen waste/domestic waste/dust/

Table5.1 Summary of Potential Pollution Sites and Pollutants

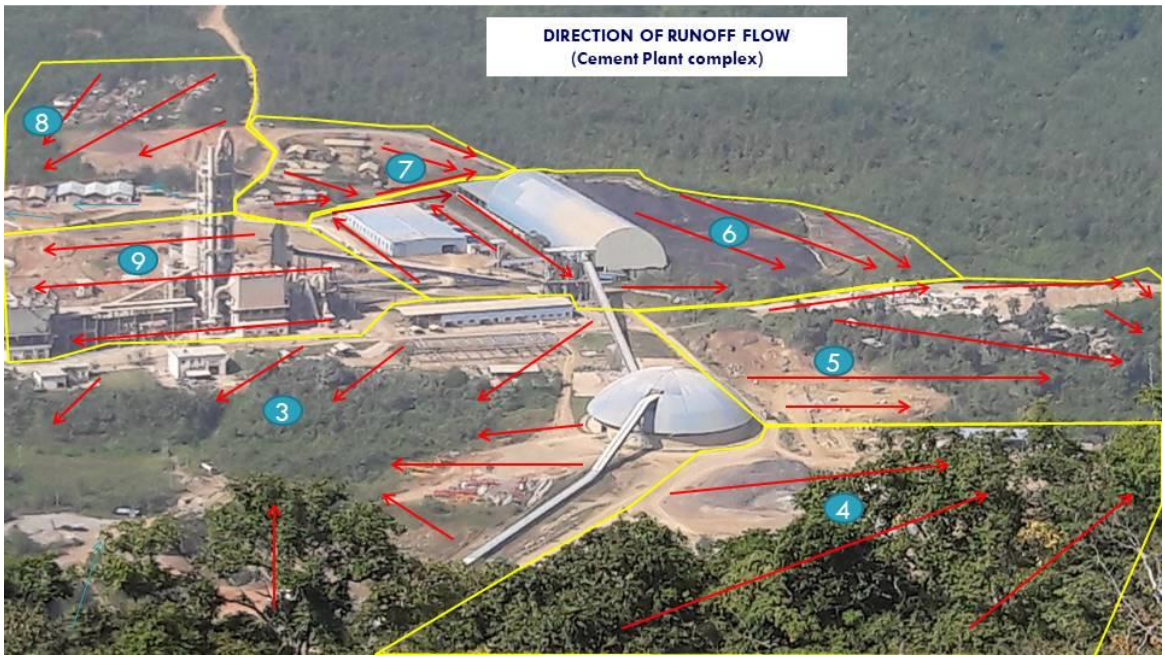


Figure 5.3 Sites of Stormwater Pollution Sources in *Area C*

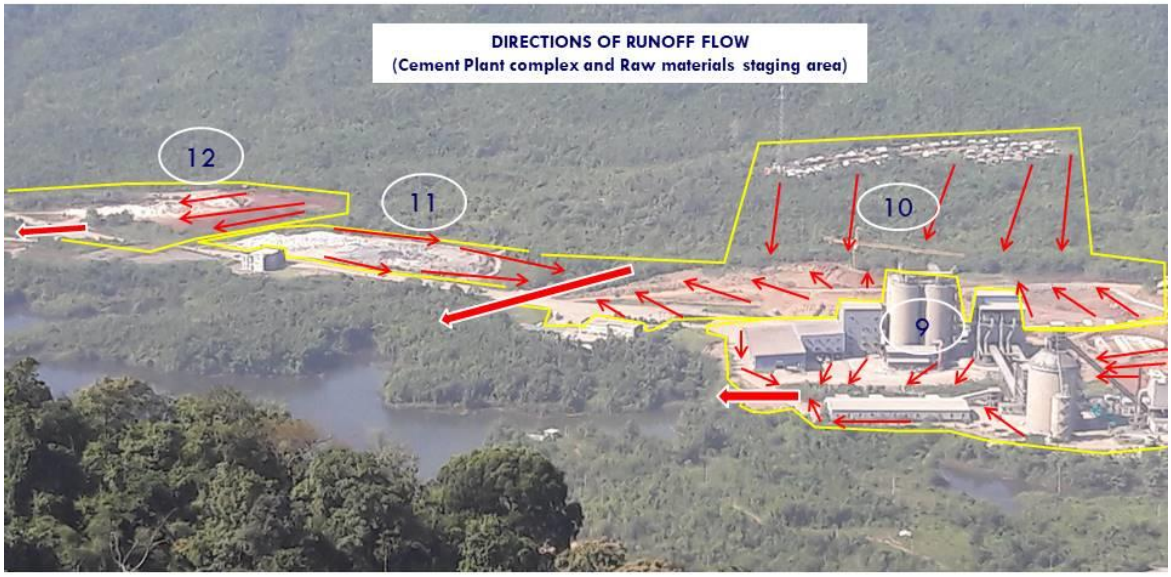


Figure 5.4 Sites of Stormwater Pollution Sources in Area C (cont:)

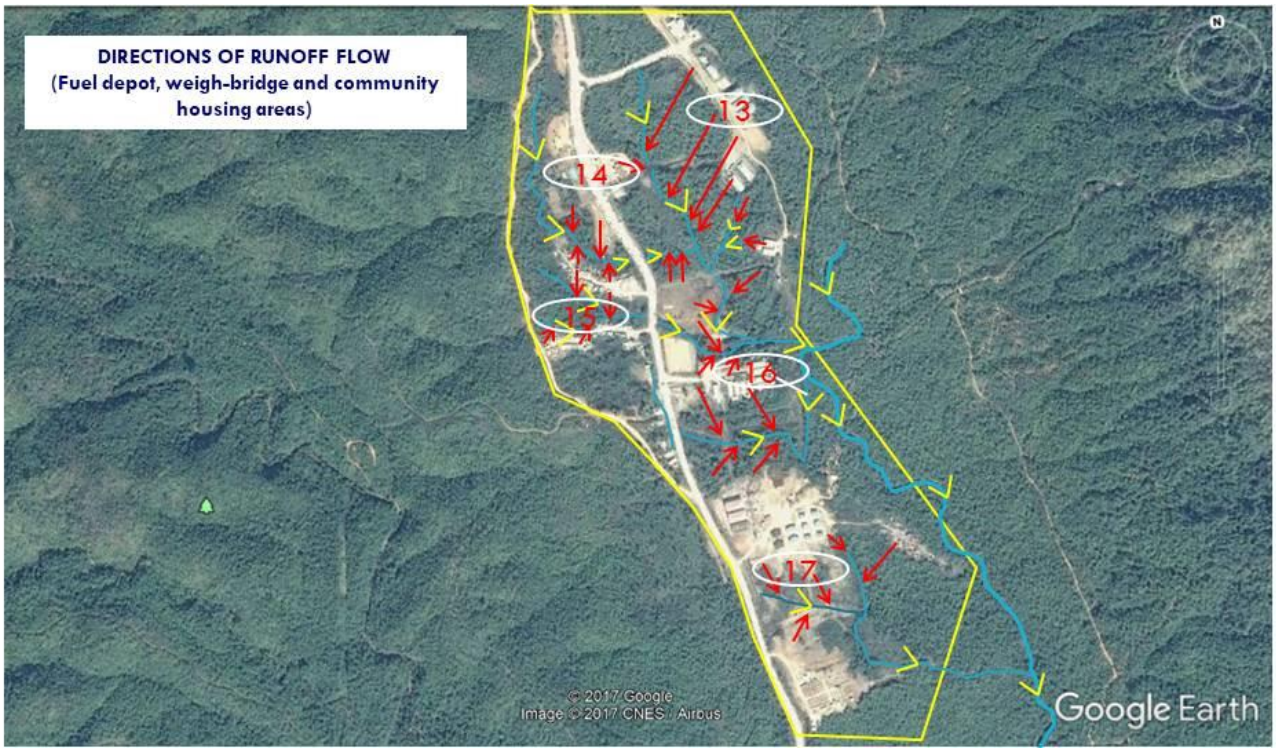


Figure 5.5 Sites of Stormwater Pollution Sources in Area D

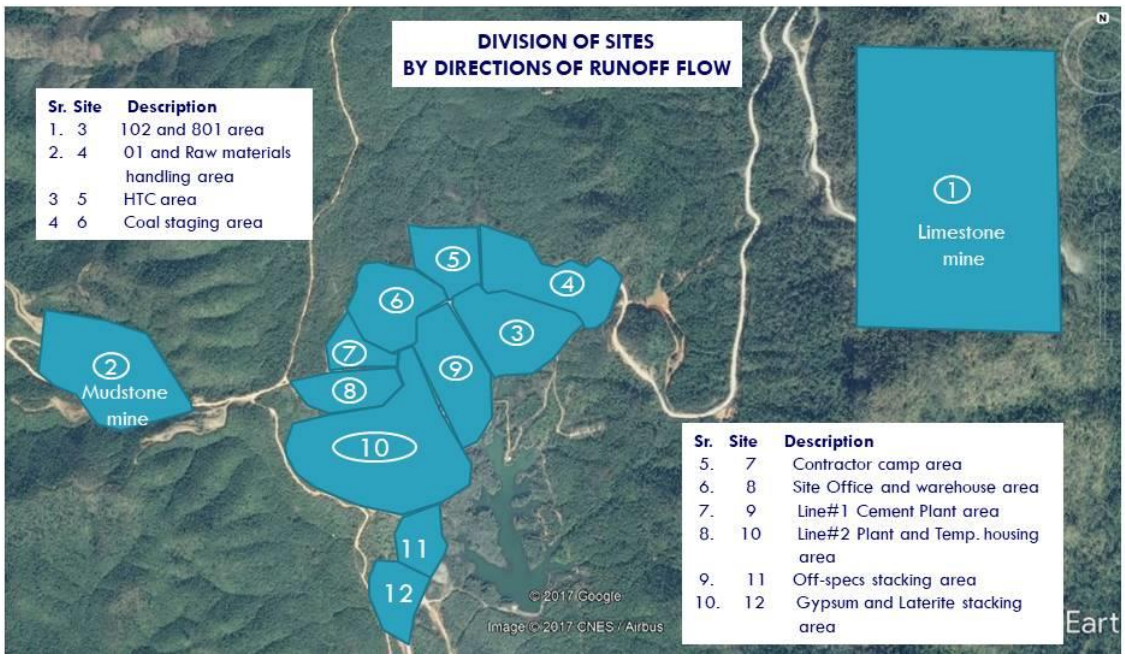


Figure 5.6 Division of Sites in *Area A,B,C*

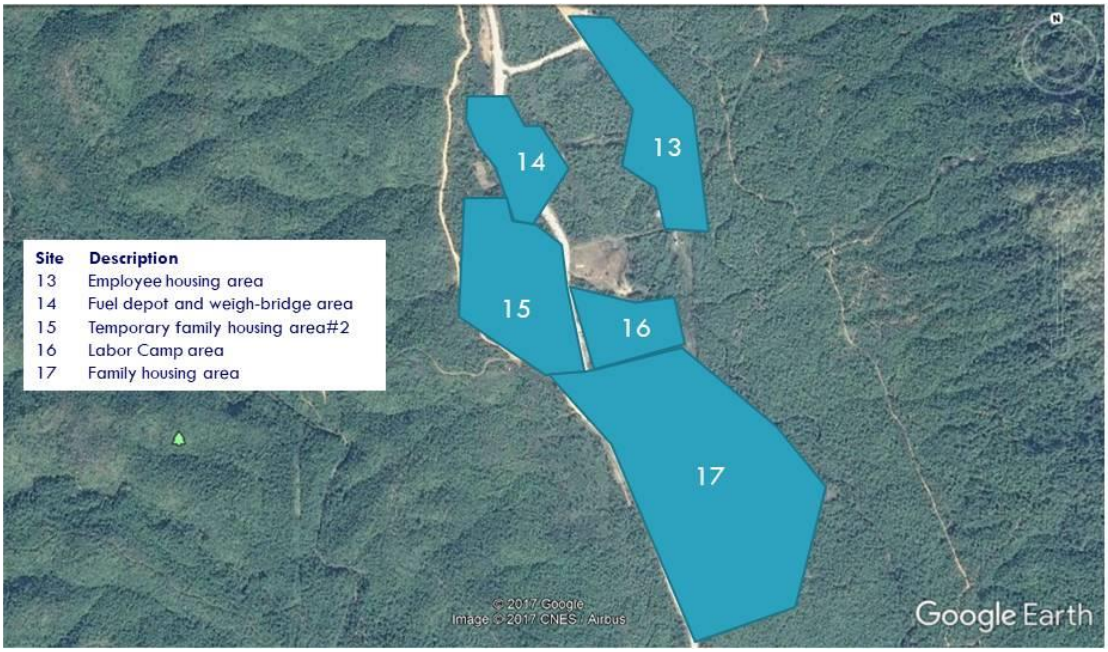


Figure 5.7 Division of Sites in *Area D*

5.3 CATCHMENT AREAS AND RUNOFF VOLUMES

Catchment areas were calculated by sites and runoff volumes were calculated from the rainfall and the individual catmint areas.

CATCHMENT AND RUNOFF FOR THE INDIVIDUAL CONTAMINATED AREA

Q	=	***Rainfall (in)***
Area	=	***Area of specific land cover (ft2)***
Runoff Volume (ft3)	=	***Q x 1/12 x Area***

Site ID	Water Source From Rainfall area	Average RainFall Max (inch)		Catchment Area(ft2)	Runoff Volume (ft3)		*Control requirement*	
		1 Month	6 Month		1 Month	6 Month	*Yes/No*	Reason/ control measures
1	Limestone Mine	18.6	92.4	6,922,262	10,729,506.10	82,617,197	N	Contained in Reservoir#2 in concession
2	Mudstone Mine	18.6	92.4	1,257,531	1,949,173	15,008,632	Y	Sedimentation control by sedimen basin and dropbxes
3	102+CVE	18.6	92.4	985,214	1,527,082	11,758,529	N	Contained in Reservoir#1 in concession
4	101+102+HME Raw Material stockpile	18.6	92.4	896,269	1,389,217	10,696,971		
5	Hi-Tech batching plant area	18.6	92.4	478,715	742,008	5,713,464	Y	Re-direct runoff to North Stormwater Pond(NSWP)
6	Coal Staging area	18.6	92.4	740,761	1,148,180	8,840,983	Y	Runoff to be close-circuit /control and contain/ treat
7	Contractor Camp area	18.6	92.4	220,427	341,662	2,630,796	Y	Waste water to control/ evaporation/ discharge
8	4E + Gantry Crane + Site Office	18.6	92.4	452,138	700,814	5,396,267	N	Runoff direct to the west Stormwater Pond (WSWP)
9	Cement Plant Line#1	18.6	92.4	853,819	1,323,419	10,190,330	N	
10	Telenor Camp + Second Line + Main Office	18.6	92.4	2,409,334	3,734,468	28,755,401	Y	Direct runoff to the west Stormwater Pond (WSWP)
11	Gypsum and Plant Gate	18.6	92.4	231,019	358,079	2,757,212	Y	
12	Laterite Stock Pile	18.6	92.4	310,435	481,174	3,705,042	Y	A settling pond to be constructed at the side of stockpile
13	Messing + 3-Storey + Technician Camp	18.6	92.4	542,998	841,647	6,480,681	Y	A contaminated drain trnch to be developed
14	Fuel farm + Weigh bridge+ Canteen	18.6	92.4	335,340	519,777	4,002,283	N	Natural runoff in to dry water course west and east
15	Main Gate + Temp. family housing	18.6	92.4	737,090	1,142,490	8,797,169	Y	A retention pond between two Temp family housing areas
16	Kitchen + Labour Camp	18.6	92.4	260,051	403,079	3,103,709	Y	A retention pond downstream Labor camp areas
17	55 Acre Family Housing	18.6	92.4	1,923,200	2,980,960	22,953,392	Y	Two retwntion ponds 1 between Labor camp and Staff family housing 2. between Staff family housing and

Table5.2 Site wide catchment areas and runoff volumes

5.4 STORMWATER PONDS / SETTLING PONDS AND THEIR STORAGE CAPACITY

STORM WATER PONDS AND CONTAINMENT PONDS			
Sr.	**Description**	**Remarks**	**Size /capacity**
STORMWATER PONDS			
1	North Storm Water Pond (NSWP)	To be constructed	160m x 120m x 3m
2	East Storm Water Pond 1 (ESWP1)	Existing (Reservoir1)	5 million gallons
3	East Storm Water Pond 2 (ESWP2)	Existing (Reservoir2)	45 million gallon
4	West Storm Water Pond (WSWP)	Existing (to be shaped)	160m x 120m x 3m
CONTAINMENT PONDS			
1	Contaiment Pond1 (CP1)	Coal staging area To be widened & deepened	50m x10m x 2m
2	Contaiment Pond2 (CP2)	Beside and west of coal staging area To be constructed	50m x10m x 2m
3	Contaiment Pond3 (CP3)	Offspecs clinker stockpile area Existing (no modification)	70mx 20mx 3m
4	Contaiment Pond4 (CP4)	Upstream of Reservoir2 To be constructed	160m x 120m x 3m
SETTLING AND EVOPORATION PONDS			
1	Settling and evaporation pond#1 in Contractor Camp Area	Contractor Camp site To be constructed	20m x 20m x 1m
2	Settling and evaporation pond#2 in Contractor Camp Area	Contractor Camp site To be constructed	20m x 20m x 1m

Table5.3 Stormwater Ponds and containment Ponds

Figure 5.8 Layout Plan Stormwater Ponds and Containment Ponds

6. STORMWATER MANAGEMENT CONTROLS

6.1 SWMP ADMINISTRATOR

The Environmental Manager shall be SWMP Administrator. He is responsible for:

- Developing the Stormwater Management Plan (SWMP)
- Developing Stormwater Action Plan (SWAP)
- Developing standard Operating procedures for Stormwater Control
- Assisting the mine operator in its implementation,
- Monitoring, Maintenance and reporting
- Revision of SWMP

6.2 STORM WATER CONTROL

In This section, how and where stormwater will be diverted away from material handling and storage areas to prevent stormwater contamination are described.

6.2.1 Area A: Limestone mine-

The Limestone mine, at present, includes the development of two starter cuts known as Stage#1 and Stage#2.

Groundwater is not expected to be encountered. Dry benches are expected except for normal wetting during precipitation events. If isolated, perched saturated zones are encountered, diversion ditches and sumps will be installed as necessary to maintain safe operating conditions within the mine.

6.2.1.1 Stormwater controls and BMPs

Clean stormwater runoff from the east slope catchment of the limestone mine naturally flows down the mountain slope to Myit Tha stream. The stormwater collection drains will direct contaminated runoffs from the mine (Stage#1 & Stage#2) and west catchment area to:

(i) Reservoir#2 through the drainline along the haul road.

(ii) the Wetland pond through watercourse and its overflow is discharged to Reservoir#1.

The construction of cut dams with stonewall on hill slopes and drop box on gradual plain will help mitigate the amount of suspended solids entering down-gradient drainage.

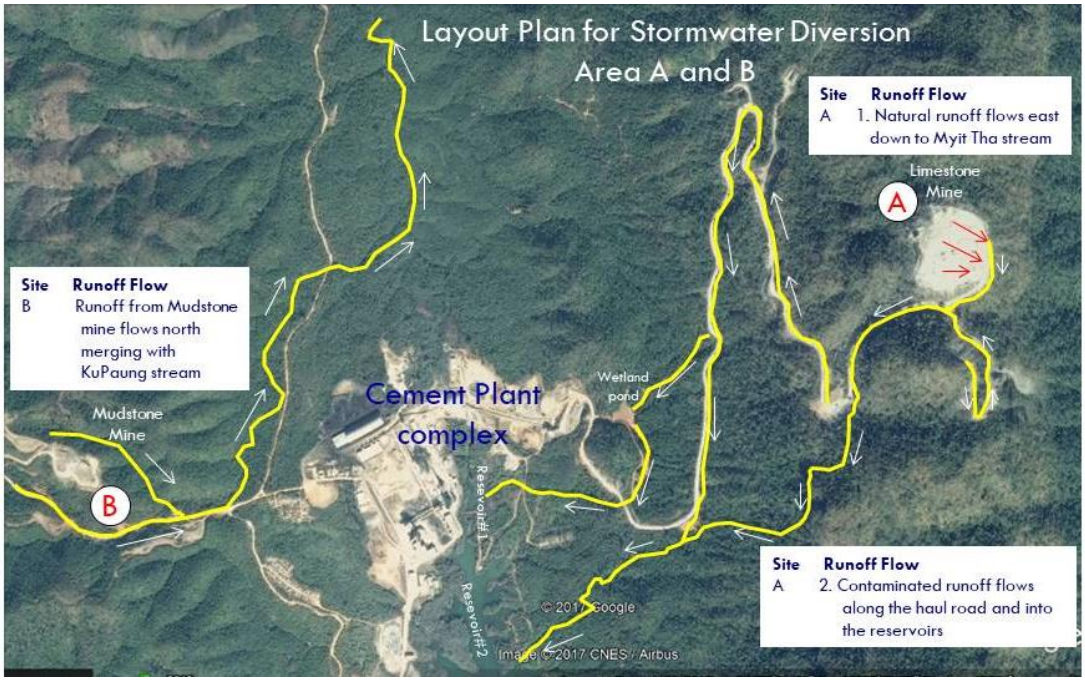


Figure 6.1 Layout Plan for Stormwater Diversion Area A and Area B

6.2.2 Area B: Mudstone mine

The Mudstone mine, at present, includes the development of first starter cut on the east slope of Modi taung.

Groundwater is not expected to be encountered. Dry benches are expected except for normal rain events. If isolated, perched saturated zones are encountered, diversion ditches and sumps will be installed as necessary to maintain safe operating conditions within the mine.

6.2.2.1 Stormwater controls and BMPs

Clean stormwater from the east catchment of the mudstone mine naturally runs down the mountain slope. The sediment carrying runoff from the mine and will be directed through the watercourse equipped with sediment basin and spaced silt traps to Kupaung stream.

6.2.3 Area C : Cement Plant Complex

As has been described in Table 5.1 and Figure 5.6, there are 10 potential pollutants sites in this area (Site3 to Site12).

6.2.3.1 Stormwater Controls and BMPs

Site3: The Reservoir#1 situated on the east of the cement plant acts as stormwater pond and sedimentation pond for the site. Clear water from the reservoir later be directed to reservoir#2 through spill way.

Clean storm water runoff from the Thapyaytaung catchment area will be isolated with a diversion trench to flow north to the Kyauktala creek and further to the Ku-paung stream.

In the same way, clean stormwater runoff from the west catchment area will be isolated with a diversion trench to flow north to the Kyauktala creek and further to the Kupaung stream. Figure 6.2.

Figure 6.2 Layout Plan for Stormwater Diversion Area C

Site4: Northern perimeter of Area C will be surrounded by containment bunds with a perimeter drain at inner side. The polluted runoffs from Site4 (HME, 101, 102 and Raw materials staging areas) will be collected in the perimeter drain and discharged into and settled in the North Stormwater Pond (NSWP) which has been planned for constructing at the far north-end part of the concession.

Site5: A containment bund, with a perimeter drain at inner side, has been constructed along the west perimeter of the Hi-Tech concrete (HTC) batching plant area. The polluted runoff from this site will be discharged into and settled in the North Stormwater Pond (NSWP). (Figure 6.2)

It will be ensured the NSWP has sufficient storage capacity for runoffs from Site 4 and Site5. Clear water from the NSWP will be used for heavy equipment wash and dust suppression.

Site6: The runoff from the site (coal staging catchment area) will be in close-circuit and contained in the Containment Pond1. The water will be neutralized as and whence required. After neutralization, the clear water will be pumped up to the West Stormwater Pond (WSWP) for dust suppression and light vehicle wash. (figure 6.2 and Figure 5.8)

Site7: The runoff from contractors' camp area will be directed to the Settling pond#3. After settling sediments, the clear water will be pumped up to the West Stormwater Pond (WSWP) for dust suppression and light vehicle wash. Domestic wastewater from this site will be collected in two settling/evaporating ponds. Waste-water absorptive plants and fish will be bred in them.

Kubyin Road (the local community bypass road) acts as the runoff boundary dividing clean and dirty stormwater area. Clean stormwater runoff from the west-hill naturally flows southwards along the valley west side the road.

Site8: Dirty runoffs from the warehouse, temporary family housing area and west-part of the cement plant area flow into the West Stormwater Pond (WSWP).

Site9: Dirty runoffs from the central area of the cement plant flow into upstream of Reservoir#2.

Site10: Dirty runoffs from (the temporary family housing area and south-part of the cement plant area) flow into the West Stormwater Pond (WSWP). Overflow of which will be directed to Reservoir#2 via spillway and watercourse.

Site11: Dirty runoffs from (gypsum and offspec clinker handling area) will be controlled by perimeter bund & drain and directed into the Settling Pond#3 which is under construction. After settling, clear water will be discharged to Reservoir#2 via spillway.

Site12: Dirty runoffs from gypsum and laterite handling area1 will be controlled by perimeter drain and directed into the Retention Pond1.

6.2.4 Area D : Employees Accommodation Complex

The Area D, Employees Accommodation Complex is divided into 5 sites (Site 13 to Site 17)

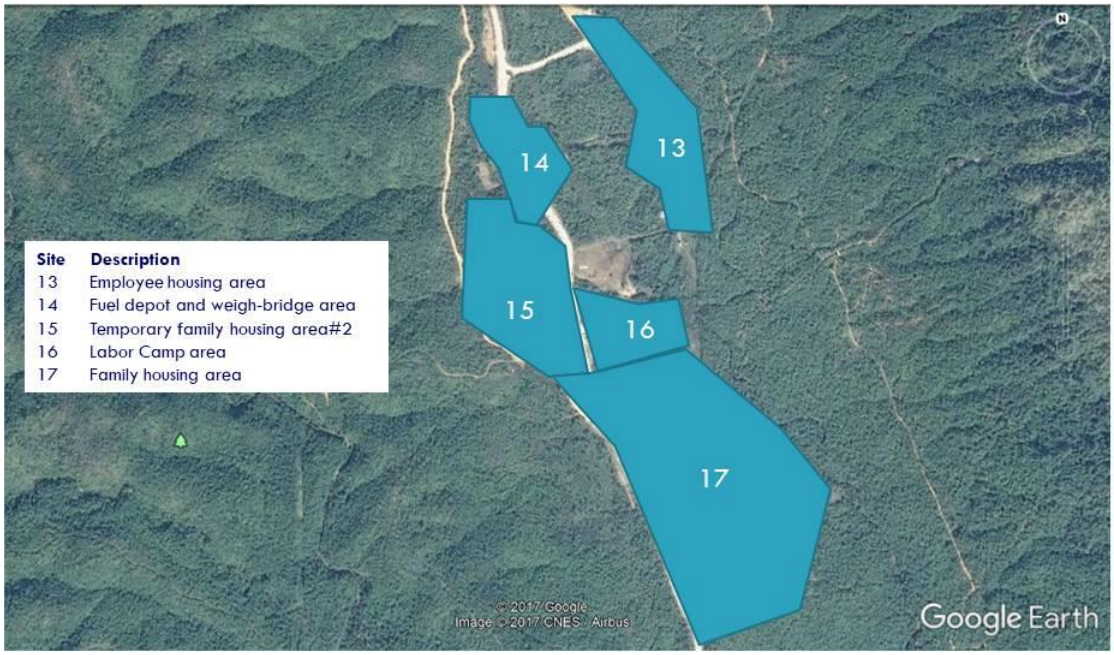


Figure 6.3 potential pollutants site in Area D

6.2.4.1 Site13: includes messing hall, clinic 3-strey staff housing Official housing and Technician accommodation. Stormwater runoff is being affected by kitchen waste and waste water from domestic use. The kitchen waste and waste water issues will be resolve by hiring consultant and a waste water management plan will be developed. Polluted Stormwater runoff from this area flows down to the central valley dry water course. The stormwater carrying TSS from gypsum and laterite handling area also flow along this dry watercourse.

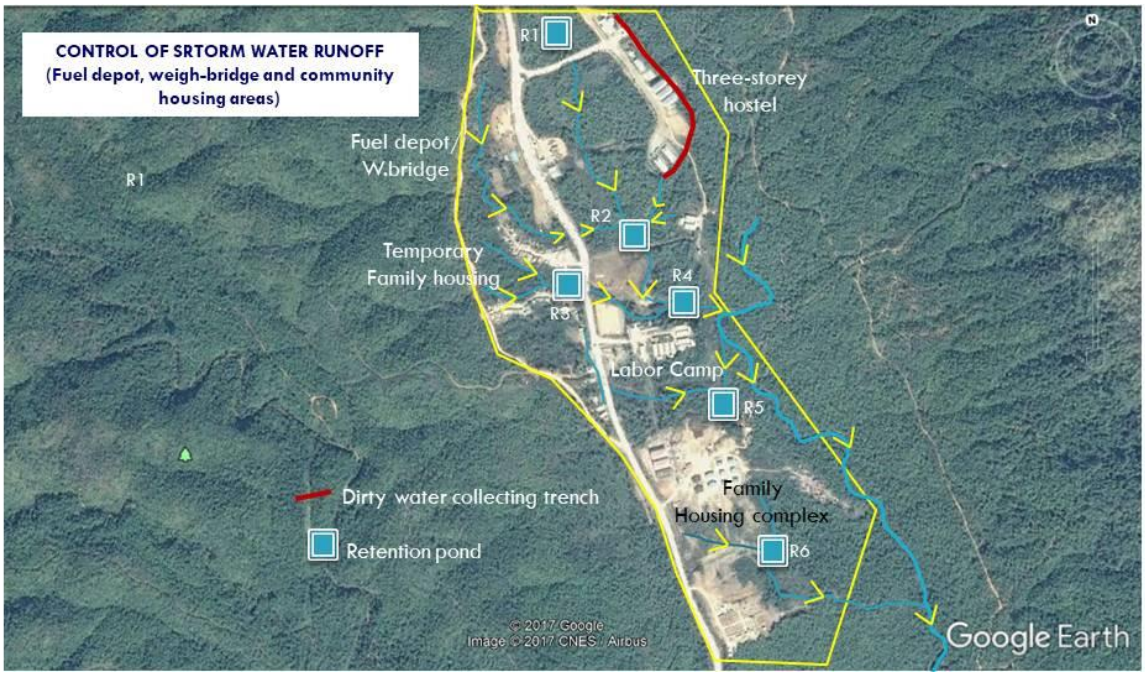


Figure 6.4 Retention Ponds Locations in Area D

6.2.4.1.1 Stormwater controls and BMPs

This area has less contamination in comparison to Area C. The area needs less clean stormwater diversion. Six retention ponds will be constructed to collect and settle before discharging to the environment.

The polluted stormwater from gypsum and laterite handling area will be collected in the retention pond R1 and decanted overflow will flow through spillway. The runoff from messing, 3-storey building that flows into east slope of the area will be directed to the dry watercourse between Officer quarter and Technician accommodation and TSS will be trapped in the second retention pond R2 (Figure 6.4)

6.2.4.2 **Site14:** comprises HSD Tank Farm and Truck weighing bridge. Potential pollutants in this area are petroleum hydrocarbon, TSS from dust.

6.2.4.2.1 Stormwater controls and BMPs

Containment wall structure has been constructed around the fuel-tank farm. Oils and lube drums will be kept on a concrete floor under the sunshade. An oil/water separator will be installed at the fuel bowser are under the foot print of vehicle. Dust suppression with water truck. Runoff from the fuel farm area will flow in to the natural settling valleyof the dry watercourse beside it and it will be directed to the retention pond R2 at central dry watercourse. The runoff from the weghbridgde and canteen will also be directed to R2.

6.2.4.3 **Site15**: This site includes two temporary family housing area. Major pollutants to the stormwater runoff in this area are domestic waste, kitchen waste, human waste and waste water.

6.2.4.3.1 Stormwater controls and BMPs

Control of these pollutants will be dealt by waste water management plan. Stormwater runoff will be retained in the retention pond R3 and overflow will be directed downstream eastwards.

6.2.4.4 Site 16: Main pollutants from this site are kitchen waste from central kitchen, human waste & waste water from labour camp and TSS from the site.

6.2.4.4.1 Stormwater controls and BMPs

Control of these pollutants will be dealt by waste water management plan. Stormwater runoff will be retained in the retention pond R4 and overflow will be directed downstream eastwards to Polaung creek.

6.2.4.5 Site 17: Main pollutants from this site are kitchen waste, human waste & waste water from staff family housing, labour family housing and TSS from the site.

6.2.4.5.1 Stormwater controls and BMPs

Control of these pollutants will be dealt by Waste Water Management Plan. Stormwater runoff will be retained in the retention pond R5 and R6. Overflow will be directed downstream eastwards to Polaung creek.

6.3 MATERIALS HANDLING AND SPILL PREVENTION:

The materials onsite that could impact stormwater runoff are: HSD, engine oil, hydraulic oil, lubricant, chemical and TSS from limestone, mudstone, laterite, gypsum, coal and off-spec clinker.

Containment wall structure has been constructed around the fuel-tank farm. Oils and lube drums will be kept on a concrete floor under the sunshade. An oil/water separator each will be installed at the HME workshop area and at the fuel bowser area. A bioremediation pad will also be constructed at the north side of the HME workshop.

Chemicals will be stored in a designated cold room with good ventilation.

Limestone, mudstone, laterite, gypsum, coal and off-spec clinker are stockpiled on hard-faced floor surrounded with containment bunds to prevent from spillage and wash-outs. Dust control is done by water trucks and low-drop & balance-profile loading, when they are handled. Slow speed hauling and control tipping process will be implemented.

6.4 SEDIMENT AND EROSION PREVENTION:

More stormwater ponds and settling pond will be constructed to reduce erosion and prevent sediment delivery to the local water. Settling and recycling process will be applied. And water treatment system, in case the contamination might be toxic to downstream user, will be in place.

Sediment and erosion prevention structure such as silt fences, sediment ponds, drop structures, check dams will be constructed where ever required and in addition non-structural (such as mulching and re-vegetation) methods will be applied.

6.5 TREATMENT OF WASTE WATER FROM CONTAINMENT PONDS

Water from containment ponds in coal staging area and HME area may need treatment before recycling. It is therefore linked with waste water treatment system as follows:

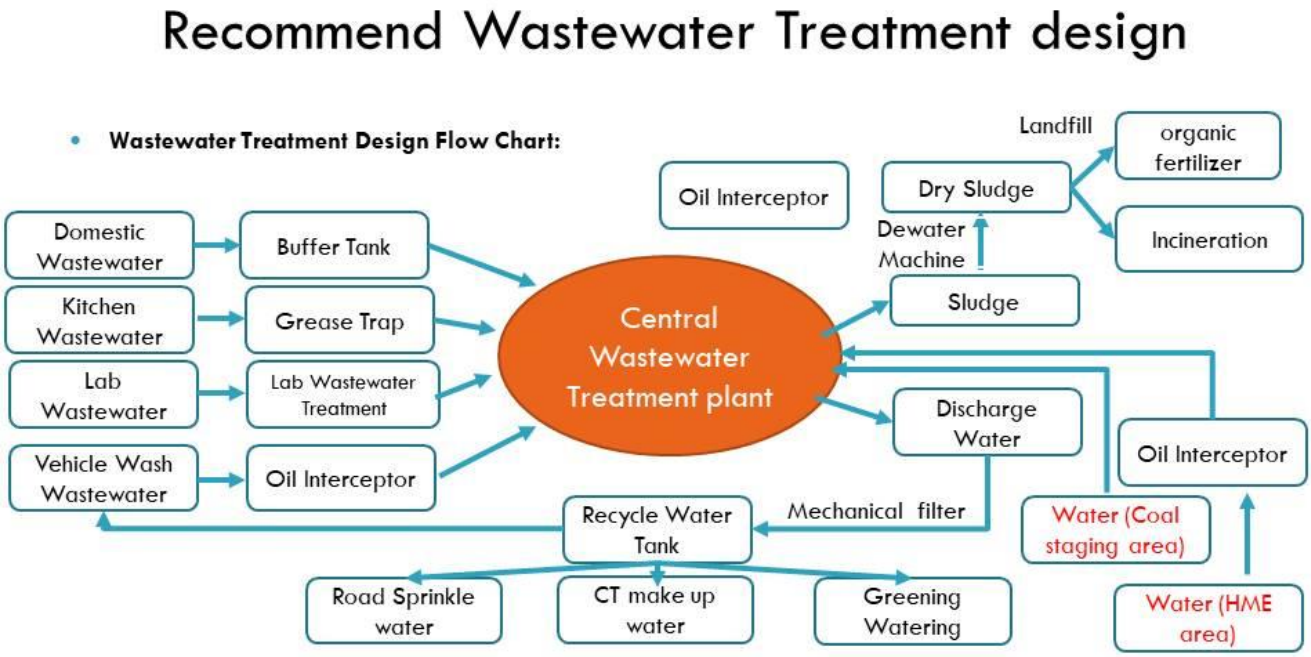


Figure 6.5 Recommended Wastewater Treatment Design

6.6 STORM WATER MANAGEMENT ACTION PLAN (SWMAP)

STORMWATER MANAGEMENT ACTION PLAN

SR. NO.	AREA	ISSUES	FIXES	RESOURCES REQD.		ACTION BY	TARGET DATE	STATUS/ COMMENTS
				Numbers	Shifts			
1	Site 4: Raw material Staging and Aggregate washing areas (101,102)	 Contaminated runoff discharging to the environment uncontrolled.	Construct a containment bund along the leading edge by digging a perimeter drain (inner side of the bund) parallel).	1xExcavator	1	U Yeyint Kyaw	20-Nov-17	Completed
2	Site 5: Between HTC and HME compounds	 Contaminated runoff discharging to the environment uncontrolled.	Construct a storm water pond (N. Storm Water Pond) at northend of the concession (north of the HME area) to collect contaminated runoff from HME and HTC Areas	1xExcavator 1x Track Dozer 1xV. Roller 3xDT	5 5 5 5	U Yeyint Kyaw	24-Dec-17	
3	Site5: HTC Batching Plant Area	 Contaminated runoff charging small sedimentation pond and the overflow channel washed out	Collect and direct the runoff into the planned storm water pond at the north, by digging a perimeter trench (dipping north) and constructing a containment bund, using the dug out material, beside (outer side) of the drain.	1xExcavator	1	U Yeyint Kyaw	28-Nov-17	90%
4	Site 6: Coal staging area (East)	 Settling pond overflow channel washed out	 (a) Backfill the washed-out holes to a level 1m above the existing floor and lay two 0.5 m dia concrete pipes. Further backfill for free board. Use dig out material from depening the sttlement pond 4 (b)	0.5dia concrete pipe 12m 1xExcavator	 1	U Yeyint Kyaw	20-Dec-17	
4	Site 6: Coal staging Area (East)	Too small storage capacity	 (b) Dig out the silts down to 1.5 m below the existing level.	1x Excavator	1	U Yeyint Kyaw	27-Dec-17	
5	Site 6: Coal staging area (East)	 Storage capacity of sedimentation pond too small.	 (a) Widen the area to the yellow dotted line.	1x Excavator 2x DT	2 2	U Yeyint Kyaw	27-Dec-17	

SR.	AREA	ISSUES		FIXES		RESOURCES REQD.		ACTION BY	TARGET DATE	STATUS/ COMMENTS
				 (b) Deepen the floor by digging 1.5 m below the existing lowest level.		Included in the above		U Yeyint Kyaw	27-Dec-17	
6	Plant ID 501		Drains filled with sediments		Clean up both north and south side-drains	1xsmall Komatsu	1	U Thein Htay and Team	10-Dec-17	
7	Plant ID 501		Water ponding at the entrance		1. Clean up coal from the ramp 2. Construct proper concrete drain ditch beside the post footings dipping south 3. Cover the drain with iron grid frame	1xsmall Komatsu Concreting iron frames for driveover	1 2	U Thein Htay and Team	10-Dec-17	
8	Site6: Plant ID 501		Runoff flows on to the concrete road and spreads washed out on the road.		Cut and clean up this area to re-direct the runoff into the culvert.	1xExcavator	0.5	U Yeyint Kyaw	23-Nov-17	Completed
9	Site 6: Plant ID 501	 The sediments inside the culvert blocked the runoff flow			1. Clean up the sediment manually 2. Clean up spillage	3xcasual Laborer	1	U Thein Htay and Team	20-Nov-17	50%
10	Site 7: Coal staging area (West)		Runoff from contractor camp is discharged without control.		Construct a sedimentation pond after the discharge point	1xExcavator 1x Track Dozer 1xVib Roller	2 1 1	U Yeyint Kyaw	28-Dec-17	

SR.	AREA	ISSUES	FIXES	RESOURCES REQD.		ACTION BY	TARGET DATE	STATUS/ COMMENTS
11	Site 7: Contractor Camp (East)	 Discharging waste water from bathrooms uncontrolled	Isolate the waste water and re-irect the water to the settling/ evaporation pond downstream via concrete drian	1x conc drain	2	U Thein Htay and Team	24-Dec-17	
12	Site 7: Contractor Camp (East)	 Discharging waste water from kitchen uncontrolled	Isolate the waste water and re-irect the water to the planned settling/ evaporation pond downstream via concrete drian	1x conc drain	2	U Thein Htay and Team	24-Dec-17	
13	Site 7: Contractor Camp (East)	 This muddy and swampy area needs be fixed	 1. Dig a Settling/ Evaporation pond 2. Cast overflow channel for decanted water 3. Construct a rock base access with crowned cross-section 4. Put drain lines on both sides of the road	1xsmall Excavtor for pond 1xsmall Excavtor for Road 1xsmall Excavtor for side drain 1x overflow channel	2 2 1 2	U Thein Htay and Team	24-Dec-17	
13	Site 7: Contractor Camp (East)		 Sheet the access on the core-shed side with red earth and shape it accordingly	Included in the above		U Thein Htay and Team	31-Dec-17	
14	Site 7: Contractor Camp (West)	 Discharging waste water in this area uncontrolled	 Isolate domestic waste water by directing the water to the planned settling and evaporation pond downstream via concrete drains.	3xlaborer 3xMason bricks, sand and cement	5 5	U Thein Htay and Team	31-Dec-17	
14	Site 7: Contractor Camp (West)		 Construct settling and evaporation pond	1xSmall Excavtor 1xExcavaator 3xDT 1x V.Roller 1x Water Truck	3 1 1 2 1	U Thein Htay and Team	31-Dec-17	

SR.	AREA	ISSUES	FIXES	RESOURCES REQD.		ACTION BY	TARGET DATE	STATUS/ COMMENTS
15	Site 7: Contractor Camp (West)	 Improper drainage	 Control runoff with proper drain	1xSmall excaavator	0.5	U Thein Htay and Team	31-Dec-17	
		 Bushes along the road shoulder	Road shoulders need bush clearing	1x Handheld motor grass-cutter	0.25	U Thein Htay and Team	31-Dec-17	
16	Site 8 &10: West Storm Water Pond Area	 Dry Plants in the West SWP	Clear all dead trees from the pond	1xbamboo raft 2xhack saw 2x labourers	2	U Thein Htay and Team	31-Dec-17	
		 Untidy bank	 1. Merge the two small ponds into one by widening at the bottle necks 2. Mark out bank-alignment and construct proper bank around the pond	1xsmall Excavtor for pond 1xLoader 2xDT 1x Water Truck	5	U Thein Htay and Team	31-Jan-18	
17	Site 11: West Storm Water Pond Area	 Contaminated runoff from unburnt clinker stockpile flows straight into the reservoir.	 Build an earthen wall for west storm water pond#2 to let the runoff settling in. Construct a proper concrete spill way.	1xExcavtor 1xTrack Dozer 3xDT 1x V.Roller 1x Water Truck	5	U Yeyint Kyaw	31-Jan-18	

SR.	AREA	ISSUES	FIXES	RESOURCES REQD.		ACTION BY	TARGET DATE	STATUS/ COMMENTS
18	Site 9: Upstream Reservoir#2 (E. Storm Water Pond#2)	 Contaminated runoff from the plant polluting the water in the reservoir#2	 Isolate and contain the contaminated runoff from the Plant site by constructing an earthen causeway to create the East Storm Water Pond#2.	1xExcavtor 1xTrack Dozer 3xDT 1x V.Roller 1x Water Truck	10	U Yeyint Kyaw	31-Mar-18	To be executed only after MD's approval
19	Site 13,15,16, 17	 TSS polluted runoffs discharge to the environment uncontrolled.	Construct retention ponds at the designated watercourse section to let TSS settle in the pond	1 x Excavator	6	Yeyint Kyaw	31-Jan-18	
20	Site 14 and HME	No oil spill control is in place inthese areas	Construct Oil/water separator at HME anf HSD refilling Station	Cement, bricksk, Masons	12	U Thein Htay and Team	15-Jan-18	
21	Site 14: HME area	Improper disposal of Waste oil and cotton rags	Construct a bioremediation pad for disposal of Waste oil and cotton rags from HME and Site14		4	U Thein Htay and Team	15-Jan-18	
				Excavator	36 shifts			

7. CONCLUSION

This conceptual Stormwater Management Plan is prepare for setting up a control system to be used for protecting clean stormwater from being contaminated , protecting soils from erosion and sendiment control. The plan will be reviewed and updated as and when required.

REFERENCES

1. APACHE Cement Plant ESIA report by National Engineering and Planning Services (NEPS) Co., Ltd. Myanmar . September 2014
2. Environmental Impacts Assessment Report February, 2016 by Myanmar Environment Sustainable Conservation (MESC)
3. Shwe Taung Cement Supplemental ESIA & Livelihood Restoration Plan 27 October 2016 (Rev1) by Environmental Resources Management (ERM).
4. Supplementary Environmental and Social Impact Assessment for Shwe Taung Cement Ltd. Cement Plant & Associated Facilities in Myanmar April 2017 by ERM
5. Pan Project Stormwater Management Plan, January 2013 by Midway Gold US Inc.
6. Storm Water Management Plan – Contents and requirements Metal Mining opertions and Mine Waste Remediation March 2010 – by Colorado Department of Public Health and Environment

Annex R
Incident Reporting and Investigation Procedure

SHWE TAUNG CEMENT CO.,LTD.	INCIDENT REPORTING AND INVESTIGATION PROCEDURE		STBM-IMS-P-008-03
	Revision	Effective Date	HSSE Department
	09-05-2020	09-05-2018	

Change History		
Rev #	**Description of Change**	**Paragraph**
00	Initial Release	All
01	Revision	All
02	Review 24 July 2017	
03	Revision 12 January 2018	
Verified by		
Name	**Designation**	**Signature**
Mr. Aung Khaing Nyi	HSSE Head	
Approved by		
Name	**Designation**	**Signature**
Mr. Aung Zaw Naing	Shwe Taung Building Material CEO	

1 Purpose

This document describes the Incident Reporting and Investigation Procedure of Shwe Taung Building Materials' entities (ST): Shwe Taung Cement Co. Ltd (STC), Shwe Taung Mining Company (STM) and High Tech Concrete Company (HTC).

The purpose of this document is to set out the procedures and associated responsibilities in the recording, investigation and analysis of an incident, accident or near-miss occurring at any of ST's premises and/or during activities engaged by ST at ST's premises or elsewhere in order to:

- Determine the underlying environmental, health, safety or social deficiency or other factor that may have caused or contributed to the occurrence of the incident, accident or near-miss (investigation and analysis phase);
- Identify the need for corrective action, the opportunity for preventive action, the implementation of corrective action and/or preventive action and thus enable continual improvement (learning and recommendation phase);
- Document and maintain the result of the incident/ accident/ near-miss investigation through an Incident Report for further communication (reporting and closing out phase).

2 Scope

This procedure is applicable for an incident (includeing accident and near-miss) that occurs or could have occurred at ST's premises and/or results from ST's activities including at the plants, mines and quarries, offices, other facilities, construction sites, during material transportation and travels,to enable their reporting, investigation and to facilitate effective implementation fo corrective and/or preventive actions.

ST employees, contractors and visitors to ST's premises shall comply with the requirements of this Procedure.

3 Definitions and Abbreviations

CEO	The Chief Executive Officer of Shwe Taung Building Materials' entities
CLO	Community Liaison Officer
FOM	Form
Environmental Incident	An occurrence or set of circumstances, as a consequence of which pollution (air, water, noise, and land) or an adverse environmental impact has occurred, is occurring, or is likely to occur
Environmental Manager	Person-in-charge of environmental aspects
EPC Contractor	Engineering, Procurement and Construction company responsible for the design, procurement, construction, commissioning and handover of the expansion project (second clinker and cement line) at STC; the EPC Contractor must appoint a health and HS Manager (HS EPC Manager) and a manager responsible for the expansion project (Project EPC Manager)
Head of Cement Business	Person-in-charge of STC and STM
Head of Concrete Business	Person-in-charge of HTC

HSSE	Health, Safety, Social and Environmental
HSSE Head	Health, Safety, Social and Environmental Department Head
HS Manager	Health and Safety Manager or person-in-charge of Health and Safety matters or Chief Safety Officer
HTC	High Tech Concrete Company
OHS	Occupational, Health and Safety
Social Manager	Person-in-charge of social aspects or social accountability manager
SOP	Standard Operating Procedure
ST	Shwe Taung Building Materials' entities i.e. STC, STM and HTC and their associated facilities and assets
ST's premises	ST's premises are defined as ST's premises, sites and facilities including the cement plant (including ancillary facilities, the cement plant expansion, the mudstone and limestone quarries) located in Thazi township of Mandalay region (STC), the coal mine located in the Kalaywa township of the Sagaing region (STM), HTC's premises and facilities in Myanmar as well as STC's, STM's and HTC's offices and head offices in Mandalay and Yangon.
STC	Shwe Tang Cement Co., Ltd.
STC Plant Operation Manager	Person-in-charge of the operations at STC (first clinker and cement line) and of the expansion project at STC (second clinker and cement line) until it is commissioned and incorporated in the operations at STC
STM	Shwe Taung Mining Company
WIS	Working Instruction
Accident	Undesired event including spill giving rise to death, ill health, injury, pollution to air, water, noise or land, environmental impact, equipment material damage or other losses
Finder/ Witness/ Reporter	person(s) directly involved in, witness of or discovering and reporting on the incident; the Finder may include the person(s) directly affected by or the subject of an incident/ accident/ near-miss
Fatality	Work-related injury or illness that results in death; fatalities are included when calculating the Lost Time Incident (LTI) incidence rate and frequency rate
First Aid Injury/ Treatment Case (FAC)	Any treatment provided in-house of minor scratches, cuts, burns, splinters etc. and any follow-up first aid/medical/nurse visit for the purpose of observation
Incident	Work-related event(s) in which an injury or ill-health (regardless of severity) or fatality occurred, or could have occurred / occurrence resulting, or having the potential to result, in an impact on health,

	safety, the environment, a material damage or other losses; an incident includes accident and near miss
Injury Classification	Classification system used for defining the types of occupational health and safety-related injuries or illnesses according to their characteristics (First Aid Injury Treatment/ Case (FAC), Fatality, Medical Aid/ Treatment Case (MTC), Lost Time Incident/ Accident (LTI/A), Restricted Work Transfer Case (RWTC))
Lost Time Incident/ Accident (LTI/ A)	A work-related incident/ accident (injury or illness) of an employee or contractor's employee to whom a physician or licensed health care professional recommends days away from work due to the incident/ accident
Major Incident/ Accident	Serious injuries, injury or ill-health leading to disability, life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning, etc.) or serious environmental pollution or damage to air, water, land (including high noise levels)
Material Damage	Any damage of property or equipment resulting from a lack of proper Occupational Health and Safety management e.g. sling failure or wrong lifting resulting in load or building damage
Medical Aid/ Treatment Case (MTC)	Any work-related injury or illness requiring medical care or treatment beyond first aid (regardless of the provider of such treatment) that does not result in a Restricted Work Transfer Case (RWTC) or Lost Time Incident/ Accident (LTI/A); medical treatment does not include First Aid Injury/Case/Treatment; see Injury Classification
Minor Incident/ Accident	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort)
Near Miss	An incident where no injury, ill-health or environmental damage occurs but that could have occurred
Negligible Incident/ Accident	Event not likely to cause injury, ill-health or serious environmental pollution or damage to air, water, land (including high noise levels)
Occupational Illness	Adverse health condition for a human being, the occurrence or severity of which is related to a person's exposure to certain job factors or to his/her work environment; the factors can be identified, measured and controlled (in Myanmar also disease specified in Schedule III of the Workmen's Compensation Act)
Restricted Work Transfer Case (RWTC)	A RWTC occurs when an employee or contractor's employee cannot perform all of his/her routine job functions but when the case does not result in days away from work; see Injury Classification

4 Responsibility and Authority

4.1 CEO

The CEO shall be responsible in overseeing that this Procedure is implemented throughout ST operations. CEO shall endorse this Procedure and have overall accountability for its management. CEO shall enable and regularly check that this Procedure is implemented and regularly reviewed, including through the ongoing work of ST's audit function unit.

4.2 Heads Businesses

Heads of Businesses (namely Head of Cement Business and Head of Concrete Business) shall enable and regularly check that any HSSE incident, accident or near-miss involving any person, plant, animal or equipment for which ST has responsibility, and that occurred or could have occurred within ST's Premises and/or during their activities on and off ST's premises, is reported (recorded and investigated) and that recurrence of such HSSE incident, accident or near-miss is minimised through the implementation of appropriate mitigation measures.

Head of Business shall determine the external communications of accidents/incidents occurred within their business.

4.3 HSSE Head

HSSE Head shall report HSSE incident, accident or near-miss involving any person, plant, animal or equipment for which ST has responsibility, the investigation results and mitigation measures implemented to the Heads of Businesses and the CEO on a regular basis via the HSSE Committee and immediately for any Major Incident/ Accident.

HSSE Head shall report incident/ accident to the relevant authorities as per the relevant requirements and calendar and in particular, incidents or accidents involving 'Occupational Diseases' as listed under the Myanmar Factories Act 1951 shall be reported to the Labour Department as required. HS Manager shall support HSSE Head in gathering information for such reporting.

HSSE Head shall enable and regularly check that this Procedure is implemented and maintained.

4.4 HS Manager

HS Manager shall be informed by Line Managers of any incident/ accident/ near-miss.
HS Manager shall review Incident Notification Forms prepared by Line Managers, the Medical Team and/or the affected persons and support the Line Managers and Contractors in gathering all evidences, information and resources for the incident/ accident/ near-miss investigation.

HS Manager shall lead the incident/ accident/ near-miss investigations and support the relevant Line Manager in the process, prepare the Incident Investigation Reports and inform the relevant Managers and Executives, workers, contractors, visitors to ST's premises or any other relevant parties of any further corrective and/or preventive actions.

HS Manager shall provide training in investigation methods and techniques to employees and contractors as needed.

HS Manager shall retain copies of Incident Notification Forms, Incident Investigation Reports and keep an up-to-date log of incident/ accidents (including near-misses) for each relevant ST's Premises. HS Manager shall report on incidents/ accidents (including near-misses, corrective actions taken and related training programme) to the HSSE Committee on a monthly basis.

HS Manager shall support HSSE Head in gathering information for reporting incidents or accidents to the relevant authorities as per the relevant requirements and calendar and in particular, incidents or accidents involving 'Occupational Diseases' as listed under the Myanmar Factories Act 1951 to the Labour Department.

4.5 **Environmental Manager**

Environmental Manager shall provide adequate support to HS Manager in the reporting and investigation of environmental incidents (including near-misses) and in the implementation of corrective and/or preventive actions.

4.6 **Social Manager**

Social Manager shall provide adequate support to HS Manager in the reporting and investigation of incidents (including near-misses) and in the implementation of corrective and/or preventive actions.

4.7 **Managers and Executives**

Managers and Executives, when Line Manager of a Finder/ Witness/ Reporter, shall participate in the incident notification, reporting and investigation process for incidents/ accidents/near-misses involving their workers, contractors and activities. The Managers and Executives shall enable and regularly check that the incidents/ accidents/ near-misses are investigated and corrective and/or preventive actions taken.

Managers and Executives shall support the HS Manager in communicating on and implementing relevant incident/ accident/near-miss corrective and/or preventive actions.

4.8 **Finder/ Witness/ Reporter**

The Finder may include the person(s) directly affected by or the subject of an incident/ accident/ near-miss.

Finder/ Witness/ Reporter is responsible for notifying any incident, accident or near-miss immediately by verbal or written means to his/her Line Manager or the Medical team.

During the incident/ accident/ near-miss investigation, the Finder/ Witness/ Reporter shall reveal any information required, attend interview sessions and provide his/her statement on the incident/ accident/ near-miss as required.

4.9 **Line Managers**

Relevant Line Manager (as a Manager or Executive) shall be notified by Finder/ Witness/ Reporter of the incident and shall immediately, and in any case within 24 hours, notify the HS Manager.

During the incident/ accident/ near-miss investigation, the relevant Line Managers shall provide supporting information as required, attend relevant interview sessions and provide his/her statement on the incident/ accident/ near-miss as required.

4.10 **HSSE Committee**

/Head of Concrete Business, /Head of Concrete BusinessThe HSSE Committee shall follow up, enable and check during the monthly HSSE Committee meetings that the Incident Reporting and Investigation Procedure is followed for any incident/ accident/ near-miss that occurs or may have occurred, and that corrective and/or preventive actions are taken, as updated by the HS Manager.

The HSSE Committee shall also monitor the implementation and effectiveness of the corrective and preventive actions during its monthly meetings.

4.11 **Medical Team**

Medical Team (on-duty on-site doctor and nurse) is responsible for providing medical treatment to the injured person.

Medical Team is responsible for preparing a medical report in a timely manner (to be included in the Incident Notification Form).

On-duty Medical Team representative holds authority to classify injury (Injury Classification) as First Aid Case (FAC), Medical Treatment Case (MTC), Restricted Work Transfer Case (RWTC) or Lost Time Injury (LTI, including Fatality).

4.12 **First Aider**

First Aider is responsible for providing the immediate first aid treatment to the injured person at the scene of the incident until the Medical Team arrives.

4.13 **Maintenance Team**

Maintenance Team is responsible for assessing and recording incidents affecting material, equipment or property (Material Damage) in the Material Damage Form and for repairing any Material Damage.

4.14 **EPC Contractor and other Contractors (or Contractors)**

STC's EPC Contractor and ST's other Contractors, and their sub-contractors, are responsible for ensuring this Procedure and its requirements are communicated to their staff and for ensuring their staff follow them as relevant.

For instance, where relevant, ST shall communicate and work with its EPC Contractor or other Contractors to ensure all accidents, incidents or near misses that occurred or may have occurred at ST's premises and during works performed for ST are reported and investigated in accordance with this procedure and that relevant corrective and/or preventive actions are implemented.

4.15 All Persons

All persons employed by ST, directly or indirectly, have a responsibility to be familiar with and follow the requirements of this Procedure.

4.16 Audit Function Unit

ST's audit function unit, under ST's CEO, is responsible for, on a regular basis, auditing that this document is implemented and for providing post-audit recommendations to be communicated to the HSSE Committee.

5 Process

5.1 Incident Reporting Procedure

To maintain a responsible corporate culture, ST's employees, contractors and visitors to ST's premises are encouraged and empowered to take immediate action when observing work-related hazards, unsafe acts or conditions and to prevent the recurrence of incidents/ accidents/ near-misses.

5.1.1 Notification

Finder/ Witness/ Reporter shall notify every incident/ accident/ near-miss occurring at the workplace by the quickest available media channel (verbal or written) to the relevant Line Manager, First Aider or member of the Medical Team.

The First Aider and/or Medical Team shall, where applicable, attend to the injured person as per the Emergency Response Plan. The Finder may include the person(s) directly affected by or the subject of an incident/ accident/ near-miss.

The Line Manager shall notify the incident/ accident/ near-miss to the HS Manager immediately and in any event within 24 hours, using the Incident Notification Form.

5.1.2 Incident Form

The Line Manager shall use the Incident Notification Form and fill in the following information:

- Name (or description) and number of involved employees, contractors, visitors to ST's premises and their respective organisational entities;
- Location of incident;
- Date and time of incident;
- Name of other witnesses;
- Brief descriptions of the incident/ accident.

The HS Manager shall check the Incident Notification Form and support the Line Manager in filling the information in the Incident Notification Form, as deemed necessary.

The completed Incident Notification Form shall be kept and classified by the HS Manager as per the relevant 'documentation and control' procedure.

5.1.3 Incident Reporting for Contractors

ST's Contractors shall implement ST's Incident Reporting and Investigation Procedure when working with ST.

Contractor shall submit a copy of an Incident Notification Form for any incident (including near-miss) that occur or may have occurred to the HS Manager, such submission to be done within specific time described as per this procedure.

5.2 Incident Investigation Procedure

5.2.1 Incident Investigation

The HS Manager shall conduct the incident investigation as soon as possible, and in any case within the specific time described as per this procedure, to (i) help secure the incident/ accident scene to preserve evidence, (ii) interview the Finder/ Witness/ Reporter and any other witnesses and (iii) complete the Incident Investigation Report. The Finder may include the person(s) directly affected by or the subject of an incident/ accident/ near-miss.

The HS Manager shall perform the incident investigation by collecting, at minima, the following information and gathering it in an Incident Investigation Report:

a. Comprehensive documentation and pictures of the scene;
b. Interview of victims and witnesses and/or Finder/ Witness/ Reporter's statements and documents;
c. Medical Incident/ Accident Report Form filled in by the First Aider / the Medical Team and or the Material Damage Report Form filled in by the Maintenance Team;
d. Completed Incident Notification Form;
e. Classification of the incident/ accident according to its severity.

The HS Manager shall execute the incident/ accident/ near-miss investigation by compiling an Incident Investigation Report according to ST's relevant Form. All Persons whom are relevant to the incident/ accident/ near-miss investigation (Finder/ Witness/ Reporter, relevant Line Managers, Medical Team, other relevant ST employees and/or Contractor's employees) shall support the HS Manager in compiling the Incident Investigation Report. HS Manager will lead the review of the relevant documents and reports, interviews of witnesses and involved parties and determination of:

a. Whether all risks had been identified and whether all mitigation measures had been implemented: what were the relevant risk assessments;
b. Whether the working party and the supervisory party had been informed about the risks and control measures;
c. Whether any authorisations were given and if yes which ones e.g. Permit to Work;
d. Whether any procedure was used (e.g. HSE, technical) and if yes which ones, whether such procedures were followed correctly, whether such procedures were incomplete;
e. What was the supervision process;
f. Whether any tools or equipment were used and if yes which ones;
g. What were the environmental conditions e.g. lightning, temperature;

h. Whether relevant job/ work related training had been provided to the injured person(s), including induction training, and if yes which ones;

i. Any other relevant information.

The Incident Investigation Report shall contain the above findings and the supporting documentation.

5.2.2 Reporting Timeframe

The Incident Investigation Report shall be issued as per the following *Table 1*:

Table 1 Time of Issue of Incident Investigation Report

Occurrence	Time
Fatality (or more than one person injured by the same incident)	Where a person, as a result of an accident arising out of, or in connection with work, dies, the HS Manager, the relevant Line Manager(s), the Plant Operations Manager and Head of Business shall be informed immediately and Incident Investigation Report completed within 2 working days after the incident/ accident happened
Lost Time Incident/ Accident	Within 2 working days after the incident/ accident happened
FAC, MTC, RWTC	Within 5 working days after the incident/ accident happened
Material (equipment, property) Damage, environmental incident/ accident	Within 5 working days after the incident/ accident happened
Minor Accident/Incident, Near Misses	Within 15 working days after the incident/ accident/ near-miss happened
Closing of Incident/ Accident Investigation Report	After implementation of all improvement actions

Incident Investigation Reports related to most signification incidents, accidents or near-misses that could impact ST's operations should be forwarded to the Head of Business for information.

Incidents and accidents affecting non-ST parties shall be reported, at minima, in compliance with applicable legislation in Myanmar and, where applicable, with insurance company requirements.

Confidentiality shall be applied. The names of injured person(s), any supervisor(s) or witness(es) shall only be included in the copy kept on site or where required by the applicable legislation. All other reports to be distributed to external parties shall be without any name.

5.2.3 Reporting Occupational Disease

Incidents or accidents involving Occupational Diseases listed under Myanmar Factories Act 1951 shall be reported to the Labour Department as required. HSSE Head is responsible for such reporting. HS Manager shall support HSSE Head in gathering information for such reporting.

5.2.4 Incident Investigation for Contractors

ST's contractors should implement this procedure for investigating incident, accident or near-miss where such incident or accident involves or could have involved any employees, workers or visitors of contractors and/or their sub-contractors working at ST's premises. Investigation of major accidents, fatalities and incidents/accidents reportable to the authorities shall involve ST personnel (including the HS manager and Managers and Executives of the departments involved).

A copy of the final Incident Investigation Report should be provided to the HS Manager within the specific time described as per this procedure.

5.2.5 Incident Investigation Attachments

The incident/ accident relevant documents to be kept as attachments for incident/ accident/ near-miss reporting and investigation purposes shall include, without being limited to, the following (as relevant):

- Photos;
- Statements;
- Interview witnesses (scripts);
- Site maps;
- Relative positions;
- Examination of equipment & machinery;
- Failed parts;
- Examination of materials;
- Examination of records.

5.3 Corrective and Preventive Action

To prevent the incident/ accident/ near-miss occurring again, the relevant departments / work areas should take and implement corrective and preventive actions. Improvements in the operating procedures shall be identified in the Incident Investigation Report and implemented under the supervision of the relevant Line Managers.

The suggested improvements shall be reviewed at the following HSSE Committee monthly meeting to determine whether any, and if so which, additional corrective and/or preventive actions are recommended. The findings of incident investigation processes and of any recommendations shall be communicated to all employees.

5.4 Training

HS Manager shall ensure All Persons working at ST's premises or carrying out ST's activities are familiar with this procedure through including a related session within the induction training, ongoing/ ad-hoc training during meetings with Contractors.

Hard copies of this procedure shall also be kept available in conveniently located ST's rooms, such as within the HR Department or at the nursing station for employees' perusal.

6 Audit and Review Policy

This Procedure will be reviewed annually by the HSSE Committee to ascertain the progress it has made in achieving the set aim and on an ad-hoc basis by ST's Audit Function Unit.

Any significant changes made to the procedure will be announced to all staff, and training provided to ensure relevant staff are made aware of updates.

7 Record Control Table

Doc; ID	Document Title	Storage	File Name	Retention
HSE-FOM-001-000-001	Incident Notification Form	HSE		Minimum 3 yrs
HSE-FOM-001-000-002	Incident Investigation Report	HSE		Minimum 3 yrs
HSE-FOM-001-000-003	Incident Record Form	HSE		Minimum 3 yrs

8 Related Documents and References

8.1 External Document

8.1.1 OHSAS 18001:2007

8.2 Internal documents

8.2.1 Communication, Participation and Consultation Procedure
8.2.2 [Incoming and Outgoing Document Procedure]
8.2.3 [Legal Compliance Procedure]
8.2.4 Emergency Response Procedure
8.2.5 Storage and Handling of Hazardous Materials
8.2.6 Waste Management Procedure
8.2.7 Incident Notification Form (HSE-FOM-001-000-001)
8.2.8 Incident Investigation Report (HSE-FOM-001-000-002)
8.2.9 Incident Record Form (HSE-FOM-001-000-003)
8.2.10 Material Damage Form

8.3 Attachments

8.3.1 Incident Notification Form (HSE-FOM-001-000-001)
8.3.2 Incident Investigation Report (HSE-FOM-001-000-002)
8.3.3 Incident Record Form (HSE-FOM-001-000-003)
8.3.4 Occupational Diseases List

Attachment A - Incident Notification Form (HSE-FOM-001-000-001)

Attachment B - Incident Investigation Report (HSE-FOM-001-000-002)

Attachment C - Incident Record Form (HSE-FOM-001-000-003)

Attachment D - Occupational Diseases List

The Occupational Diseases listed below are, under Myanmar Factories Act 1951, required to be reported to the authorities.

Incident Report Type	Incident Type	Incident Agent	Injury Type	Occupational Disease (Myanmar)
Near Miss	--	Animals, Plants and Insects	Amputations	Anthrax
Injury or Damage	Caught In Between Objects	Dust, Gas, Liquid and Chemicals	Asphyxia or Drowning	Lead poisoning or its sequelae
Dangerous Occurrence	Cut or Stabbed by Objects	Electrical Equipment	Bites and Stings	Mercury poisoning or its sequelae
Occupational Disease	Exposure to Electric Current	Electrical Installation	Blindness	Phosphorus poisoning or its sequelae
	Exposure to Extreme Temperature	Explosives or Flammable Substances	Burns	Arsenic poisoning or its sequelae
	Fall From Heights	Goods/ Cargo	Burns or Hypothermia with more than 20 MC days	Poisoning by bezene and its homologues or the sequelae of such poisoning
	Fire and Explosion	Industrial Machine	Concussion	Poisoning by nitro and amido deriatives of bezene and its homologuea (trinitrotoluene, anillin and others) or the sequelae
	Over-exertion and Strenuous Movements	Lifting Appliances or Gears	Concussion with more than 20 MC days	Poisoning by nitrous fumes or its sequelae
	Property Damage	Lifting Equipment - Cranes	Crushing Fractures and Dislocations	Dope poisoning (by any substance used as or in conjunction with a solvent for acetate of cellulose) or its sequelae
	Slips Trips and Falls	Lifting Equipment - Lifts & Hoists	Cuts and Bruises	Poisoning by carbon bisalphide or its sequelae
	Strike against Objects	Lifting Equipment - Mobile Work Platform	Multiple Injuries	Poisoning by nickel carbonyl or itse sequelae
	Struck By Falling Objects	Lifting Equipment - Other	Paralysis	Epitheliomatous cancer or ulceration of the skin due to tar, pitch, bitumen, mineral oil or parafin, or any compund, product or resideu of any of those substances
	Struck by Moving Objects	Lifting Equipment - Piling Machines	Puncture Wound	Ulceration of the corneal surface of the eye due to tar, pitch, bitumen, mineral oil or parafin, or any compund, product or resideu of any of those substances
	Work-related Traffic Incidents	Means of Access - Gangway	Sprains and Strains	Chrome ulceration or its sequelae

	Collapse/Failure of Structure & Equipment	Means of Access - Ladders	Others	Compressed air illness or its sequelae
	Collapse of Formwork/ Failure of its Supports	Means of Access - Others		Cataract caused by exposure to rays from molten or red-hot metal
	Collapse/Failure of Structure & Equipment	Means of Access - Scaffold		Subcutaneous cellulitis of the hand (beat hand)
		Means of Access - Stairs or Steps		Subcutaneous cellulitis or acute bursitis over the elbow (beat elbow)
		Metal Items excluding knives and needles		Inflammation of the sinovial lining of the wrist joint and tendon sheaths
		Physical Workplace - Floor or Level Surfaces		Glanders
		Physical Workplace - Formwork		Telegraphist's cramp
		Physical Workplace - Roof		Dermatitis produced by dust or liquids
		Physical Workplace - Structures		Ulceration of the skin produced by dust or liquids
		Pressurised Equipment - Pressurised Piping or Accessories		Ulceration of the mucous membrane of the nose or mouth produced by dust
		Vehicles - Bus, Car, Motorcycles		Writer's cramp
		Vehicles - Excavator, Forklift, Lorry, Truck, Prime Mover		Twister's cramp caused by twisting of cotton or woolen (including worsted) yarns
		Other Incident Agents		Inflammation, ulceration, malignant disease of the skin and subcutaneous tissues, due to exposure to X-Rays or radio-active substances

Annex S
Occupational Health and Safety Plan;

1) Purpose

The purpose of a Health and Safety Management System (HSMS) is to provide a structured approach towards achieving health and safety goal as outlines in Shwe Taung Building Materials (STBM) Occupational Health and Safety Policy.

This procedure specifies the requirements to enable STBM to provide safe and healthy working conditions for the prevention of injuries and illnesses and proactively improve their health and safety performance.

All STBM business unit must develop, implement and continually improve their own HSMS, including associated processes and their interactions, in accordance with the requirements of this procedure and any other legal requirement applicable to the Country or other requirements to which the Country subscribes.

2) Scope

This procedure applies to all STBM businesses and joint ventures when STBM is either the majority shareholder or the managing partner. The procedure covers all individuals whom is under STBM management control (i.e., employees, contractors & sub-contractors, contracted transporters, suppliers and visitors at STBM sites)

3) Definition

Accountability - a person is accountable to a person of higher authority for task areas which have been delegated to them. Accountability follows lines of command and reporting relationships within the organizational hierarchy

Competent - ability to apply knowledge and skills to achieve intended results

Contractor - a person or company engaged to carry out work for and on behalf of STBM, whether inside STBM premises or pertaining to its vehicles or properties and / or engaged in the delivery of STBM's products

Corrective action - actions to eliminate the cause/s of a non-conformity or an incident and to prevent reoccurrence action to eliminate the cause/s of a non-conformity or an incident and to prevent reoccurrence

Head of Business - Person-in-charge of each Business Unit under STBM (HT Precast, HTC, STC, STM)

Hierarchy of Controls - the following hierarchy of control must be used in the development and applications of controls

i. Elimination of the hazard
ii. Substitution of less hazardous materials, processes, operation or equipment
iii. Engineering and processes controls

iv. Warning/Signage, administrative controls and management strategies
v. The use of Personal Protective Equipment (PPE)

HSIP	- Health and Safety Improvement Plan
HSMS	- Health and Safety Management System
OHS Manager	- Plant or Site Health and Safety Manager or person-in-charge of Health and Safety matters
Plant Manager	- Person-in-charge of the operations for each Business Unit
STBM	- Shwe Taung Building Materials Business Sector
STC	- Shwe Taung Cement Co., Ltd.
STM	- Shwe Taung Mining Co., Ltd.
HTC	- High Tech Concrete Co., Ltd.
HTP	- High Tech Precast Co., Ltd.
HS	- Plant or Site Health and Safety Department
RCA	- Root Cause Analysis. A method to identify the root cause of the incident
SOP	- Standard Operating Procedure

4) General Requirement

4.1 Leadership and Engagement

4.1.1 Policy and Rules STBM

Health and Safety Policy and Rules articulate senior management's expectations and commitment to health and safety, providing a visible direction for the entire organization and must be displayed at all Business Unit. The health and safety rules apply to everyone and are non-negotiable.

4.1.2 Roles, responsibilities and accountabilities

Roles and responsibilities must be clearly defined and communicated at all levels of the organization. The assignment of roles and responsibilities must be reviewed periodically and updated as required. Health and safety responsibilities must be included in all job descriptions.

4.1.3 Leadership, annual objectives and budgeting

All STBM, employees in leadership roles (e.g. Management Committee, Country CEO, Head of Business Unit, Plant Managers, Head of Department) are responsible for maintaining a robust health and safety culture. Fundamental to this is making health and safety as a first priority, including health and safety in their annual objectives, budgets and routine staff meetings and taking the lead in promoting health and safety and conducting health and safety management reviews.

4.1.4 Line management and employees

Line management is responsible for all health and safety implementation, communication and compliance in their respective areas.

Employees at every level of the organization must assume responsibility for those aspects of HSMS over which they have control, including reasonable responsibility for their own health and safety and that of others. All levels of management must hold their direct reports (N-1s) accountable for health and safety performance.

4.2 **Health and safety organization**

A specific health and safety organization must be defined and implemented throughout STBM down to site level to ensure that the line management is adequately supported, guided, coached and challenged. STMB Head of Health and Safety must report to the STBM CEO and be part of the country leadership team. STBM and all its Business Unit should have a sufficient number of health and safety professionals with adequate background, training, capabilities and authority to implement their responsibilities.

4.3 **Rewards, recognition and consequence management**

Managers' and employees' health and safety performance and behavior must be taken into consideration during the annual performance appraisal process as well as for career progression. STBM and all its Business Unit must have a program for recognizing exemplary health and safety performance. STBM and all its Business Unit must have a Consequence Management program in place, aligned with the Group Consequence Management process, for managing breaches of health and safety Policy and Rules.

5) Objective and Planning

5.1 **Health and Safety Ambition**

STBM's Health and Safety Ambitions are defined by the Management Committee.

All Business Unit must develop their health and safety programs to align with the STBM ambitions and achieve the desired outcomes using the Health and Safety Improvement Plan (HSIP) process

5.2 **Health and Safety Improvement Plan**

All Business Units will develop an annual HSIP following STBM HSIP process:

A. Discovery and budget
B. Planning process (country level)
C. Planning process (unit level)
D. Mid-year review
E. Year-end review

Plans will be set for both routine and strategic objectives at STBM and Business Unit level. All Business Unit strategic plans will be tracked at Country level and be reviewed by quarterly.

6) Operation and Support processes

6.1 Competent people

All Business Unit must ensure that employees and contractors are competent to satisfy the requirements of their roles and responsibilities on the basis of appropriate ability, knowledge and skills gained through education, training, qualification and/or experience. The recruitment of new employees or promotion of existing employees and the engagement of contractors must include a documented assessment of the health and safety competencies, needed to fulfill the role for which they are being selected or promoted to.

6.1.1 Training

STBM and all its Business Unit must have a training plan detailing the requirements for health and safety training and how they will be met. The course content for managers, supervisors, members of the health and safety function, and shop floor levels must consider local and legal requirements as well as individual development needs. A tracking system must be in place to ensure that training is completed according to the requirements in the training plan

- All employees and contractors must be trained to work safely and manage health and safety in their areas.
- All new employees and contractors must undertake induction, awareness and training, which must include an assessment mechanism to confirm understanding and knowledge retention. Initial training must include an orientation of the site, as well as general and job-specific training. Training must be also conducted when employees or contractors transfer to new roles or when an operating process change.
- Refresher training must be performed periodically as legally required or as a result of assessment activities, audits and incidents or in response to any significant changes.
- Management training must include the leadership aspects of health and safety.
- Supervisors training must include the leadership aspects of health and safety as well as specific training on STBM health and safety procedures and practices
- For the health and safety function, competencies must include technical expertise, managerial and leadership skills, and change management abilities (coaching, communication skills, etc)
- Visitors must be provided with induction training commensurate with site risks to which they might be exposed.

6.1.2 Authorization

All Business Unit must have a system to identify those tasks that require specific authorization and track which employees and/or contractors are authorized to perform those tasks.

7) Communication, consultation and empowerment

STBM and all its Business Unit must communicate openly with all stakeholders on relevant health and safety issues. Employee participation in health and safety activities must be encouraged and promoted at all levels of the organization. Participation in such activities must be taken into consideration when setting annual personal objectives and as part of the performance appraisal process.

7.1 **Employee ability to stop unsafe work**

All employees must have the authority to stop a task which they deemed is unsafe or unhealthy and be empowered to take the necessary means to correct the situation. Moreover, when confronted with an unsafe or unhealthy work condition, employees must take reasonable immediate and corrective action to address the condition. As a minimum, the employee must inform the person in charge of the area and that person must take actions to mitigate the situation.

7.2 **Communication**

STBM and all it Business Unit must implement a communication system that facilitates top-down and bottom-up communication through appropriate media and tools. Specifically, countries/units must ensure that relevant health and safety information, including health and safety results, fatalities and critical incidents notifications good practices and key lessons, is shared and discussed.

7.3 **Grievance and Conflict Resolution**

All Business Unit must implement grievance and conflict resolution mechanisms that allow employees and contractors and external stakeholders to directly or anonymously raise issues or make complaints with respect to health and safety performance and management.

8) Risk Management

8.1 Risk assessments which are appropriate to the nature and stage of all activities must be systematically conducted in consultation with stakeholders. All reasonably foreseeable hazards and associated risks must be eliminated or reduced to a level of risk that is acceptable before starting any task. Specifically, risk assessments shall be undertaken for:

- All high-risk activities
- All hands-on work where risks are not already controlled through procedures or work instructions. Appropriate risk controls must be developed according to the “hierarchy of controls” and be prioritized, applied and maintained.

8.2 Standard Operating Procedures (SOPs) must be developed, implemented and maintained for repetitive tasks, especially critical ones (e.g., hot work, confined space entry, working at height, etc.). Tasks without SOPs shall have a task risk assessment conducted prior to work starting.

8.3 Contractor Management

All Business Unit must have management processes to select and engage suppliers and contractors so that they are able to identify, prevent and manage health and risks in their supply chains. This shall include processes for prequalification, communication and training in STBM health and safety requirements and for monitoring and improvement of each contractors' health and safety performance. These management processes must be aligned with the requirements set in the STBM Code of Business Conduct and related policies as well as with applicable local and national laws and regulations.

8.4 **Occupational Health Management**

8.4.1 Medical Monitoring

All countries/units must have a risk based medical monitoring that includes pre-employment, periodic screening and post-employment medical exams.

8.4.2 Fitness for Work

Fitness-for-work management processes must be established, including rehabilitation for injured employees and, where appropriate, contractors.

8.4.3 Industrial Hygiene Monitoring

All Business Units must have a risk based annual industrial hygiene plan that should be incorporated into the routine HSIP. The plan must be followed and completed each year. The plan must cover high-risk materials and be focused on personal monitoring. Any exposures that exceed the ACGIH-TLVs or the local regulatory limits must be addressed through the hierarchy of controls. Annual IH studies should be incorporated into the discovery and budget phase of the HSIP for review when preparing the strategic plan.

8.5 **Hazard Communication**

Management is responsible for ensuring and verifying that employees and contractors are trained and understand the health and safety hazards associated with their work and the control measures that must be applied. Relevant health and safety hazard information must be disseminated from Safety Data Sheets following risk assessment of the substances and its use in the work environment. Information must be readily accessible to employees and contractors at all times and communicated to employees, contractors, and visitors, as appropriate.

8.6 **Management of Change (MOC)**

A documented review (management of change) process must be established for temporary or permanent changes such as changes in equipment, operation, etc that have the potential to alter existing, or introduce new, health and safety risks. These reviews should be conducted and any compliance/conformance issues addressed prior

to initiation of the change (i.e. during design, pre-start-up, commissioning). A process of sign off confirming that all health and safety issues identified were addressed must be part of the overall Management of Change process. A completed MOC document must be submitted with all CAPEX budget requirements.

8.7 **Emergency Preparedness**

All Business Units must ensure that procedures and resources are in place to ensure that in the event of an incident our people, the public, the environment, our assets and our reputation are protected from harm.

8.7.1 Emergency Plan

Emergency plans must include the different foreseeable emergency scenarios as well as a medical emergency response plan. The essential requirements are:

I. Emergency plans that are risk-based and take into account:
- Hazards inherent to our processes, stored energy and materials
- External hazards from surrounding industrial processes and material transported by road, rail and sea
- Geographic location which can potentially expose a site to natural disasters, civil unrest and insurgency
- Availability, effectiveness and accessibility of external support or partners, e.g. local authorities, medical facilities, other businesses, Non-Governmental Organizations.

II. Plans that address:
- The health and safety aspects of any emergency response.
- The response strategies for handling all potential emergencies including medical emergencies.
- The internal organization, responsibilities and external stakeholders required to manage different emergency scenarios.
- The business continuity plan in case the emergency escalates into a crisis.

III. An identified and designated authority responsible for ensuring that:
- Effective plans are in place and clearly communicated to all stakeholders, especially when changes are made.
- Competent response teams, internal and external, are established.
- Appropriate equipment and facilities are available to support the emergency response, and are compatible with external necessary resources.
- Plans are reviewed regularly, to validate and strengthen their robustness, and that lessons learnt from drills and the root cause analysis of incidents are incorporated.

IV. A communication system is in place to ensure that:

- There are agreed protocols for information exchange with all stakeholders.
- Relevant personnel receive appropriate media training.
- All stakeholders are aware of how to respond in case of emergency.

V. Regular drills are conducted (annually as a minimum), using a variety of scenarios that reflect the main

8.7.2 First Aid and Medical Facilities

All Business Unit should ensure, as appropriate, that:

- First aid and medical facilities and equipment capable of serving all personnel and all identified potential first aid and medical emergency scenarios are available, internally or externally.
- When the medical facilities are managed internally, suitably qualified personnel must be employed at the worksite to maintain and efficiently operate the medical service. Specific procedures must be defined to manage the purchasing, deployment, maintenance, repair and disposal of medical equipment.

8.8 **Documentation and Record Keeping**

All Business Unit must establish a process for creating, distributing, controlling and managing documents and records prepared in support of HSMS requirements. The documents and records must comply with legal requirements relating to data protection, medical confidentiality and document retention. The documentation management process must ensure that:

- Health and safety documents are approved prior to use, when created or update.
- The latest versions of applicable documents are available at points of us.
- Documents remain legible and readily identifiable.
- Documents of external origin determined by the organization to be necessary for the planning and operation of the HSMS are identified and their distribution controlled.
- Health and safety documentation is effectively and systematically stored.
- Obsolete documents are promptly removed from use to prevent their unintended use and that suitable identification is applied to them if they are retained for other purposes.
- A system exists for communicating changes in documentation to those people on whom the document impacts.

9) Performance Evaluation

9.1 Audit and Performance Monitoring STBM and all its Business Unit Health and Safety conducts audits at planned intervals to assess whether the unit's HSMS conforms to the requirements of this HSMS standard and other Group health and safety standards. Each

audit shall follow a set protocol and schedule. Non-conformities are reported to unit and country management, who are then accountable for devising an action plan that addresses those non-conformities in a timely manner, as part of their HSIP. Countries must ensure each unit has their health and safety audit process and conducts a health and safety self-assessment every year following the Group Health and Safety audit protocol and any additional local regulatory requirements. In addition to health and safety audits, STBM Health and Safety will maintain a procedure to monitor and measure health and safety performance by using a STBM Health and Safety Scorecard that will track the extent to which health and safety objectives are met based on a combination of leading and lagging indicators.

9.2 Incidents Reporting, Investigation and Corrective Actions All incidents must be reported and learnings shared at an appropriate management level. All Business Unit must conduct incident investigations to determine immediate and root causes, including contributing factors such as management and system deficiencies, and develop remedial actions for preventing the same or similar events occurring in the future. Records of investigations must be kept. STBM Health and Safety must distribute the lessons learned from fatalities and critical incidents as appropriate. For events where the lessons learned are applicable to all Business Unit, a Key Lesson Learn will be issued, including mandatory actions and timelines for implementation. All Business Unit must maintain a corrective and preventive action system to establish lessons learned from incidents, including those distributed by STBM Health and Safety, and correct identified deficiencies and implement any identified opportunities for improvement. The corrective and preventive action system must address any event or condition that has the potential to cause damage or loss.

10) Management Review

Health and safety management reviews must be conducted at least on an annual basis at Business Unit. Reviews must follow a formal documented process and must be led by a senior leadership team member at country level and, where appropriate, other levels of the organization. The purpose of these reviews is to:

- Review health and safety performance and identify any changes to health and safety risks, legal requirements and other obligations, practices, organizational circumstances, external context, etc., that may have occurred since the previous year's review.
- Determine the continued suitability, adequacy and effectiveness of health and safety policy, objectives, plans, systems, programs and processes.
- Evaluate any need for change and establish actions to improve the system, its processes and resources needs with the aim of driving continual improvement.

11) Training

All STBM people who are responsible for HSMS activities should be trained according to STBM Health and Safety training requirement and Myanmar Occupational Safety and Health law.

12) Record

All records related to HSMS activities should be maintained on site for a minimum of two years or longer if required by local law or regulation

Annex T
Community Health and Safety Plan

SHWE TAUNG
CEMENT CO.,LTD.

SHWE TUANG CEMENT CO., LTD

COMMUNITY HEALTH PROGRAM

Change History		
Rev #	**Description of Change**	**Paragraph**
00	Initial Release	All

Prepared by		
Name	**Designation**	**Signature**
U Aung Khaing Nyi	Head of HSSE	
Verified by		
Name	**Designation**	**Signature**
U Kyaw Naing Soe	Head of Cement Business	
Approved by		
Name	**Designation**	**Signature**
U Aung Zaw Naing	Shwe Taung Building Materials CEO	

Table of Contents

1. INTRODUCTION

Myanmar is facing large cement shortages and high demand to import. There are new cement plants which are being built in various part of the country to meet local demand. They are the activities which are a component of the umbrella under the Myanmar Ceramic Industries of Ministry of Industry. Shwe Taung Cement Co., Ltd. is one of the cement plant projects, which daily production capacity is 1500 Tons of medium production in Myanmar and situated between Ku Byin (56 households) located some 3 km north of the plant, and Pyi Nyaung village (535 households) which is located approximately 7 km south of the site, in Thazi Township.

STC operate a coal mine located in Sagaing region in western Myanmar, about 150 km from the plant site which supplies coal to the cement plant, its sole customer for coal. The coal mine covers an area of some 1,376 hectares and is 15 km in length and 900 meters wide. The villages of Paluzawa (59 households), Chaungzon (19 households) and Nanmawke (14 households) are located 5 km to the west of the mine and are the only communities located in proximity to the facility. Coal extraction is via the open cast method with annual production currently at some 60,000 tons per annum and this will increase to 150,000 tons once the expansion is complete. Coal from the mine is transported via a 5 km road and then stored at a staging area located adjacent to the Chindwin River. From this point the coal is transported via barge to Mandalay and then by road to the plant which is some 220 km. The coal mine only operates during the dry season for up to 6 months and stockpiles coal for the remaining time of the year as used at the cement plant. There is a base camp situated near the Paluzawa village.

The project is defined as a category A project according to IFC's Policy on Environmental and Social Sustainability as it has the potential for significant adverse environmental impacts. STC is committed to compliance with IFC's requirements and commissioned an international consultancy to undertake an assessment of E&S issues aligned with the Performance Standards and develop associated management plans for the project's construction and operational phase. As part of the several management plans have been developed to address impacts identified in the ESIA and are implemented as part of an environmental management system for the Shwe Taung Cement Co., Ltd. Several activities associated with the Project may impact upon the health safety and security of the local community.

2. PURPOSE

The purpose of this Community Health Program (CHP) is to provide a clear set of actions and responsibilities for the control of impacts affecting the health of the communities within the Project's area of influence.

The CHP includes measures to respond to the following potential impacts identified in the ESIA:

- Changes to community health profile including exposure to disease, changes in availability and quality of water resources and food insecurity and nutritional status;
- Changes to community health and wellbeing including changes to social and cultural cohesion; and
- Changes to community health profile related to traffic, emergency responses, unplanned events, crime and conflict.

This Community Health Program (CHP) has been compiled to address the specific impacts that are anticipated to occur as a result of planned mining developments and cement production. This program sets out a formal system by which Shwe Taung Cement Co., Ltd. can manage and implement mitigation measures that will avoid or reduce the significance of impacts related to community health by raising local awareness on health issues and providing health checkup programs, etc.

This CHP is considered to be a 'live' document and will need to be amended periodically in light of operational changes and learnings experienced during its implementation.

The CHP also provides a mechanism for assessing the STC EHSS performance and for maintaining records of any changes in the scope of the Project. It aims to record data that is required for inclusion in the STC Annual Monitoring Report (AMR) and the future Shwe Taung Cement Sustainability Report, prepared annually regarding progress and performance.

3. CHP OBJECTIVES AND KEY PERFORMANCE INDICATORS

Community health is defined as environmental, social and economic resources to sustain emotional and physical wellbeing among people in ways that advance their aspirations and satisfy their needs in their unique environment.

The responsibility of our CHP is to provide the affecting communities to sustain emotional and physical wellbeing to satisfy their needs in their unique environment. The objectives of CHP are as follows:

1. To prevent disease, promote health and prolong life within the projected area of influence
2. To encourage people to actively participate in their own healthcare and wellbeing

3. To work together with the primary healthcare providers from government, CSO, NGO, INGO and other social organizations to provide coordinated support

4. To improve the knowledge of traffic rules in the communities and reduce the rate of incident and accident especially among young people

5. To increase public awareness and understanding of the determinants of health and disease.

Key performance indicators (hereafter KPIs) are used to identify where our community healthcare and patient care services are enough, reliable and meeting our expected standards, and we can see our services should need further improvement or not from this KPIs.

KPIs cannot improve quality, however, they effectively act as flags or alerts to identify good practice, comparability within our services, where there are opportunities for improvement and where a more detailed investigation of standards is warranted. The ultimate goal of KPIs is to contribute to the provision of a high quality, safe and effective service that meets the needs of service users.

The following table shows the performance indicators of our community healthcare services.

Key Performance Indicators	**Description**
Number of times STC/ STM Medical Team visited villages per month	Measures the healthcare service is sufficient for each village.
Overall Patient Satisfaction	Survey the satisfaction of patients upon STC / STM healthcare service to evaluate the provided health care services around Cement Plant and Coal Mine operations.
Patient Care Hours per month	Records the amount of times to nearby villages.
Medicine and Medical Equipment Costs per month	Shows the amount that the company is spending on medicines and medical equipment costs used to treat patients.
Referrals per month	Shows number of patients that were referred to township/district public hospital or private hospital

Public Health Awareness Program per month	Shows on public awareness and understanding of the determinants of health and disease
WASH Program	Shows on Health Education (Water, Sanitation & Hygiene [WASH] in Schools & Community)

4. MANAGEMENT, LINKAGES AND LITERATURE REVIEW ON POLICY GUIDELINES

4.1 APPLICATION AND COMMENCEMENT

The requirements set out in this program apply to all STC operations including contractors. The Community Health Program (CHP) will be implemented at the construction phase and continue to the end of the Project life.

4.2 AUTHORITY AND MANAGEMENT

CEO of Shwe Taung Building Materials (STBM) has the authority to approve this Program.

Cement Business Head is the custodian of this Program. Any requests for changes to this CHP must be addressed to this person and will be subjected to the appropriate review and aproval processes as outlined in STBM procedures.

4.3 LINKAGE TO OTHER ENVIRONMENTAL AND SOCIAL PLANS

The CHP links with a number of other social and environmental management plans, the details of this link are described in *Table 1.1*.

Table 1.1 Details of Linkages between the CHP and Other Management Plans associated with the Shwe Taung Cement Plant

Management Plan	Overlap of this Plan with Content of Other Plans	Document
ENVIRONMENTAL PLANS		
Environmental Monitoring Plan (EMP)	Air quality has a direct consequence for human health. The Air Quality Monitoring Plan (AQMP), which is part of EMP, discusses the avoidance, mitigation and management measures required to protect human health.	https://drive.google.com/open?id=11V-hm0X5KgF8mYS0ogX8472cxkm5Iue-
Solid Waste Management Plan (SWMP)	Management of solid waste is directly related to community health and safety. The WMP includes measures related to management of hazardous materials and environmental and natural resources and	https://docs.google.com/document/d/1KTwSKQ8ar4_2L8HCM7-dscdZZhDv9LiRR8x6vKxrmq0/edit

	considers human health.	
Mine Closure Plan (IMCP)	Discusses measures related to the long-term health and safety related to closure planning.	https://drive.google.com/file/d/1SX5Cn1ZieMUPuA6QKIzeT5zI_2jKyXni/view
OCCUPATIONAL HEALTH, SAFETY AND RISK PLANS		
Emergency Response Plan (ERP)	The ERP outlines emergency response measures in the event of unplanned events occurring as a result of the Project. This includes stakeholder engagement during emergency events.	https://drive.google.com/file/d/16mqwP-otb1sna4CXtVItq5k_45XPiF4V/view
SOCIAL PLANS		
Stakeholders Engagement Plan (SEP)	The SEP discusses mitigation and management measures related to in-migration and the consequences for community health and safety.	https://drive.google.com/file/d/1-KEDR_Ch6sRHA5PJ9sSiG9wK4-6jwCCw/view

4.4 SUMMARY OF LEGAL AND OTHER REQUIREMENTS

A summary of the legal requirements and standards relevant to the CHP are presented below.

4.5 NATIONAL LEGISLATION AND POLICY

Under Section 7 of the Environmental Conservation Law and Articles 52 and 53 of the Environmental Conservation Rules of the Republic of the Union of Myanmar, STC is required to undertake an EIA to obtain an Environmental Compliance.

The Project would be undertaken in line with national regulation and international standards. Local laws relating to EIA include: Environmental Conservation Law (2012); Environmental Conservation Rules (2014); National Environmental Quality (Emission) Guidelines (2015); and the Environmental Impact Assessment (EIA) Procedure (2015).

With the release of the final Myanmar EIA Procedure in December 2015, the National Environmental Quality (Emissions) Guidelines were also released. These Guidelines provide the basis for regulation and control of noise and air emissions and effluent discharges from projects in order to prevent pollution and protect the environment and public health. These standards are equivalent to the World Bank Group General Environmental, Health and Safety (EHS) Guidelines (2007) and the EHS Guidelines for Cement and Lime Manufacturing (2007) and Mining (2007).

4.6 PUBLIC HEALTH LAW (1972) & ENVIRONMENTAL STANDARDS

4.6.1 Public Health Law (1972)

Purpose: to ensure the public health include not only employees but also resident people and cooperation with the authorized person or organization of health department. It is concerned with the protection of peoples' health by controlling the quality and cleanliness of food and to improve living standard of people while improving the health status of country.

4.6.2 Environmental Standards for Industrial Pollution Control in Myanmar

The Myanmar Government has developed Environmental Quality Standards (EQS) (2016), Environmental Impact Assessment Procedure (2015), Environmental Conservation Rules (2013) and Environmental Conservation Law (2012) for the purposes of preventing significant industrial pollution. The EQS standard present pollution limits for emissions to atmosphere and water resources and noise emissions that can affect the environment as well as community.

4.7 INTERNATIONAL LEGISLATION AND STANDARDS

IFC Performance Standards

This section sets out the relevant local policy, legal and institutional framework that the Project will follow, and that includes the following local regulations and international standards:

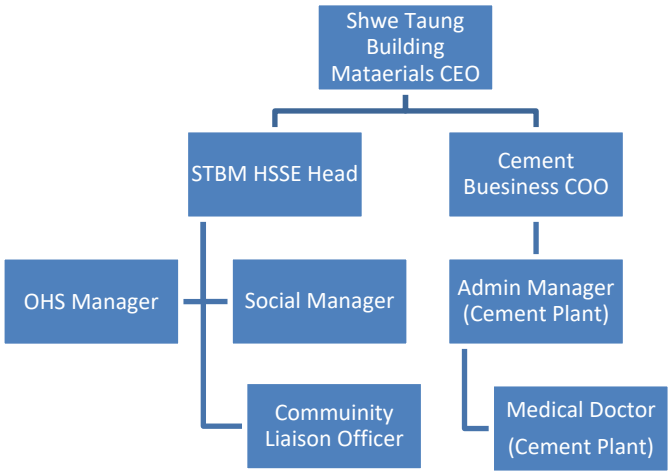
- IFC Performance Standards (IFC PS) (2012);
- World Bank Group (WBG) Environmental Health and Safety (EHS) General Guidelines (2007);
- EHS Guidelines for Cement and Lime Manufacturing (2007); and
- WBG EHS Guidelines for Mining (2007).

In addition to above standards, we will also engage with the securing the underlying determinants to health, including such issues as access to safe drinking water and sanitary, health-related information, environmental and occupational health.

5 OVERALL ACCOUNTABILITY AND RESPONSIBILITY FOR THIS PROGRAM

With respect to this CHP, STC has the responsibility to ensure that adequate measures are developed and implemented by parties, including third parties, to adhere to this CHP. Furthermore, STC and STM has the responsibility for ensuring that specific responsibilities allocated to them are organized and implemented. STC has the responsibility to ensure that their employees and contractors are trained and aware of all required Community Health and Safety procedures. The overall accountability and responsibility for implementing these mitigation and avoidance measures will lie with the Administrative and EHSS Departments; however, other functions will also be responsible for implementation of measures including the Occupational Health and Safety Manager, Security Manager and Human Resources (HR) functions.

5.1 THE OVERALL ACCOUNTABILITY AND RESPONSIBILITY FOR STC



5.1.1 CEO of Shwe Taung Building Materials (STBM)

The Shwe Taung Building Materials CEO shall be kept apprised of key developments this program.

5.1.2 Cement Business Chief Operation Officer (COO)

The Cement Business Chief Operation Officer (COO) shall be responsible for:

(a) overseeing the implementation of this CHP;

(b) providing enabling conditions (including required financial and manpower resources and full senior management support from the CEO and from STBM BOD)

5.1.3 HSSE Head

The HSSE Head is the person in charge of the HSSE Department and ensure that this CHP is implemented. The HSSE Head shall ensure that this CHP is implemented and shall also be responsible for identifying and logging gaps and H&S issues which need to be addressed before they become a significant risk to STC operations and for capturing and sharing lessons learned. The HSSE Head shall also ensure that the CHP aligns with the other plans and procedures developed by STBM, as well as aligns with WGB EHS Guidelines and Local regulations.

5.1.4 Social Manager

The Social Manager, reporting regularly to HSSE Head, shall support for the implementation of the CHP from Admin Manager of STC.

The Social Manager shall provide monthly reporting to the HSSE Head community health and safety matters and regularly checking monthly reporting information and statistics, submitted from Admin Managers of STC and STM, to ensure effective implementation of this CHP throughout STC operations

5.1.5 Admin Manager STC

The Admin Manager, reporting to Head of Cement Business, shall be responsible for monitoring the day-to-day implementation of the CHP is undertaken as required, such as support for procuring enough medicines and required medical equipment's whenever visit the villages, and providing the documentation facilities of medical records, and etc.,

The Admin Managers and STBM HR Department shall recruit and manage the required staff under this CHP.

5.1.6 Medical Doctor (STC)

The Medical Doctor (STC) / Medical Officer, reporting to Admin Manager STC / STM, shall be responsible for the regular visit (3 times per month for each village) Pyi Nyaung and Ku Pyin villages as per the existing program.

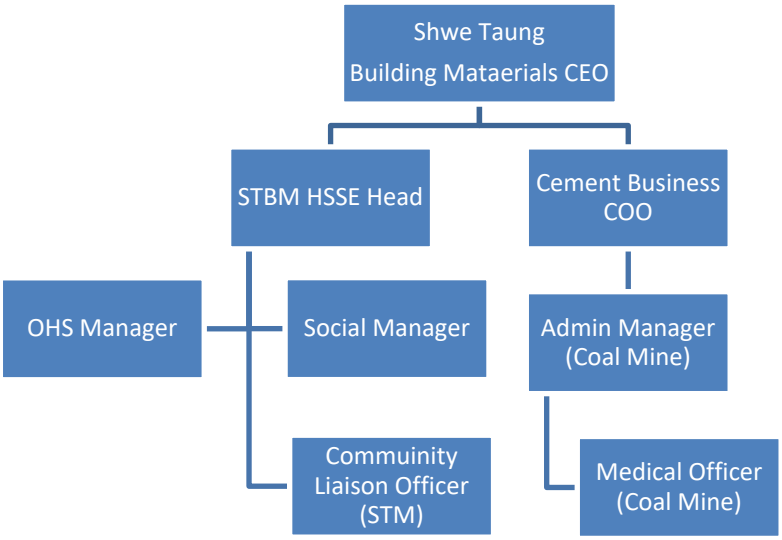
He/she should provide health care support, medical surveillance, keep the medical treatment, provide awareness trainings from the community, collect health data/statistics according to a pre-defined list of data points, from a pre-defined list of data sources as related to statics data, prepare a monthly health data and condition analysis report, and submit to the Admin Manager and Social Manager for review etc.,

5.1.7 Community Liaison Officer (STC)

Community Liaison Officer shall arrange to communicate the villagers of Ku Pyin and Pyi Nyaung villagers in advance the medical doctor / officer visit date and time to each village,

survey on the satisfactory of villagers on provided health care service from STC, plan and implement each CHP program initiative as defined in section 6 of this CHP, and monitor the results and report to the Social Manager, and etc.

5.2 **THE OVERALL ACCOUNTABILITY AND RESPONSIBILITY FOR STM**



5.2.1 **CEO of Shwe Taung Building Materials (STBM)**

The Shwe Taung Building Materials CEO shall be kept apprised of key developments this program.

5.2.2 **Cement Business Chief Operating Officer (COO)**

The Cement Business COO shall be responsible for:

(a) overseeing the implementation of this CHP;

(b) providing enabling conditions (including required financial and manpower resources and full senior management support from the CEO and from STBM);

5.2.3 **HSSE Head**

The HSSE Head is the person in charge of the HSSE Department and ensure that this CHP is implemented. The HSSE Head shall ensure that this CHP is implemented and shall also be responsible for identifying and logging gaps and H&S issues which need to be addressed before they become a significant risk to STC operations and for capturing and sharing lessons learned. The HSSE Head shall also ensure that the CHP aligns with the other plans and

procedures developed by STBM, as well as aligns with WGB EHS Guidelines and Local regulations.

5.2.4 **Social Manager**

The Social Manager, reporting regularly to HSSE Head, shall support for the implementation of the CHP from Admin Manager of STC.

The Social Manager shall provide monthly reporting to the HSSE Head community health and safety matters and regularly checking monthly reporting information and statistics, submitted from Admin Managers of STC and STM, to ensure effective implementation of this CHP throughout STC operations.

5.2.5 **Admin Manager STM**

The Admin Manager, reporting to Head of Cement Business, shall be responsible for monitoring the day-to-day implementation of the CHP is undertaken as required, such as support for procuring enough medicines and required medical equipment's whenever visit the villages, and providing the documentation facilities of medical records, and etc.,

The Admin Managers and STBM HR Department shall recruit and manage the required staff under this CHP.

5.2.6 Medical Officer (STM)

Medical Officer, reporting to Admin Manager STM, shall be responsible for the regular visit (1 month/visit) Paluzawa, Chaungzon and Nanmawke villages and, nearby villages (one month/visit Ta Bu Chaung and Ywarthar during the dry season as these 2 villages are located other side of Chintwin River) as per the existing program. He/she should provide health care support, medical surveillance, keep the medical treatment, provide awareness trainings from the community, collect health data/statistics according to a pre-defined list of data points, from a pre-defined list of data sources as related to statics data, prepare a monthly health data and condition analysis report, and submit to the Admin Manager and Social Manager for review etc.,

5.2.7 Community Liaison Officer (STM)

Community Liaison Officer shall arrange to communicate the villagers of Paluzawa, Chaungzon, Nanmawke, Ta Bu Chaung and Ywarthar villagers in advance the medical doctor / officer visit date and time to each village, survey on the satisfactory of villagers on provided health care service from STM, plan and implement each CHP program initiative as defined in section 6 of this CHP, and monitor the results and report to the medical doctor and Social Manager.

6. STBM COMMITMENTS AND KEY COMPONENTS OF THE CHP

In terms of community health program, STC's strategy is to implement programs that contribute to the maintenance of a healthy workforce and local community. This document outlines STC's commitment and approach to mitigating community health and safety risks that may arise as a direct or indirect result of the Project.

Some of the significant risks to be considered include:

- Possible pressure and/or additional demand on community health services associated with the influx of workers from outside the Project Area;
- Possible change in community wellness as a result of alcohol, and substance abuse associated with the influx of workers from outside the Project Area;
- Possible Change in Community Health as a result of sudden spread of communicable and non-communicable diseases including sexually transmitted diseases (STDs) associated with the influx of workers from outside the Project Area;
- Possible pressure on traffic and transportation network associated with construction and operations activities; and
- Possible change in water and air quality associated with construction and operations activities.
- Access to medical facilities for communities due to rehabilitated and widened roads;
- Improved healthcare infrastructure;
- Improved community health awareness;

The necessary control measures and Community Health Program (CHP) will be informed and adapted in response to the risks identified through the Stakeholder Engagement process.

6.1 PROGRAM TO REGULARLY COLLECT AND MONITOR HEALTH STATISTICS AND BASELINE DATA

The key objective of this program is to collect the baseline health data of the local communities around STC Cement Plant and STM Coal Mine project areas via company provided health care services, identify and understand the status of community health needs, plan improvement areas to guide the community and support with the prioritizing community needs and consider appropriate allocation of available resources.

The primary data is used as a baseline data of STC and STM Clinics, and collect indicators from local public health centers as secondary data in this CHP. It will collect monthly from STC clinics and quarterly from local public health centers. Those The data collection and analysis will need to be disaggregated among different social groups e.g. women, men, children, elderly, etc. to implement a gender-sensitive Community Health Program (CHP) for the cement plant project affected area and coal mine affected area.

Respect for confidentiality is important to safeguard the well-being of patients and ensure the confidence of society in the doctor-patient relationship. STC note the collection and use of personal information of villagers who received our health care facilities, including use for statistical purposes, to encourage public participation and to ensure that data are used for the purpose for which were collected. STC committed that statistical data are not used in ways that could cause adverse impacts on individuals.

The descriptive analysis is applied to carry out for the future reference to improve implementation of the CHP communicable disease sub-program; revise the scope of service provided by the STC-supported community health facilities, raising the local awareness program on health issues, work with government agencies and NGOs for health checkup programs, and etc. According to the Cement Plant and Coal Mine health care facilities' monthly report of (38) diseases and other diseases under national surveillance, the most common diseases are Seasonal Flu, General Debility (Low Blood Pressure), Conjunctivitis, Ureteric Colic, and Gingivitis and so on.

The first year statics/data is collected and analyzed as baseline data set for both Cement Plant and Coal Mine areas (i.e. starting point health condition of the local communities). All future collection and analysis of the same data points will then be analyzed to compare against the baseline/starting point condition). Having a clear starting point is crucial for monitoring/tracking future changes in health/hygiene conditions in the local communities, and trying to determine what has caused future changes.

Sr	Name of disease
1	Acute Appendicitis
2	Acute Gastritis
3	ARI (Bronchitis, Bronchieatis, Phenumonia)
4	Arithritis
5	Asthma
6	Burns (Any Kinds of Burns)
7	Cellulitis
8	Cervical Spondylosis
9	Conjunctivitis
10	DHF (Dengue Haemarrhagic Fever)
11	Diabetes Millitus (Known Case)
12	Diarrhoea
13	Dysentery
14	Food Drug Allergy (Any Kinds of Allergy)
15	Food Poisoning
16	General Debility (Low Blood Pressure)
17	Gingivitis
18	Herpes Simplex
19	Insect Bite
20	K/C of Fits
21	Low Back Pain
22	Lump (Any Kind of Lump)
23	Malaria
24	Mouth Ulcer
25	Nail Prick
26	Neural Ache
27	Otitis Media
28	Piles
29	Renal Colic
30	Seasonal Flu
31	Septic Boils
32	Snake - Bite
33	Sore Throat
34	T.B (All forms of new diseaseexpect Meninditis)
	A. Diagnosed Clinically
	B. Bacteriologically Confirmed
35	Tooth Ache
36	Typhoid & Parthyroid
37	Ureteric Colic
38	Viral Hepatitis

Other Diseases	
Sr	**Name of disease**
1	Hypertension
2	Occupational Injury
3	RTA (within the area of Factory)
4	Urinary Tract Infection

6.2 **MANAGEMENT OF COMMUNICABLE DISEASE**

Management of potential incidence of communicable diseases in relation STC's workforce includes pre-placement medical examination of all workers. This will be supported by periodic medical examinations that are supplemented by the Occupational Health Monitoring Program and a Monitoring and Evaluation (M&E) system. In addition, a workplace policy and program on HIV prevention and mitigation of HIV impacts will be implemented. As a means to improve the health context in which the Project operates, STC will collaborate with regional/local Government and relevant NGOs to support improvements to existing health services to handle the potential increase in population numbers and changes to the existing health profile of the area. This may include improving health facilities, the quality of medical personnel, the diagnostic capacity and treatment, the provision of vaccines, and the capacity to address epidemics and pandemics. STC, in collaboration with the local and regional Government, local emergency providers and local health care facilities will develop and implement Emergency Response Plan (ERP) within 2 years to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment. The ERP must:

- Be applicable to all contractors as well as local communities;
- Consider access to health care, major incidences, exposure to hazardous materials, multiple casualty events, epidemics and pandemics; and
- Make provisions for awareness-raising activities and emergency response training to the communities that are considered to be at higher risks.
    - STC will monitor the emergence of major pandemics through World Health Organization (WHO) alerts. If the WHO Pandemic Alert Scale reach Phase 4, the company will implement the relevant ERPs.
    - Phase 4: characterized by verified human-to-human transmission of an animal or human-animal influenza reasserting virus able to cause "community-level outbreaks." The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk for a pandemic. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.

As a means to mitigate impacts related to the increased incidences of HIV/AIDS and other STIs STC will develop and implement an HIV/AIDS Prevention Program for its workforce.
In addition, the following measures will be implemented:

STC will update STG Code of Conduct with key health and safety elements that will include:

- Zero tolerance of illegal activities by all personnel;
- Forbidding the use of prostitution;
- Forbidding illegal sale or purchase of alcohol;
- Forbidding the sale, purchase or consumption of drugs; and
- Forbidding illegal gambling and fighting.

- The updated Code of Conduct will be adhered to by all Contractors and Shwe Taung Cement Co., Ltd. employees. Any employee or Contractor found in violation of the Code of Conduct shall face disciplinary hearing which may result in dismissal.

- STC will support to care and treatment of HIV-positive employees.

- STC at the worker camp to promote safe sexual practices.

- In partnership with local health officials and relevant NGOs, STC will undertake information, education and communication campaigns around safe sexual practices and transmission of STIs and HIV/AIDS as well as targeting condom distribution (including female condoms) within 2 years at Cement Plant and Coal Mine.

- In partnership with local authorities and relevant NGOs, STC will support women's empowerment and education program to promote women's rights and safe sexual practices (including the use of condoms and female condoms) and support.

As a means to mitigate impacts related to sanitation and water-borne diseases
STC will*:*

- Conduct information, education and communication campaigns amongst STC/STM employees and workers on hygiene and sanitation.

- Partner with local authorities and relevant organizations as (e.g. donors, civil society and NGOs) to facilitate delivery of sufficient supply, and adequate quality, of water to the project affected villages (including schools of those villages).

6.3 **MANAGEMENT OF THE TRANSMISSION OF MALARIA**

To mitigate impacts related to the transmission of malaria, STC will develop and implement an Integrated Malaria Control, Prevention and Treatment Program at Coal Mine operation. The program will include the following key aspects:

6.3.1 **Vector Management**

- STC will avoid the creation of mosquito breeding conditions/ habitats through creation of proactive surface water management, in particular, reduce the presence of standing water onsite through environmental controls at Coal Mine. Such measures include repairing leaking pipes, dewatering of open excavations and effective drainage systems along access roads.

6.3.2 Control and Reduction of Individual Risks

- Personal protection and behavior modification measures e.g., awareness raising and education program, and mandating compliance with appropriate anti-malarial chemoprophylaxis when recommended.

- Reduce the potential for mosquito-human interactions in workforce accommodation and office buildings through the use of screens at windows and doors, application of air conditioners and fans, the use of bed nets and other measures.

- Ensure that the workforce has access to prompt, accurate and effective diagnosis and treatment while working on site or in remote areas.

- Develop and implement a malaria information booklet and training material for the workforce. These materials will be used as part of a new employee induction, as well as part of annual refresher training sessions on malaria.

6.3.3 **Limit Effect of Infection**

- The malaria immunity status of all employees and malaria transmission patterns of labour source areas will be considered and catered for when considering treatment options.

- Partnership and collaboration in community malaria awareness programs with key external stakeholders to ensure community collaboration and enhance program sustainability.

- Ensure availability of general malaria treatment at both clinics of Coal Mine and Cement Plant used by the workforce and local communities. This will be achieved through a partnership with the Ministry of Health and Sports and/ or relevant NGOs.

Table : shows an example of an integrated malaria control program.

PRIMARY CONTROL	
Vector Management	
ENVIRONMENTAL	**CHEMICAL**
Site Selection Buffer zone; distance from vector breeding areas/population with active malaria transmission.	**Larval control** Destruction through biological, mechanical or physical means. No DDT may be used!!
Source Reduction Environmental modification to reduce vector habitats; environmental manipulation to produce unfavorable conditions for vectors	**Adult Mosquito Control** In-door residual spraying, space spraying and long lasting insecticide-treated bed-nets and other materials.
SECONDARY CONTROL (A,B,C)	
Control/ Reduction of individual risk	
AWARENESS Malaria and personal protection information distribution	**BITE PROTECTION** Bed-nets, physical exclusion, personal protection
CHEMOPROPHYLAXIS Regular chemoprophylaxis for those considered at risk	

6.4 **Management of Increased Incidences of Chronic/ Acute Respiratory Infections**

Impacts on the ambient air quality as a result of Project activities (construction and operation) at Cement Plant and Coal Mine are associated with:

- The generation of dust during site clearance and preparation;
- The generation of dust from road traffic (Cement and Coal Transportation roads); and
- Exhaust emissions (which may include sulphates, nitrogen oxides and particulate matter) from construction and operational vehicles (including approximately 200 vehicle movements per day related to transporting cement by road) as well as machinery (e.g., generators).

The measures and recommendations included in this *Section* should be read in conjunction with measures included in the Environmental Management Plan (*ESIA Report*).

In partnership with the government, and NGOs; STC will develop and implement educational campaigns to inform families about the early warning signs of acute respiratory infections that indicate the need to seek care.

STC will adhere to WHO guidelines for infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in STC managed health care facilities.

STC will implement the following mitigation measures with regard to road transportation:

- The lowest sulphur fuel usage possible so as to minimize harmful emissions.
- Develop and implement equipment and vehicle maintenance program to reduce emissions and dust generation.
- A speed limit of approximately 30kmh should be maintained within Cement Plant and Coal Mine.
- STC will implement a dust suppression program (on STC and STM controlled roads), including covered loads, vehicle washing and road wetting, particularly in areas where the road passes close to dwellings, schools and businesses.
- Any directly affected individuals will be able to lodge grievances with the STC using the grievance procedure regarding dust emissions that could be linked to the Project.

6.5 **MANAGEMENT OF INCREASED RISK OF ROAD TRAFFIC ACCIDENTS**

Given the previously rural nature of the Project Area and surrounds, communities are unaccustomed to high levels of road traffic, and have not been exposed to common road safety measures, thus increasing their vulnerability to road traffic accidents. When the second line is started operation, it will increase the road traffic levels in the cement plant and coal mine area. STC will develop and implement a Traffic Management Plan that provides specific traffic calming measures related to identify sensitivities along the transport route. The Plan will make provisions for the following:

- Develop and implement a Driving Policy. This will include:
  - Restrictions on vehicle speeds;
  - Forbidding non-Project passenger transport;
  - Forbidding alcohol and drug use;
  - Forbidding reckless driving;
  - Forbidding mobile telephone use whilst driving;

- Develop and implement a Road Safety Awareness Campaign.

  STC will implement a road safety awareness campaign to improve community knowledge of the dangers of road traffic and safe behavior in and around roads. This program will be implemented in partnership with the local government, especially traffic police and road transportation administration department. Such a program may be targeted at local schools to help inseminate road safety information to children who may be particularly vulnerable to vehicle traffic.
- All staff that drive vehicles should have driver license.
- Mechanically limit heavy goods vehicles speeds.
- Install alarms in heavy goods vehicles that sound when driver and passenger do not have seatbelts engaged.
- STC will implement a stakeholder engagement, consultation and information disclosure process prior to use of the road connection to Cement Plant and Coal Mine. This will allow stakeholders to understand the upcoming increases in vehicle traffic, the plans for vehicle movements and driving policies, and to provide feedback on transportation plans.
- STC will establish an Emergency Response Plan (ERP) for the proposed road connection that details the agreed protocols, process, engagement and investigation processes for various relevant potential emergencies (Road Traffic Accidents - RTAs, spillage etc.) along the road connection. The ERP will include management and monitoring requirements as well Key Performance Indicators (KPIs) related to emergencies and emergency response.

6.6 **VOLUNTARY PROGRAM TO IMPROVE COMMUNITY AND WATER BODY HYGIENE CONDITIONS**

We can see in nearby villages, located around our cement factory and coal mine which people use the local rivers, streams, and other water source as many purposes such as washing the cloths, bath and cooking usage, watering the plants and sometime throwing the garbage into water bodies. Villagers are using water sources for drinking and cooking is not a problem while

washing the cloths near the river bank and throwing the garbage into river can pollute the river and water sources, so they could not get cleaning water from the river in near future. Therefore, we do need to promote their health knowledge via consultation and promotion such as WASH program (Water, Sanitation and Hygiene) and waste segregation program.
We will promote WASH program and garbage segregation program not only in Community but also in schools. The purpose of these activities in schools is improving their health and learning performance of school-aged children who can directly affected to their parents and family members because children are enthusiastic promoters of their newly acquired hygiene skills and can potentially be effective agents of change within their homes and community. If practices are consistent with the cultural environment, children's advocacy in home and community.

6.6.1 **WASH Program at Schools**

WASH program should be target to schools because students can influence to their parents and they bring the good practices to their home, then they can develop the good practices at their home. After they developed good practices within their families, they will spread this culture to community, therefore that can reduce the rate of diarrhea and the pollution to environment.

This program also focuses on the development of life skills and the mobilization and involvement of parents, communities and local government to work together to improve hygiene, water and sanitation conditions.

While there are many approaches based on differing cultural insights and environmental and social realities, any WASH intervention should include:

1. Sustainable, safe water supply points, hand-washing stands and sanitation facilities;
2. Fully integrated life skills education, focusing on key hygiene behaviors for the community and using participatory teaching techniques;
3. Outreach to families and the wider community.

STC will support the following support to raise the awareness among the community

1. Water quality: Water for drinking, cooking, personal hygiene, cleaning and laundry is safe for the purpose intended.
2. Water Quantity: monitor the water quality and results are available at the project affected villages for drinking and personal hygiene, and for food preparation, cleaning and laundry.
3. Hygiene promotion: Correct use and maintenance of water and sanitation facilities is ensured through sustained hygiene promotion. Water and sanitation facilities are used as resources for hygiene education.
4. Toilets: Sufficient, accessible, private, secure, clean and culturally-appropriate toilets
5. Control of vector-borne disease: Students, teachers and villagers in the unique environment are protected from disease vectors.
6. Cleaning and waste disposal: The school environment is kept clean and safe.

6.6.2 **Health Promotion and Hygiene Behaviors for Students**

Key factors	Knowledge	Attitudes	Practices
Safe use of toilets and urinals: Diarrhea and worm infections are two main health concerns that affect people on a large scale and can be improved through appropriate toilet and urinal use.	Exposed excreta are the leading cause of spreading diseases and making people sick. Behaviors can lead to worm infections.	Children recognize the importance of safe and use of toilets and urinals, including the safe disposal of faeces and hygienic anal cleansing followed by washing hands with soap.	Children practice the safe use of toilets and urinals, including the safe disposal of faeces and hygienic anal cleansing followed by washing hands with soap. Depending on age, children maintain and operate school toilets and urinals.
Personal hygiene: Many diseases can be attributed to poor personal hygiene.	Personal hygiene impacts diseases.	Children understand appropriate personal hygiene: washing hands with soap, wearing slippers, cutting nails regularly, brushing teeth, combing hair and the regular washing of body and hair.	At all times, children wash hands with soap, wear slippers, cut nails, brush teeth, comb hair and regularly wash the body and hair.
Hand washing with soap: Hand washing at critical moments reduces the risk of diarrheal diseases by 42-48% and significantly reduces the incidence of acute respiratory diseases.	Hand washing with soap drastically reduces diarrheal and acute respiratory diseases.	Children understand the importance of hand washing with soap after toilet use, before preparing food.	Hands are washed with soap after toilet use, before and after eating, before preparing food.
Food hygiene: Eating healthy food is essential for the well-being and survival of each human being. Eating 'contaminated' food (also known	Food hygiene and diseases are linked. Food should be stored appropriately. There are recognizable signs when food is spoiled.	Children know how to store food appropriately and recognize common signs of spoiled food.	Raw fruits and vegetables and raw meat, poultry or fish are treated and stored appropriately.

as 'food poisoning' can be a significant source of diarrheal diseases.			

Developing appropriate hygiene behavior and practice are greatly enhanced by allowing children to fully participate. In this way, children:

- Learn and adopt new concepts and skills quicker.
- Acquire useful knowledge from participating in environmental activities.
- Are a source of creativity, energy, initiative, dynamism and social renewal.
- Contribute meaningfully to environment restoration and protection in their communities.
- Are forceful advocates who carry healthy lifestyle messages home and to their community.

6.6.3 **Waste Segregation Program for Community**

The main goal of the program is to stimulate improved co-operation between all stakeholders that contributes to sustainable improvement of recycling and organize waste management. Besides, STC desires to improve the health and living standard of community while reducing the impact to environment. When garbage are irresponsibly mixed together and dumped in an open space or vacant lost in the surrounding environmental, they can cause diseases. Pests such as the cockroaches, flies, mosquitoes, rodents and the like make them as their food. Garbage then becomes their breeding media, or even their harborages. Because of favorable environment, pests multiply very fast over a short period of time and start to get into homes and villages.

Segregation of all garbage by type will avoid potentially undesirable combined effects and will facilitate the reuse, recycling, recovery and disposal of the various wastes. We will divide the type of garbage into the following:

Categories	Type of Waste
Organic or Biodegradable wastes	Which is typically originating from plant or animal sources and that may be degraded by other living organisms. e.g Leftover food (which can feed to the animal like pigs) and kitchen waste, green waste
Recyclable wastes	Paper, glass, bottles, tin cans, newspaper which can use again.
Hazardous waste	Paints, chemicals, tires, batteries, old engine oil, fertilizers
Biohazardous waste	Clinic waste like needles, expired pharmaceutical drugs (intended for clinic)

We will hold waste segregation campaign, waste collection in nearby villages by any chance, setting up a local centralized garbage collection area and landfill; and regular voluntary actions by community members to clean up local streams to ensure they are free of garbage; designating areas for livestock to get their drinking water and for washing, and making sure those areas are separate from areas of water for human use; organizing areas for community members to get their water and do their washing, to avoid people washing themselves in public water bodies which will likely pollute the water and cause people to become sick if they use that water later. These activities will improve and encourage the local people concerning environment awareness which will minimize the environmental impact.

6.8 **OVERALL PROGRAM TO RAISE HEALTH AWARENESS**

Promoting awareness of community health issues and preventative action is a vital part of our program's mission and impact. Through the effective healthcare professionals and volunteers, the community is provided with helpful and hopeful information and assistance. In our community health program, we provide the malaria program, communicable disease control program, chronic/ acute respiratory infections control program, WASH program and reproductive health program.

We believe planning for sustainability requires, first, a clear understanding of the concept of sustainability and operational indicators that may be used in monitoring sustainability over time. Important categories of indicators include:

1. Maintenance of health benefits achieved through an initial program
2. Level of institutionalization of a program within a company
3. Measure of capacity building in the recipient community

Second, planning for sustainability requires the use of programmatic approaches and strategies that favor long-term program maintenance. We decide that the potential influences on sustainability derive from three major groups of factors:

1. Project design and implementation factors
2. Factors within the organizational setting and
3. Factors in the broader community environment

Thus, we focus on the relevant community engagement approach to provide the effective community healthcare system. The approach tools are social or village mapping, mobility mapping, body mapping, making seasonal calendar and after that the matrix scoring and nominal group process is applied to know the priority health problem in the community.

7. **CONCLUSION**

Community health is a field of public health that focuses on studying, protecting or improving health within a community. Community health covers a wide range of healthcare interventions, including health promotion, disease prevention and treatment. It also involves strategic management in public administration to be a systematic and effective program. Thus, we use the community engagement approach and narrow down the possible control actions to cover all of the affected community.

According to Myanmar National Health Plan 2017-2021, the Myanmar health system currently faces many challenges. A rise in public spending on health is 0.2 percent of GDP in 2009 (the lowest in the world) and slightly over 1 percent in 2014. It also led to visible improvement in the fight against communicable diseases – malaria, tuberculosis, and HIV/AIDS. Myanmar currently allocates only 3.65 percent of its total budget on health, which is extremely lower than the global and regional standards.

Our business is encouraging to be all inclusive social welfare and wellbeing in our specific vicinity by improving adequate healthcare. We are striving to be supportive and responsible business in Myanmar. The importance of preventing the communicable diseases and the sudden outbreak are of necessity to control in advance so that we can strongly promise preventing potential hazards of the communicable diseases which we will provide the compatible healthcare service programme for all common diseases in the community as much as we can.

STC is committed to compliance with IFC's requirements and the Performance Standards Guidance (4) Community health, safety and security of the local community. We enforce to make better community in the local community by providing adequate healthcare services. In this Community Health Program, we focus on nearby communities to prevent disease, to promote health, to encourage people to participate in their own healthcare and to provide coordinate care with the primary healthcare providers.

Our action plan will be implemented on the many sectors that are the management of communicable disease especially Malaria in STM Coal Mine, quality management of water resources and food security, management of chronic/ acute respiratory infections, reproductive health program and sexually transmitted diseases.

Our program management is based on a 'live' document that will need to be amended periodically in the light of operational changes and learning experienced. STC Annual Monitoring Report (AMR) will be the first step of the future Shwe Taung Cement Sustainability Report aim to see the progress and performance of the actions of this CHP.

According to our mission and core value, we are committed to the sustainable development of its human resources and environment. Our accountability is not only for the shareholder but to all stakeholders. We strongly regard all the stakeholders for its persistent support and courage in developing our sustainable business. It has already initiated its exertion for the Corporate Social Responsibility in the healthcare development of Pyi Nyaung and Paluzawa communities. Thus, we are consecrated to strengthen and maintain our long lasting relationship to create a better future for our country together.

Annex U
Emergency Response Plan

SHWE TAUNG CEMENT CO.LTD	EMERGENCY RESPONSE PLANNING		STBM-IMS-P-006-00
	Revision	Effective Date	HSSE Department
	07-05-2020	07-05-2018	

Change History		
Rev #	**Description of Change**	**Paragraph**
00	Initial Release	All

Prepared by		
Name	**Designation**	**Signature**
Mr Aung Khaing Nyi	HSSE Head	
Verified by		
Name	**Designation**	**Signature**
Mr Kyaw Naing Soe	Head of Cement	
Approved by		
Name	**Designation**	**Signature**
Mr. Aung Zaw Naing	Shwe Taung Building Materials CEO	

1.1 **Purpose**

The purpose of this procedure is to provide guidelines for emergency preparedness and response (EPR), and documents methods in place to help protect employees, contractors and visitors in the event of an emergency situation associated with the activities and facilities of Shwe Taung Building Materials' entities (ST): Shwe Taung Cement Co. Ltd (STC), Shwe Taung Mining Company (STM) and High Tech Concrete Company (HTC).

The procedure provides directions for coordinated and effective response to an emergency by:

- Documenting the overall emergency response process and interfaces;
- Identifying potential emergency scenarios that could occur;
- Identifying the procedures which apply to emergency events and the tactical response plans to be used in the event of an incident;
- Defining the roles and responsibilities of personnel in an emergency event;
- Determining resources, tools and equipment required in an emergency event;
- Describing training, practices, inspections, audits and monitoring required to ensure site emergency procedures are effective.

This is the overarching framework for EPR within ST: each individual site of ST's premises should develop its own plan tailored to the site and context.

1.2 **Scope**

This Procedure is applicable to all personnel, contractors and visitors that are at ST's premises including the cement plant, the coal mine and the quarries as well as during material and product transportation.

1.3 **Definitions and Abbreviations**

Area Warden	ST employee appointed as responsible for overseeing and ensuring the safe and complete evacuation of staff, contractors and visitors of their dedicated area in an event of emergency
CEO	The Chief Executive Officer of Shwe Taung Building Materials' entities
Chief Warden	Site incident commander in an event of emergency

Deputy Chief Warden	Assistant to the Chief Warden in an event of emergency
Environmental Manager	Person-in-charge of environmental aspects
EPC Contractor	Engineering, Procurement and Construction company responsible for the design, procurement, construction, commissioning and handover of the expansion project (second clinker and cement line) at STC; the EPC Contractor must appoint a health and safety manager (HS EPC Manager) and a manager responsible for the expansion project (Project EPC Manager)
ERP	Emergency Response Procedure
ERT	Emergency Response Team
Fire Safety Manager	ST employee qualified to conduct fire-fighting
First Aiders	ST employees qualified to provide first aid
FOM	Form
Head of Cement Business	Person-in-charge of STC and STM
Head of Concrete Business	Person-in-charge of HTC
HSSE	Health, Safety, Environmental and Social
HSSE Head	Health, Safety, Environmental and Social Department Head
HS Manager	Health and Safety Manager or person-in-charge of Health and Safety matters or Chief Safety Officer
HTC	High Tech Concrete Company
OHS	Occupational, Health and Safety
PPE	Personal Protective Equipment, or equipment worn to minimise exposure to hazards that may cause serious workplace injuries and illnesses; PPE may include items such as gloves, safety glasses and shoes, earplugs and muffs, hard hats, respirators, or coveralls, vests and full body suits
Social Manager	Person-in-charge of social aspects or social accountability manager
SOP	Standard Operating Procedure
ST	Shwe Taung Building Materials' entities i.e. STC, STM and HTC and their associated facilities and assets
STC	Shwe Tang Cement Co., Ltd.

STC Plant Operation Manager	Person-in-charge of the operations at STC (first clinker and cement line) and of the expansion project at STC (second clinker and cement line) until it is commissioned and incorporated in the operations at STC
ST's premises	ST's premises are defined as ST's premises, sites and facilities including the cement plant (including ancillary facilities, the cement plant expansion, the mudstone and limestone quarries) located in Thazi township of Mandalay region (STC), the coal mine located in the Kalaywa township of the Sagaing region (STM), HTC's premises and facilities in Myanmar as well as STC's, STM's and HTC's offices and head offices in Mandalay and Yangon.
Site Operation Manager	Operation manager of a specific operational location, site or area
STM	Shwe Taung Mining Company
WIS	Working Instruction
Assembly Point	External area deemed safe to be used as muster point during emergency calls. There is one Assembly Point per pre-defined relevant areas of STC premises.
Emergency	A serious, unexpected and often dangerous situation requiring immediate action.

2 EMERGENCY ORGANIZATION

2.1 **Emergency Response Team**

To effectively handle an emergency, an *Emergency Response Team* must be organized before an emergency occurs. In addition, all staff members should be aware of their roles to ensure safety, efficiency and communication in the event of an emergency.

The Emergency Response Team (ERT) is appointed by Site Operation Manager as prime personnel to implement emergency response plans at each location. The ERT shall include, but not be limited to, Line Manager / Frontline Manager / relevant supervisor, HS Manager, trained personnel for responding in different emergency situations (such as fire and explosions, confined space, rescue from heights, gas releases, etc.), medical (doctor, nurse and first-aiders as available on site), security personnel and other representations from different departments.

The typical ERT will be headed by a Chief Warden assisted by a Deputy Chief Warden and Area Wardens/Deputy Area Wardens for each pre-defined relevant areas of ST's premises (operational location, site or area). The ERT is responsible for executing emergency response actions, setting up of emergency evacuation assembly areas for each operational location, site or area, activation of an emergency alarm and organizing the evacuations. The ERT will also be in charge of coordinating the rescue of personnel and cooperating with the Line Managers / Frontline Managers, Firefighting Team, ambulance and First Aid Team to do so.

2.2 **CEO**

CEO shall be responsible in overseeing that this procedure is implemented throughout ST operations.
CEO shall endorse this procedure and have overall accountability for its management.
CEO shall enable and regularly check that this Procedure is implemented and regularly reviewed, including through the ongoing work of ST's audit function unit.

2.3 **Heads of Businesses**

Heads of Businesses (namely Head of Cement Business and Head of Concrete Business) shall enable and regularly check that potential emergency situations are identified and that emergency response

plans are in place with competent emergency organization and necessary emergency response equipment and infrastructures are in place for their business.

2.4 **Site Operation Manager**

The Site Operation Manager shall:

- Evaluate and declare emergency situations.
- Nominate emergency response team members.
- Provide resources and nominate responsible persons for ERP development & implementation.
- Provide resources for emergency response installations and equipment.
- Provide resources for emergency response and preparedness training and drills.
- Assure compliance with legal requirements.

In an emergency situation, the Site Operation Manager is responsible to:

- Authorize the shutdown of operations in their operational location, site or area and relevant operational location, site or area-wide evacuation;
- Provide information to spokesperson designated by ST Corporate Communications Department;
- Coordinate the activities of external emergency services and work closely with them during emergency management;
- Provide external emergency services with relevant information for emergency management and also information and decisions to any actions that concern the company SOPs and policies;
- Determine the termination of the emergency event and authorize re-entry upon complete recovery.

2.5 **HSSE Head**

The HSSE Head's responsibilities are to:

- Report the emergency response training/drill findings and ERP review outcomes to Heads of Businesses and the CEO on a regular basis.
- HSSE Head shall enable and regularly check that this Procedure is implemented and maintained.
- Ensure emergency response equipment/installations are maintained and inspected as required.
- Ensure ST's compliance with legal requirements.

2.6 **HS Manager**

The HS Manager will:

- Lead the development and maintain the Emergency Response Plans.
- Lead the emergency risk assessment for each ST area of operations.
- Assist the HSSE Head in the development, maintenance and review of the ERP.
- Lead the emergency risk assessment of abnormal operations, project activities.
- Ensure all relevant emergency response forms and records are maintained and up-to-date in accordance with HSSE management system requirements.
- Plan and implement emergency response training/drills.
- Lead the review of ERP post training/drills.
- Maintain up to date list of emergency response equipment and installation at ST's premises.
- Lead the inspection of emergency response equipment/installations.
- Ensure emergency response teams (Chief Wardens, Deputy Chief Wardens, Area Wardens, Medical Teams, First Aiders, Fire Safety Managers, Site Security Teams, as well as Managers and Executives and Contractors) receive regular training that enable each of their members to fulfill their respective roles under this procedure.
- Maintain an updated log of such trainings.
- Propose to the HSSE Committee during its monthly meetings the updated lists of the emergency response teams and appoint such persons as relevant.

2.7 **HSSE Committee**

HSSE Committee shall follow, enable and check every three months during the monthly HSSE Committee Meetings that the HS Manager enables this Procedure.

2.8 **Chief Warden**

The Chief Warden will act as site incident commander in an event of emergency for his/her operational location, site or area. The Chief Warden will assist the Site Operation Manager in forming the Emergency Response Team (ERT) and be the person in-charge of emergency response actions. The Chief Warden will:

- Liaise between employees, workers, contractors, visitors at ST's premises, Site Operation Manager / Line Manager / Frontline Manager / relevant supervisor and Area Wardens during an emergency situation.
- Assess the situation of the incident and activate the project ERT members for counter measures.
- Command and direct Emergency Response Team (ERT);
- Direct counter measures and emergency procedures to control and suppress the situation and decide on the evacuation of the operational location, site or area as appropriate.
- Lead the implementation of the emergency response procedures as defined in the ERP.
- Determine incident control zones;
- Set up field incident command post;
- Lead the emergency evacuation at the site.
- Evaluate and declare emergency situations in absence of Site Operation Manager.
- Ensure emergency responders' safety and monitor personnel fatigue and stress;
- Deploy emergency equipment and appliances;
- Direct rescue operations if necessary;
- Maintain constant communication with Site Operation Manager and the emergency responders;
- Work closely with the person-in-charge at the incident command post;
- Ensure proper decontamination of equipment and responders;
- Coordinate recovery activities.

The Chief Warden is appointed as such by the HS Manager, with the approval of the HSSE Committee. The Chief Warden appoints Area Wardens and deputy area wardens, with the approval of the HS Manager who retains an updated log of Area Wardens.
The Chief Warden shall receive regular and dedicated training that enables the Chief Warden to fulfill its role under this procedure.

2.9 **Deputy Chief Warden**

The Deputy Chief Warden will assist the Chief Warden on the coordination and execution of the Emergency Response Procedure and cover the duties of the Chief Warden when s/he is not at site.
The Deputy Chief Warden will collate and report the headcounts of the emergency evacuation to the Chief Warden and direct the search and rescue of any missing personnel.

The Deputy Chief Warden is appointed as such by the HS Manager, with the approval of the HSSE Committee.

The Deputy Chief Warden shall receive regular and dedicated training that enables the Deputy Chief Warden to fulfill its role under this procedure.

2.10 Area Wardens

Area Wardens are responsible for overseeing and ensuring the safe and complete evacuation of staff, contractors and visitors in their respective operational locations, sites or areas during an emergency situation under their Chief Warden.

Area Wardens shall:

- Perform headcount at their respective areas or assembly areas;
- Assist in determining last known locations of persons unaccounted for;
- Perform methodical sweep of their areas to check all persons have evacuated;
- Direct the evacuation of the persons in their respective areas (or assembly areas) should an evacuation be ordered by their Chief Warden;
- Prevent unauthorized entry into the incident scene;
- Keep persons accounted for within the assembly area;
- Report all information to their Chief Warden.

The Area Warden is appointed as such by the Chief Warden, with the approval of the HS Manager. Area Wardens receive support from their deputy area wardens, also appointed as such by the Chief Warden, with the approval of the HS Manager.

The Area Warden shall receive regular and dedicated training that enables the Area Warden to fulfill its role under this procedure.

2.11 Line Manager / Frontline Manager / supervisor (Managers and Executives)

The Line Manager / Frontline Manager / relevant supervisor (as Managers and Executives) will inform personnel, contractors and visitors under their responsibilities in case of an emergency situation.

The Line Manager / Frontline Manager / supervisor will evacuate all personnel from their respective work areas (operational location, site or area) calmly upon activation of the emergency alarm, assist any personnel who require any help, assemble their personnel at their relevant emergency assembly area. They will assist the Area Warden to conduct headcount and report as soon as possible to the Chief Warden and/or ERT.

When evacuating, the Line Manager / Frontline Manager / supervisor will also remove all sensitive documents (take with them during evacuation or safeguard/ lock in offices) and shut down all electrical equipment if possible.

The Line Manager / Frontline Manager / supervisor (Managers and Executives) shall receive regular and dedicated training that enables each of them to fulfill their role under this procedure.

2.12 **Medical Team**

It shall be the responsibilities of the medical doctor to:

- Establish the casualty collection point or medical post or first aid area;
- Manage triage situation, if any;
- Provide medical status updates to the Chief Warden / Deputy Chief Warden;
- Provide professional medical advice to the First Aiders;
- Provide medical aid to the serious cases.

Doctor on site will assess the medical needs, determine outside emergency support requirements and establish first aid area, with the support of the nurse on site. The doctor will also coordinate, direct and report to the external professional medical personnel any injured personnel. The doctor will report the status of any injured personnel to the Chief Warden / Deputy Chief Warden.

The Medical Team shall receive regular and dedicated training that enables each of its members to fulfill their respective roles under this procedure.

2.13 First Aiders

Qualified first-aiders are responsible for administering first-aid operations in an event of medical emergencies or injuries), render first-aid to any injured personnel (employees, workers, contractors, visitors, etc.), where applicable under the supervision of doctor or nurse.

The First Aiders shall receive regular and dedicated training that enables them to fulfill their role under this procedure.

2.14 Fire Safety Manager

The Fire Safety Manager will lead the Firefighting Team in conducting firefighting in the event of a fire emergency, directing staff, contractors, visitors to evacuate from the scene of fire, removing any flammable materials.

The Fire Safety Manager will coordinate the rescue of staff, contractors, visitors from the scene of fire.

The Fire Safety Manager and the Fire Safety Team members shall receive regular and dedicated training that enables them to fulfill their respective roles under this procedure.

2.15 Site Security

It shall be the responsibilities of the Site Security Team Leader to:

- Establish perimeter security to prevent unauthorised entry into incident scene;
- Deploy Security officers as route marshalls;
- Ensure that external emergency services are directed to the incident scene or incident command post as soon as they arrive on site.

The Site Security Team Leader is in charge of deploying the Site Security Team which will be responsible for controlling and monitoring the movement of vehicles and people coming in or out of ST's premises, of keeping a count of the contractors and subcontractors' manpower on site at all times, and of informing the HSSESite Operation Manager (or Head of Business) on such number in case of an emergency situation.

The Site Security Team will also stop all personnel/ vehicles from entering ST's Premises in the event of an emergency.

The Site Security Team members shall receive regular and dedicated training that enables them to fulfill their respective roles under this procedure.

2.16 EPC Contractor and other Contractors (Contractors)

ST's EPC Contractor and ST's other Contractors (Contractors) are responsible for ensuring this Procedure and its requirements are communicated to their staff and for ensuring their staff follow them as relevant.

For instance, where relevant, ST shall communicate and work with its EPC Contractor or other Contractors to implement corrective actions that are relevant to them. The EPC Contractor or other Contractors must participate.

Prior to appointing Contractors, and once Contractors are appointed, their ST's project/activity owner shall:

- Ensure that potentials for emergency situations are identified and assessed and that adequate emergency response plans/ processes/procedures are in place for the tasks/activities/projects under the responsibility of Contractors.
- Ensure that Contractors are aware of relevant this Emergency Response Procedures.

Contractors who are undertaking activities for ST shall have an emergency response plan for their applicable scope of work. To ensure consistency and compliance with this procedure and their relevant emergency response plan, Contractors, in consultation with ST, shall prepare a bridging document, which identifies all and bridge gaps between Contractors and ST's arrangements for the management of emergency situations.

The objectives of the bridging document are to demonstrate that:

- Project activities can be undertaken safely;
- The relevant safety management system has defined and covered all activities;

- Where aspects of the Contractor and ST's systems may be jointly used, the interfaces are well defined and operable; and
- Any differences from the Contractor's relevant emergency response plan and this Procedure are identified.

*NOTE: During the cement plant expansion project installation/commissioning phase at STC's premises all Contractors' relevant emergency response plans will bridge the STC ERP.

In an event of emergency, Contractors will inform all their personnel of any emergency situation and carry out any evacuation as and when instructed to do so. Contractors will then ensure all personnel are evacuated from their work areas and assembled at the relevant emergency assembly areas, conduct headcount of their work personnel and report the headcount to the HSSErelevant ST's Chief Warden / Deputy Chief Warden. When evacuating their work area, Contractors will ensure all machinery, equipment, etc. are shut down, if possible, before leaving. Once evacuated, Contractors will keep their personnel assemble neatly at their respective positions and wait for further instructions from HSSEST's Chief Warden / Deputy Chief Warden.

In the event of missing personnel, Contractors will promptly inform the ERT on the last known working area of the missing personnel.

2.17 All Persons

All persons employed by ST, directly or indirectly, have a responsibility to be familiar with the requirements of this Procedure.

2.18 Audit Function Unit

ST's audit function unit, under ST's CEO, is responsible for, on a regular basis, auditing that this document is implemented and for providing post-audit recommendations to be communicated to the HSSE Committee.

3 EMERGENCY RESPONSE PLAN (ERP)

The HS Manager shall lead the development and annual review of the emergency response plan for each of ST's Premises. Based on site risk assesment, potential emergency situations that may occur at the site or during site activities shall be determined. An emergency response plan (ERP) shall be developed for each relevant location.

3.1 SITE EMERGENCY RESPONSE PROCESSES

A site-specific ERP shall detail emergency response processes to be undertaken in an event of a particular emergency for each of ST's Premises. The ERP shall include, but not be limited to, the following emergency response processes.

3.1.1 Building Evacuation

The ERP should contain a written evacuation procedure. The procedure should identify specific actions to be taken by ST staff, contractors and visitors when evacuation of buildings, plants, site areas is required, including actions to be taken by the site incident commander and the Area Wardens. Reasons for an evacuation may vary and differences in response based on the event may be necessary. At a minimum, the ERP should address:

- Specific evacuation routes (including building maps);
- Emergency assembly points and alternates (as necessary);
- Instructions specific to fire and bomb threat incidents;
- Critical operations, if any, that may need to be shut down prior to evacuation; and
- Post evacuation accounting of ST's staff, contractors and visitors.

At least annually, the site should schedule and conduct a practice evacuation drill. The results of this drill should be used to identify any building evacuation issues and identify opportunities for improvement in the communications and evacuation process.

3.1.2 Shelter In Place

In certain emergency situations, such as storm warnings, evacuation is not advisable. Sheltering in place may be a more appropriate response. The ERP shall contain procedures

addressing shelter in-place locations and personnel accountability procedures.

3.1.3 Fire

The ERP shall address fire hazards within the site, including potential fuel and ignition sources. The ERP should address, at a minimum:

- Fire control systems available;
- Alarm systems in use;
- Guidance on firefighting by ST employees; and
- Information on evacuation procedures when alarms are sounded.

3.1.4 Chemical Spill

Where applicable, the ERP shall contain information on response procedures in the event of a spill or a release of hazardous materials. This should include the processes to secure the spill/release areas, evacuation of people from the areas, clean up, treatment, handling and disposal of materials.

3.1.5 Medical Emergencies

The ERP shall contain a discussion of appropriate steps to be taken in the event of a medical emergency involving an ST employee or visitor. At a minimum, the ERP should address:

- Assessment of the condition of the injured/ill individual;
- Appropriate emergency contact phone numbers;
- Availability of trained personnel to provide aid, as necessary; and
- Availability of emergency response equipment.

The ERP shall address response procedures to be used in the event of a contagious disease outbreak within the site. The ERP shall also address protocols and techniques for limiting the spread of the diseases.

3.1.6 Adverse Weather Conditions/ Natural Disasters

As some of ST sites are located in remote areas and ST operations involve long distance transports of materials and goods, it is recommended that the ERP includes emergency responses in events of severe weather such as heavy rainstorms, typhoons, as well as when natural disaster events

such as flooding, earthquake, etc. occur. The ERP should include mechanisms to receive timely of warning of potential weather and natural disaster events, communication systems, processes to secure facilities/installations, decisions to suspend operations, business continuation plan, and communication procedures to staff, contractors and visitors.

3.1.7 Failure / Collapse of Structure / Landslides

ST operations involve quarry and mine sites. The ERP should include emergency response in an event of structure failures, collapse of quarry or mine structures and/or landslides. Processes and procedures should be in place to mitigate the damages, rescue trapped or injured workforce and

3.1.8 Vehicle Accidents

The ERP shall include emergency responses in events of vehicle accidents during travel to and from sites and transports of materials and goods. The ERP should include mechanisms to communicate incidents in a timely manner, to secure the scene of the incidents, to respond to emergencies at the scene such as fire and/or spill, and to replace the vehicle and/or to rescue staff.

3.1.9 Civil Unrest/Violence

The ERP shall document appropriate responses to civil disturbances and active protests, as well as the potential for violence against ST staff or contractors. Procedures should include employee notification of active events and actions to be taken by the site incident commander.

3.1.10 Bomb Threat/Suspicious Packages

Although not a common occurrence, all bomb threats or receipt/identification of suspicious packages should be taken seriously. The ERP must provide guidance on:

- Appropriate responses by an employee receiving a bomb threat via phone, including data that should be gathered;
- Appropriate reactions in response to the identification of suspicious packages;
- Follow-up actions by the site incident commander; and
- Appropriate emergency contact phone numbers.

Examples of simplified emergency response processes are provided in Attachments 2-8. These should be posted in key areas of ST's premises such as staff canteens, nursing stations, main offices, main staff entrances, or any other places deemed relevant.

3.2 **RESPONSIBILITIES**

The ERP shall outline responsibilities of the Chief Wardens, relevant Area Wardens and ERTs. Where specific employee actions are required by any element of the ERP, these actions shall be Defined and communicated during training.

3.3 **EMERGENCY RESPONSE TRAINING AND DRILLS**

All ST's employees shall be trained on the requirements of their ERP. Training shall include, at a minimum, information on:

- Evacuation routes and assembly points;
- Site alarm systems (visual and audible);
- Post evacuation/shelter in-place personnel accounting procedures;
- Shelter in-place locations and conditions;
- Fire, explosion and chemical release hazards within the operational location, site or area;
- Available fire, explosion and chemical release control systems;
- Potential other emergencies in the workplace and appropriate response actions; and
- Critical operations which may require shutdown prior to evacuation.

The site shall determine schedule for emergency training and practices for other types of emergency and document in the HSSE Monitoring and Review Plan. It is suggested that emergency scenarios for training/ practice are not repeated; desk top exercise can also be used.

3.3.1 **Fire Safety Training**

Fire safety briefing shall be given to all new staff, contractors and visitors (likely to be present on site for more than 1 day). A refresher fire safety briefing shall be provided to all staff at least once a year. Content of fire safety briefing shall cover, at a minimum:

- General concept of fire prevention;
- Response to fire alarm;

- Emergency exits and evacuation routes;
- Use of fire extinguishers; and
- Current fire services installations.

3.3.2 **Fire Evacuation Drill**

All staff and contractors present at the site must participate in the fire drill in order to familiarize themselves with the escape routes and gain experience from a planned evacuation. HS Manager shall inform time and date of the fire drill in advance to all staff, at least one week before.

The HSSE Head and HS Manager will review the result of fire drill and evacuation procedures. During the fire drill, HS Manager or his/her representative shall facilitate the planned evacuation and count the total number of staff and contractors involved.
Fire drills at ST's Premises should be carried out at least once every 6 months.

3.3.3 **Chemical Spill Drill**

Chemical spill emergency response briefing and drill shall be given to relevant staff and contractors. A refresher briefing shall be provided at least once a year. Content of chemical spill emergency response briefing shall cover, at a minimum:

- General concept of safe chemical storage, different kinds of spill containments, the materials' characteristics and storage requirements, compatibility and reactions, etc.;
- Response to spills for different materials;
- Area containment/cordon;
- Evacuation of irrelevant people from the area;
- Use of spill control and clean up kits;
- PPE requirements;
- Disposal of clean up materials.

3.4 COMMUNICATIONS

3.4.1 Internal Communication

Different types of emergency events will require different levels of response. Events will be evaluated by the Site Operation Manager or Chief Warden. Only the Site Operation Manager or Chief Warden has the authority to declare an emergency and activate the Emergency Response Plan.

When an emergency is confirmed, the Chief Wardenwill notify the necessary personnel to respond to their area of assignment. The methods of communication listed below in descending order will be used (a being the primary mode of communication followed by alternative modes). Notifications will be given in plain language and in the different main languages likely spoken on site. Code words shall not be used.

a. Intercom/PA System;

b. Telephone;

c. Runners.

Emergency response team contact information shall be maintained and up-to-date at all time. Contact list template is provided in Attachment 1. Site office extension/contact number shall also be maintained up-to-date and lists readily accessible at all times and should be posted in key areas of ST's premises such as staff canteens, nursing stations, main offices, main staff entrances, or any other places deemed relevant).

3.4.2 External Communication

The ERP shall describe procedures for external communication, including for contacting external emergency services; contacting families of injured and media communication (it is suggested to have designated persons and protocol, including when and what to communicate by which media).

3.5 ACCIDENT AND MAJOR INCIDENT REPORTING

All incidents including injury, damage, environmental damage, non-conformance, near misses, regardless of severity must be reported as per the Incident Reporting Procedure.

3.6 EMERGENCY RESPONSE EQUIPMENT AND INSTALLATIONS

The ERP shall describe types of emergency response equipment required at each of ST's Premises. These may include but not be limited to:

- Firefighting equipment;
- Fire evacuation facilities (exit signs, fire doors, alarm system, PA system);
- First-aid boxes;
- Automated external defibrillator (AED);
- Chemical Spill Emergency Equipment;
- Personal Protective Equipment (PPE).

Also in this section requirements / arrangements for equipment maintenance and inspection should be included.

4 AUDIT AND REVIEW POLICY

This procedure must be reviewed and updated annually by the HSSE Committee, after emergency response drills and practices or after any change in operations, physical installations or plans, and on an ad-hoc basis by ST's Audit Function Unit, to ensure its continuing suitability, adequacy and effectiveness. The review shall be formally documented.

Any significant changes made to the procedure will be announced to all staff, and training provided to ensure relevant staff are made aware of updates.

This Procedure will be made available online, provided to Contractors and a written copy kept at all times in the following locations:

Table X Emergency Response Procedure Distribution

Location	Number of Copies
Total	

5 RELATED DOCUMENTS AND REFERENCES

5.1 External Documents

5.1.1 Earthquake And Tsunami Hazard in Myanmar (Maung Thein et al, J., 2009)

5.1.2 Cement Sustainability Initiative (2004) Health and safety in the cement industry: Examples of good practice, World Business Council for Sustainable Development

5.2 Internal Documents

5.2.1 HSE Management System Document (HSE-SOP-011)

5.2.2 Incident Reporting and Investigation Procedure (HSE-SOP-001)

5.2.3 Waste Management Procedure

5.2.4 Storage and Handling of Hazardous Materials

5.2.5 Fire Prevention Check List (HSE-FOM-010-007-001)

5.2.6 Permit to Work Form (HSE-FOM-010-007-002)

5.2.7 Emergency Report Form (HSE-FOM-010-007-003)

5.2.8 Assembly Point Roll Call Form (HSE-FOM-010-007-004)

5.2.9 Work Instruction for Emergency (HSE-WIS-010-007)

5.2.10 Work Instruction for Fire Drill (HSE-WIS-010-008)

5.2.11 Emergency response team activities analyzing (during a fire drill) –template report

5.2.12 Fire inspection card

6 ATTACHMENTS

6.1 Emergency Contacts

6.2 Evacuation Plan

6.3 Fire Emergency Response

6.4 Chemical Release Response

6.5 Worker Injuries Response

6.6 Heavy Rainstorm/Typhoon/Thunderstorm Response

6.7 Vehicle Accident Response

6.8 Social Unrest / Intruder Response

6.9 Fire Extinguisher Inspection Record Template
6.10 Hydrant Inspection Record Template
6.11 First Aid Kit Record Template

Attachment 1 - Emergency Contacts

CONTACT LIST OF MAIN STAFF, WARDENS AND EMERGENCY NUMBERS

Shwe Taung Cement Co., Ltd. (STC)			
Office Hours	XXX to XXXX	Contact Number	XXXX
		After Hours Contact Number	XXXX
Shwe Taung Mining (STM)			
Office Hours	XXX to XXXX	Contact Number	XXXX
		After Hours Contact Number	XXXX

Emergency Appointment	**Contact Detail / Radio**	**Stand-In Control Contact Detail / Radio**
Chief Warden		
Deputy Chief Warden		
Area 1 Warden		
Area 1 Deputy Warden		
Area 2 Warden		
Area 2 Deputy Warden		
Etc….		

Emergency Services	**Contact Numbers**	**Who Contacts?**
Internal Emergency Number (control room)	Phone intercom 3055 (main gate) And Radio emergency 155450	Anyone discovering an emergency
Fire Brigade	XXXX	Chief Warden or Deputy Chief Warden

Police (criminal incidents)	XXXX	General Manager or HSSE Manager
Ambulance (medical treatment required)	XXXX	Chief Warden or Deputy Chief Warden
Poisons Information	XXXX	Chief Warden or Deputy Chief Warden
Electricity	XXXX	Chief Warden or Deputy Chief Warden
Gas	XXXX	Chief Warden or Deputy Chief Warden
Water	XXXX	Chief Warden or Deputy Chief Warden
Roads Services (any incident affecting roads)	XXXX	Chief Warden or Deputy Chief Warden

0.1 **Contact List of Main Staff, Wardens and Emergency Numbers**

In the event of an emergency, the process to follow is broadly:

- Contact Chief Warden / Site Operation Manager / Control Room either via dialing XXX or radio;
- Activate the nearest emergency alarm if necessary;
- Make the area safe without putting anyone in the line of fire or other emergency;
- If safe to do so, provide assistance to injured persons;
- Inform Line Manager / Frontline Manager / supervisor;
- Await further instructions.

0.2 **Access for External Emergency Services**

In the event an external emergency service requires access to STC premises, escorts and direction guides may need to be dispatched.

Shwe Tang Cement Co., Ltd. (STC) address is:

XXXXXXX

Shwe Tang Mining (STM) address is:

XXXXXXX

Attachment 6.1 Evacuation Plan

8 EVACUATION PLAN

In the case where an emergency occurs and the building/area/site needs to be evacuated, the Site Operation Manager/ site incident commander will be responsible for initiating the evacuation, managing the assembly point(s), and issuing the all clear/return to work instruction. Area Wardens are responsible for ensuring that all ST's employees, contractors and visitors have evacuated the building and are accounted for.

Figure X Map of Areas and Evacuation Routes at the Site

XXXXX – Insert area specific evacuation procedures and route maps.

Table 1 List of Areas at the Site

Description of Area / Known Name	Boundaries	Assembly Point Location

Figure X Map of Areas and Assembly Points at the Site

ADD MAP

Each pre-defined relevant areas of ST's premises will have at least one designated external Assembly Point.

Attachment 2 Fire Emergency Response

If you notice a fire or smoke on site – Stay calm

Step 1: Move away from immediate danger.

Raise the alarm by manually activating the nearest fire alarm "pull station".

If there is no pull station nearby, call emergency phone XXX or radio channel XXX.

Raise vocal alarm to alert nearby persons and get help.

Advise your Area Warden / Line Manager / Frontline Manager / supervisor immediately.

Step 2: If it is a small fire, attempt to use a portable fire extinguisher to control the fire from spreading.

Check for casualties / injured persons; attempt to help if it does not pose any danger to you / surrounding people

Step 3: Evacuate using designated fire exist.

Follow the instructions from your Area Warden / Line Manager / Frontline Manager / supervisor

DO not re-enter the site until the Chief Warden gives the all clear.

When in doubt, evacuate.

If you hear a fire alarm

Step 1: Leave at once, taking direction from the Emergency Response Team.

Do not delay yourself by gathering personal items.

Before you open any door, feel the door with the back of your hand: if the door is cold, proceed to slowly open.

Step 2: If there is no smoke in hallways or stairwells follow your site/ building's evacuation plan and get out quickly using designated fire exits.

Close doors behind you, however do NOT lock the door.

Use the stairway and proceed down and out of your building or area. Never go up.

Step 3: Assemble at your emergency assembly area with your team and under the supervision of your Frontline Manager / Line Manager / supervisor.

Make sure you are being accounted for.

Remain within your Area Warden at all times.

Await further instructions.

DO not re-enter the site until the Chief Warden gives the all clear.

If you are part of the ERT

- Frontline Manager / Line Manager / supervisor and Area Wardens must take day-sheet, visitors' book, daily attendance book, evacuation checklist.
- The Area Wardens shall check their designated areas have been evacuated and all personnel moved to assembly points, shut down or switch off gas, air conditioning, machines and appliances but leave lights on, confirm all doors, windows and hatches are closed to contain fire and block off smoke, confirm alarm has been activated and emergency services advised of details and location, position "NO ENTRY" signs at gates, report personnel headcounts.
- At the emergency assembly area, Frontline Manager / Line Manager / supervisor and Area Wardens shall gather headcount of the personnel and ensure all personnel are accounted for. ERT shall take over the control of the area.
- The First Aid Team shall collect the nearest First Aid Kit, administer first-aid treatment to the injured if there are any and it is safe for them to do so.
- The Rescue Team shall be informed and instructed to organize search and rescue of all reported missing personnel immediately.
- The Area Wardens shall inform the Chief Warden / Deputy Chief Warden of any smoke or fire alerted to, and location
- The ERT shall report the status of the emergency to the Chief Warden / Deputy Chief Warden.
- The Chief Warden / Deputy Chief Warden shall assess the seriousness of the emergency incident and decide on the next course of action and whether to evacuate the personnel from the site.
- The Chief Warden / Deputy Chief Warden shall confirm all personnel are being moved for evacuation.
- Advise the external emergency services as necessary and check or activate all other immediate or follow-up actions.

- Dispatch a worker in a vehicle to the main ST's relevant premise entrance and/or coordinate with the Site Security Team to control incoming traffic and to escort emergency services to the site.
- Instruct the Site Security Team to position "NO ENTRY" signs at gates.
- Liaise with Medical Team, Site Security Team and other ERT members.
- Hand the situation to external emergency services (Fire Brigade) on arrival and advise them and Site Operation Manager of:
  i. Any unaccounted-for personnel
  ii. Latest situation and actions taken
- Await instructions.

- After the incident, the Chief Warden / Deputy Chief Warden shall compile an emergency incident report and submit the report to the Head of Business and HSSE Head.
- The Chief Warden / Deputy Chief Warden shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

If you are trapped in smoke or heat

- Before you open any door, feel the door with the back of your hand: if the door is warm to the touch, do not attempt to open the door.
- Stuff the cracks around doors with towels, rags, clothing or tape, and cover vents to keep out smoke.
- Stay low to the floor, and if possible, cover your mouth and nose with a damp cloth or dust mask to help you breathe.
- If there is a phone in the room where you are trapped, call control room / outside to tell them exactly where you are located, even if you hear or see emergency services nearby.

Attachment 3 Chemical Release Response

If you spot chemical spillage

- Move people in immediate danger to safety.
- Shut down or switch off equipment but leave lights on.
- If safe to do so, assist and care for injured personnel and call for first aid assistance.
- Carry out a brief first assessment of:
    i. the quantity spilled
    ii. The environment affected (e.g. confined within site, spillage to surrounding land, etc.)
    iii. The type of oil or chemical (e.g. hazardous or non-hazardous, poisonous, explosive, etc.)
- If safe to do so, make use of spill kits to restrict movement of spill.
- Inform your Line Manager / Frontline Manager / supervisor immediately.
- Restrict access to the area.
- Await instructions from Area Warden or Chief Warden.

If you are part of the ERT

- Move people in immediate danger to safety and ensure their continued safety and care.
- Restrict access to area.
- Contact on-site emergency services if necessary.
- Chief Warden / Deputy Chief Warden to initiate evacuation if necessary.
- If the oil / chemical spillage is non-hazardous and is confined within defined boundaries, apply the 3Cs (control, contain and clean) procedure:
    i. Try to contain the oil / chemical spillage.
    ii. Control the spillage and prevent from spreading by isolating the source of the spill. Ensure that the spillage does not flow into the public drainage system.
    iii. Clean up the spill with the appropriate clean-up measures stated in the oil / chemical's Safety Data Sheet (SDS).
    iv. If clean up cannot be conducted, contact external qualified cleaning contractors to carry out the clean-up operation.

- In the event of non-hazardous oil or chemical spillage to public areas (e.g. public roads, drainage, etc.):
  i. Stop any further spillage from the project site by blocking all leakage points.
  ii. Carry out spillage control measures using the most suitable method of containment, depending on the type of oil / chemical spillage and the estimate volume of spillage.
  iii. Prevent further flow of spillage into the public areas by blocking the entry points (at locations such as drains, creeks, water courses, sewers, etc.) by measures such as using sand bags, provide bunding around entry points, etc.
  iv. Use the available types of spillage control / clean-up kit, sand, soil or other materials, etc. to further contain and clean up spillage.
  v. Ensure that all personnel involved in the spillage control work are issued with and attired in the appropriate personal protective equipment (PPE) to prevent control of the spillage materials with the personnel.
  vi. Ensure that contaminated material / waste are stored in sealed containers and properly labelled. All contaminated material / waste shall be disposed of properly in accordance to Myanmar Environment's regulations, ST Waste Management Procedure and Storage and Handling of Hazardous Materials.
  vii. Arrange for immediate remediation of the affected areas, after the spillage is brought under control.
  viii. Contact the public emergency services to control the situation if the measures to stop the spillage from the project site are not effective.
- Liaise with all relevant external parties (i.e. authorities, emergency services, etc.).
- Inform Site Operation Manager of the incident/ situation and keep him/her informed of the status of the emergency.

- After the incident, the Chief Warden / Deputy Chief Warden shall compile an emergency incident report and submit the report to the Site Operation Manager and HSSE HEad.
- The Chief Warden / Deputy Chief Warden shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

The Hazardous and Dangerous Materials Register is referred to in the Storage and Handling of Hazardous Material Procedure procedure and are maintained under the supervision of HS Manager.

The Hazardous and Dangerous Materials are located XXX.

Attachment 4 Worker Injuries Response

If you witness a worker injuries

- Raise alarm by shouting "Help! Help! Help!".
- Inform your Line Manager / Frontline Manager / supervisor immediately.
- Warn other people to stay away.
- If safe to do so, provide assistance to any injured personnel.

If you are part of the ERT

- Upon reaching the location of the emergency incident / situation, take over the control of the area.
- Help all other persons to leave the area immediately and cordon off the affected area, except for ERT members who are conducting medical treatment, rescue and/or evacuation of the personnel.
- Inform HSSEMedical Team and report the status of the accident.
- The First-Aid Team shall administer first-aid treatment to the injured or help the injured walk to the first aid treatment room for basic treatment.
- On-site Medical Team shall assist in treating the injured person and advising whether the injury is minor (e.g. the injured person is still conscious and is able to move with assistance) or severe (e.g. injuries sustained are critical and injured person is either unconscious or is not able to move); depending on the diagnostic, Medical Team shall advise on the most suitable from of transport to send the injured person to the nearest clinic/ hospital with a ST's Medical Team member to accompany the injured person.

- After the incident, the Medical Team shall compile an incident report and submit the report to the HSSEHS Manager.
- The Medical Team shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

Attachment 5 Heavy Rainstorm/Typhoon/Thunderstorm Response

Whenever a heavy rainstorm and thunderstorm occurs, staff and contractors who are outdoors in exposed areas should:

a) Suspend all outdoor activities;

b) Stay indoor or seek shelter in buildings;

Caution: If a safe shelter is not available, do not stand on hill tops or near any highly conductive objects such as trees, masts, aerials, water taps, pipes, wire fences and similar metal installations. Since lightning current is conducted away through the ground, you should not lie down especially when the ground is wet. Instead you should crouch down to minimize the area in contact between you and the ground.

c) Stay away from low-lying coastal areas or rivers;

d) Suspend any form of water activities;

Caution: Avoid using telephone or other plugged-in electrical appliance, including computers.

e) Stay indoors or take shelter in a safe place until the heavy rain has passed;

f) Inform your immediate Line Manager / Frontline Manager / supervisor after a safe place has been found.

Attachment 6 Failure / Collapse of Structure / Land Slides Response

If you witness failure or collapse of structure

- Raise alarm by shouting "Help! Help! Help!".
- Inform your Line Manager / Frontline Manager / supervisor immediately.
- Warn other people to stay away from the affected structure at least until ERT arrives.
- If safe to do so, provide assistance to any injured personnel.

If you are part of the ERT

- Upon reaching the location of the emergency incident / situation, take over the control of the area.
- Help all other persons to leave the area immediately and cordon off the affected area, except for ERT members who are conducting rescue and/or evacuation of the personnel.
- Inform the Chief Warden / Deputy Chief Warden and report the status of the emergency.
- The Chief Warden / Deputy Chief Warden shall assess the seriousness of the emergency incident and decide on the next course of action: if the situation is beyond control and/or endangers the lives of personnel, emergency evacuation shall be activated and headcount activated by Area Wardens.
- If there is an outbreak of fire, the Firefighting Team to proceed.
- The Rescue Team shall proceed and check for any casualty or persons trapped in the location and conduct rescue.
- The First-Aid Team shall administer first-aid treatment to the injured if there is any.
- The Chief Warden / Deputy Chief Warden shall liaise with all relevant external parties (i.e. authorities, emergency services, etc.).
- The Chief Warden / Deputy Chief Warden shall inform Site Operation Manager of the emergency incident / situation and keep him/her informed of the status of the emergency.

- After the incident, the Chief Warden / Deputy Chief Warden shall compile an emergency incident report and submit the report to the Site Opertaion Manager and HSSE Head.

- The Chief Warden / Deputy Chief Warden shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

Attachment 7 Vehicle Accident Response

If you are involved in vehicle accident

- In the event of a bus accident or breakdown, ensure the safety of staff and public first.
- Call emergency services if required.
- Inform your Line Manager / Frontline Manager / supervisor immediately.
- Warn other people to stay away from the vehicle.
- If safe to do so, provide assistance to any injured personnel.

If you are part of the ERT

- Evaluate the emergency situation.
- Notify emergency Medical Team as appropriate.
- Organise replacement vehicle as needed.
- Inform local communities.
- Inform injured personnel's family.

Attachment 8 Social Unrest / Intruder Response

If you witness intruder or hostage taking

- Notify site incident commander who will make a decision whether and how to approach the intruder.

If you are the site incident commander

- When approaching the protesters/ intruder, politely greet them and identify yourself.
- Ask the intruder the purpose of his/her visit.
- Inform the intruder that all visitors shall register at XXXXX.
- If intruder's purpose is not legitimate, ask him/her to leave. Accompany intruder to exit.
- If intruder refuses to leave:
    - The site incident commander to notify the Police (keep intruder unaware of call for help if possible).
    - Walk away from the intruder if he/she indicates a potential for violence. Be aware of intruder's actions at this time (where he/she is located in school, whether he/she is carrying a weapon or package, etc).
    - Maintain visual contact with intruder from a safe distance.

Witness of hostage taking:

- If hostage taker is unaware of your presence, do not intervene.
- Notify site incident commander.
- Site incident commander call police immediately. Give dispatcher de tails of situation; ask for assistance from hostage negotiation team.
- Seal off area near hostage scene.
- Follow the police instruction regarding evacuation or lock down.
- Give control of scene to Police and Hostage Negotiation Team.

If taken hostage:

- Follow instructions of hostage taker.
- Try not to panic. Calm others present.
- Be respectful to hostage taker.

Attachment 9 Fire Extinguisher Inspection Record Template

No	Inspected Date	Location	Quality							Total	Inspector Name	Sign	Section Head	Sign	Remark
			2kg	4kg	5kg	8kg	9kg	25kg	50kg						
1		Thaphay 1 to 9	0	0	9	0	0	0	0	9					
2		Gandamar	0	2	0	0	0	0	0	2					
3		Thayaphi Camp	0	2	0	0	0	0	0	2					
4		Mahawgani Camp	0	1	0	0	0	0	0	1					
5		Khaye 1to2	0	2	0	0	0	0	0	2					
6		Gangaw Camp	0	1	2	0	0	0	0	3					
7		Htinshu Camp	0	1	2	0	0	0	0	3					
8		Ingyinn Camp	0	3	0	0	0	0	0	3					
9		Main Office	0	0	4	0	0	0	0	4					
10		Site Office	0	0	1	0	0	0	0	1					
11		Chinese Office													
12		Base Camp	0	0	8	0	0	0	0	8					
13		101 Section	0	0	3	0	0	0	0	3					
14		101 Contron Room	0	0	2	0	0	1	0	3					
15		102 Contron Room	0	0	0	0	0	1	0	1					
16		103 Contron Room	0	0	0	0	0	1	0	1					
17		201 Contron Room	0	0	0	0	0	1	0	1					
No	**Inspected Date**	**Location**	**Quality**							**Total**	**Inspector Name**	**Sign**	**Section Head**	**Sign**	**Remark**
			2kg	**4kg**	**5kg**	**8kg**	**9kg**	**25kg**	**50kg**						
18		202 Section	0	0	4	0	0	0	0	4					
19		202 Contron Room	0	0	5	0	0	1	0	6					
20		302 Section	0	1	4	0	0	0	0	5					
21		303 Contron Room	0	0	3	0	0	1	0	4					
22		303 Section	0	0	4	0	0	0	0	4					
23		405 Section	0	0	6	1	4	0	0	11					
24		405 Contro Room	0	0	2	0	0	1	0	3					
25		403 Section	0	0	4	0	0	0	0	4					
26		403 Contron Room	0	0	2	0	0	0	0	2					
27		402 Contron Room	0	0	1	0	0	1	0	2					
28		501 Contron Room	1	0	1	0	0	1	0	3					
29		502 Control Room	0	0	2	0	0	0	0	2					
30		601 Air compressor	0	2	0	0	0	0	0	2					
31		603 LQC Room	0	6	2	0	0	0	0	8					
32		603 CCR Room	0	0	4	0	0	0	0	4					
33		701 Section	2	1	2	0	0	0	0	5					
34		701 New Section	0	0	4	0	0	0	0	4					
35		801- Generator	0	0	2	0	0	0	0	2					
36		801 Contro Room	0	0	3	0	0	1	0	4					
37		Store	0	1	3	0	0	0	0	4					
No	**Inspected Date**	**Location**	**Quality**							**Total**	**Inspector Name**	**Sign**	**Section Head**	**Sign**	**Remark**
			2kg	**4kg**	**5kg**	**8kg**	**9kg**	**25kg**	**50kg**						
38		HME	0	0	0	5	0	0	0	5					
39		Magazine(Tan 30)	0	0	5	0	0	0	0	5					
40		Magazine(Tan100)	0	10	0	0	0	0	0	10					
41		Fuel Station (Oil)	0	0	4	0	0	0	1	5					
42		**Labour Camp Messing**	0	0	4	0	0	0	0	4					
43		3 Storey Messing	0	1	0	0	0	0	0	1					
44		New Weight Bridge	0	0	2	0	0	0	0	2					
45		Old Weight Bridge	0	0	0	0	0	0	0	0					
		Total	**3**	**34**	**104**	**6**	**4**	**10**	**2**	162					
	Store vufusefpm&if;		10	12	34	4	3			63					

Reported By

Signature

Name Chan Min Zaw

Position Staff I

Department HSE

Approved By

Signature

Name Kyaw Thiha

Position Safety Manager

Department HSE

Attachment 10 Hydrant Inspection Record Template

No	Inspected Date	Location	Quantity						Total	Inspector Name	Sign	Section Head	Sign	Remark
			Hoses	Hydrant	Nozzle	Inlet	Spanner	Outlet						
1		405												
2		401												
3		304												
4		801												
5		701												
6		701 (North)												
7		201												
8		501												
9		502												
10		603												
11		403												
12		405												

Reported By

Signature
Name Chan Min Zaw
Position Staff I
Department HSE

Approved By

Signature
Name
Position
Department HSE

Attachment 11 First Aid Kit Record Template

No	Inspected Date	Location	Quality									Total	Inspector Name	Sign	Section Head	Sign	Remark
			ORS	Neo bun	Spirit	Septi cline	Paper Tape	Hansa plast	Band age	Cotton	E - Glove						
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

	Reported By			Approved By	
Signature			Signature		
Name	Chan Min Zaw		Name	Kyaw Thiha	
Position	Staff I		Position	Safety Manager	
Department	HSE		Department	HSE	

Annex V

ECD Comments and Responses to Comments Table (2024)

Initial comments and suggestion of the Environmental and Social Impact assessment report of extension production from 715000 ton to 2934965 ton per day of existing Limestone Quarry project in Pyi Naung Village of Tharzi Township in Mandalay Region

No	Findings	Comment/ Remark	Response
1.	Executive Summary		
	Executive Summary is not enough information in report. There is not included the full information of the Limestone quarry.	(1) In the executive summary, the following is required to include for limestone quarry project because there is it enough information in the report; i. A Map which can be described the existing parts of project and extension parts. ii. Description of comparisons of existing project parts, Infrastructures, constructed production buildings and machines, and extension project's parts, infrastructure and constructed production buildings and machines. iii. Existing resources using and required resources of the extension project parts (Demand of Electricity, Water, raw materials, fuels and human resources, etc.) iv. Process of Limestone Quarry such as methodology of the Limestone quarry, Types of Mine, Mining Plan, Timetable, Transportation, Pre-gridding, and Type of machineries and numbers of labors. v. Executive Summary of Environmental Management Plan in operation phase and Monitoring Plan. Plan for proceeding of Decommission phase because it is really important of Limestone Project, Budget for the Decommission Phase and detail of verdant plan after Decommission phase.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant. Please refer Annex - J: Process of STM Limestone Quarry Please refer Annex - K: STM Conceptual and Mine Closure and Rehabilitation Plan

No	Findings	Suggestion	Response
	Although significant issues and main impacts are mentioned in table 1.3, mitigation measures and monitoring requirement are not summarized.	To include the summary of mitigation measures for project impacts and monitoring requirements at table 1.3 or of below relevant sections.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	It is found out that below facts are not summarized in Executive summary. 1. Assessment of project alternative 2. Proposed mitigation measures 3. Proposed monitoring plan 4. Environmental management plan	To include at the executive summary – Summary of 1. Assessment of project alternative 2. Proposed mitigation measures 3. Proposed monitoring plan 4. Environmental management plan	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	EIA Consultants and their responsibility Although academic experiences, years' experience, area of expertise of EIA consultants are mentioned in table 2.1, page 13, there is no provision of which chapter and component of the report are prepared by which consultants.	At table 2.1, page 13, to include the description of chapter and sections prepared by each one of the 7 consultants.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	It is found out that there is one consultant who registered individually and consultants registered under ERM-Hong Kong.		ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
2	Policy, Legal and Institutional Frame Work		
	The Description of the Chapter 3 Policy, Legal and Institutional Frame Work are copy of the content of the laws and there is not described the related section of laws which has to be followed by project component as legal commitments.	(1) To describe the related section of laws which has to be followed by project component as legal commitment (To write as the description of the project component will follow by those sections of laws) (2) The laws and rules to follow are as follow; 1. The Environmental Conservation Law, 2012 (Section 7 (o), 14, 15, 24, 29 2. The Environmental Conservation Rules, 2014 (Section 69)	Section 3.1 is revised accordingly.

No	Findings	Suggestion	Response
		3. EIA Procedure (Paragraph 102 to 110, 113, 115, 117 4. EQES 5. Law protecting Ethnic Right, 2015 (Section 5) 6. Myanmar Investment Law, 2016 (Section 50(d) 51,65 (e to q, expect n), 73) 7. Myanmar Investment Rules, 2017 (Section202,203,206) 8. Myanmar Insurance Law, 1993 (Section 15, 16) 9. The Protection and Preservation of Antique Objects Law, 2015 (Section 12) 10. The Protection and Preservation of Ancient Monuments Law, 2015 (12,15 (b), 20(b) 11. The Protection and Preservation of Cultural Heritage Regions Law, 1998 (Section 16,18,22) 12. Public Health Law, 1972 (Section 3(1) (4)(5) 13. The Protection and Prevention of Communicable Disease Law, 1995 (Section 3(a)(9), 4,9,11 14. The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Section 9) 15. Myanmar Fire Force Law, 2015, (Section 25) 16. The Petroleum and Petroleum Product Law, 2017 (Section 9(a)(d), 10(a)(b)(d)(e)(n) 17. Petroleum Rules 1937 Chapter 3 and 4) 18. Conservation of Water Resources and Rivers Law , 2006 (Section 8(a)(b), 9,11(a)(b), 12,19,21,22,30) 19. Engineer Council Law, 2015 (Section 37, 34) 20. Forestry Law, 2018 (Section 12) 21. The Protection of Biodiversity and Conservation Areas Law, 2018 (Section 3(a)d)(e), 40(a)(b)(c), 41(a)(c) 22. Export Import Law,2012 (Section7)	

No	Findings	Suggestion	Response
		23. Labour Organization Law,2011 (Section 17-22) 24. The Leave and Holidays Act, 1951 (Write to summarise) 25. Factories Act, 1951 (Write to follow prescription of the Occupational safety, Health for workers, Warfare) 26. Employment and Skill Development Law, 2013 (5,14,30 (a)(b) 27. Minimum Wages Law,2013 (Section 12,13(a)(b)(c)(d)(e)(f) 28. Payment of Wages Law,2016 (Section 3,4,5, 7 to 13, Chapter 3 -14) – missing 10 29. Social Security Law, 2012 (Section 11(a), 15,18,48(b), 49,75 30. Workmen Compensation Act, 1923 (Security) 31. Mining Law,1994 (Section 29) 32. Mandalay City of Development Law 33. Mandalay Regional Fresh Water Fishery Law 34. Mandalay Regional Fishery Law (Same as 33?) 35. Prevention from danger of chemical and associated Materials Law, Section 15(a)(b),16,17,22,23(a),27 36. Private Industrial Enterprise Law, 1990 (Section 4,13(b)(e)(f)(g), 15(a)(b) 37. Export Import Law,2012 (Section7) (Note: Already in 22) 38. Related section of Industrial Use Explosive Substances Law (2018)	
	The policies complied to proceed the project by project component are described in Section 3.7, page 45. However, there is no description for the policies of Biodiversity conservation.	(1) To describe the policies of Biodiversity conservation in the policies chapter (e.g. STC Biodiversity and Ecosystem Services Policy, STC Anti – illegal Logging Policy etc.)	Section 3.7 is updated. Policies related to biodiversity conservation are described in Section 2 to Section 4 of the Biodiversity Action Plan in Annex E.
	Contractor's nature and commitments The survey related to limestone quarry are contracted with FFI. But, there is no nature and commitment	To include the agreement letter of project proposed person's agreed to **Contractor's nature and commitments**	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	of that project proponent. And there is no agreement on commitment has been found.		
	Laws those need to be followed by project proponents are listed in section 3.7. However, those are just the title and not enough detail information on process and law. Laws regarding biodiversity conservation are attached in annex. But, no provision in this chapter.	(1) Among regulations described at section (3.7), page (45), the project proposed person have to describe the detailed regulations set out for environmental, social, health and safety. (2) Project proposal person has to include regulations for biodiversity conservation. (eg. STC biodiversity and Ecosystem Services Policy, STC Tnti illegal Logging Policy etc.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant. Please refer Annex - L: Occupational Health and Safety Policy Please refer Annex: E Biodiversity Action Plan
	It is mentioned that a concession of 600 acres in size of forest area has been allocated for limestone extraction by a lease agreement for 25 years with Forest Department. However, there is not described the official documents for the lease agreement and the permission documents from Chief-of-staff office of Defence service (Army) for exploration.	(1) Add in appendix – documents of lease agreement and plan for extension with related departments in operation phase. (2) To describe the approval of Chief-of-staff office of Defence service (Army) to export, import, transportation, storage, using, handling. Transferring of the operational exploration materials in appendix. (3) In this section, the project proposal person has to include regulations for the type of works that need to have permissions received from ministries (eg. beneficial agreement (PSC) with ministry of mining such as environmental conservation, mine closure fund, CSR development funds and regulations for approval of Chief-of-staff office of Defence service (Army) to export, import, transportation, storage, using, handling, transferring of the operational exploration materials.) and also contractual commitments are to be included.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant. Please refer Annex - M: CSR Fund and Mine Closure Fund of STM Limestone Quarry Due to present condition, it will not be disclosed in EIA report of exporting, importing, transportation, storage, using, handling, transferring of the operational exploration materials. STM has fully complied on the regulation from Ministry of Defense, Myanmar.
3	**Project Description and Alternatives**		
	Project Description Project description is described in page 48-60. However, only summary of the Limestone Quarry process is described in page 49 and other	(1) To describe the detail information about the Limestone Quarry and required Photos and Maps because it is a EIA report for Limestone Quarry (e.g. Road constructed for Limestone Quarry project, energy usage and resources, required fuel and storage areas water volume for the current project,	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant. It should, however, be noted that the limestone quarry is located together with the cement plant and mudstone quarry such that ancillary facilities (e.g. wastewater treatment plant for staff, non-hazardous solid waste management facility, utility (power and water), staff accommodation etc) are of

No	Findings	Suggestion	Response
	project description related for the cement factory (e.g. Road, Electricity usage, fuel storage area, water supply and usage, wastewater discharge and purification, hazardous and non-hazardous waste management) It is found that there is no description for the detail information about existing quarry.	drainage systems of existing Quarry project, drainage management systems, overburden Waste, Waste Rock and existing Management systems) (2) To describe the detail information of the methods of existing Limestone production and parts, changes of advanced methodology for Limestone quarry expansion project, new building plan, extended machines and required natural resources (required Electricity and energy, water, raw materials, fuel, Human Resources)	shared use with the cement plant and mudstone quarry.
	Main Components of Project It is described that the limestone will be produced in 600 acre of forest area on the ridge of the Tha Pyae mountain range of Thazi Township, Pyi Nyaung Village and Kubyin Area with lease agreement from the Forest Department renewed annually since 31 March 2011 and operating agreements for large scale production of limestone in a production sharing system from the Ministry of Mines for 25 years starting 22 December 2010, and then the limestone quarry is located to the east of the STC cement plant and the Project aims to produce 715,000 per year using of the digging and exploration method and it is estimated that limestone reserves of 110 million tonnes, is expected to be mined down from ~750 m to 550 m above sea level. Though it is described that it will be required 2.9 million tonnes of limestone for second line operation and it is found that it will be enough for 37 years of the cement factory's lifetime, there will have to produce Limestone from somewhere for 13	(1) Although it is described that the Limestone mountain will be extracted down from 750m to 550m above sea level for 37 years and it will be enough for the 30 years life time of Cement factory in this report, it is found that the contract time for the cement Plant is in EIA report of Cement Plant for 50 years. So that we found that it will be required to produce of limestone for 13 years form other area. Therefore, it must be corrected the right information and it has to be described for the limestone extraction plan from other area after 37 years. (2) To describe the Mining Plan including the detail information about yearly plan (e.g. 1 to 5 years, 5 to 10 years, 10- 15 years, etc.) volume, height of sea levels, mining places) (3) To describe the highest sea level of the bottom of the limestone mountain and the condition of the Limestone area (e.g. Flat land, plateau or hole) after mine closing (after digging up to more than 550m of ASL)	(1) While it is understood that the STC cement plant area is leased under a 50-year agreement from the Forest Department of Ministry of Environmental Conservation and Forestry on 31 March 2016, the current expected lifespan of the STC cement plant is 30 years and the supply from the limestone quarry should thus be sufficient. If the lifespan of the STC cement plant is expanded beyond 37 years, STC will study the supply of limestone and ensure that all necessary permits will be obtained before further limestone extraction. ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant. (2) Please refer Annex - J: Process of STM Limestone Quarry and Mine Plan (3) The descriptions of sea level and the condition of the limestone area have been supplemented in Section 4.1.1.

No	Findings	Suggestion	Response
	years because the contract term is only for 50 years. It is describe that the detail of the exploration plan could not be available and mine closing and rehabilitation of the mine plan will be included in IFC's Environmental and Social Action plan. Only above information are summarized and there is no further detail about those.		
	Site Maps There is not enough maps for Limestone Quarry Project though there are maps for Cement plants and other parts.	(1) To describe the Contour Map for the 600 acre of the Limestone Quarry area. (2) To describe the Maps for existing and expansion area of Limestone extraction with relevant coordinate points. (3) To describe the contour maps showing mining Sequences as yearly mining plan (e.g. 1 to 5 years, 5 to 10 years, 10- 15 years,, etc.) with ASLm maps showing mining sequences and Maps for changed land use and land cover.	Please refer Annex - J: Process of STM Limestone Quarry and Mine Plan
	Procedure of Mining There is not described the mining procedure, data of exploration, type is mine, storage. Transportation and plan for exploration, materials for that and pre-plan for exploration.	(1) Procedure of limestone extraction- To describe- 1. The mining procedure for limestone extraction 2. The detail information of materials and machines, operational method and quantities of those. 3. The plan of top soil and vegetation to remove of the original Limestone mountain and amount, disposal and management plan to do it. (2) Mining- To describe- 1. The Mining procedure and Blasting Pattern Designs 2. The detail Mining schedule whether it will be planned to mine during the traditional celebrating festivals or not and etc.	(1) Mining procedure has been added in Section 4.1.2. (2) Mining procedure and blasting pattern are added to Section 4.1.2. (3) Yearly mining schedule is provided in Table 4.2. (4) Materials used for blasting operation is detailed in Table 4.4, with the permit of blasting material storage attached in Annex I. Method of storage and transportation as well as permit to work system related to blasting is also added to Section 4.1.2. (5) Description about the limestone crusher and the conveyor belt is presented in Section 4.1.1. (6) Details of blasting materials used is added in Table 4.4., with calculation of limestone production added in Table 4.1 to Table 4.2.

No	Findings	Suggestion	Response
		3. The information of the mining materials, data of technology, place of resources, storage plan, transportation plan, detail description of the technology of arsenals (Interior Wall, Exterior Wall, Foundation, Floor, Fire/Weather/ theft-resistant, lining) 4. Record of mining materials in and out, plan for the replace an order, detail plan for destroy or discharge the unused mining materials. 5. Add in annex for Detail Calculation of Data Sheet of mine using and limestone production. (3) Gridding of Limestone- To describe 1. To describe the Limestone gridding and transportation such as building of gridding, machines using for gridding, plan for transportation from mining site to gridding machine, working system of conveyors connecting with Gridding machines and Cement factory, detail data of conveyors (dust collector at turning point, etc.)	
	Project Schedule There are described the project schedule for estimated period of construction, operation and decommissioning phases in page 60. However, it is only for the cement factory's operation and it is not for Limestone quarry project.	(1) To add the Project timetable (Schedule) including the period of receiving lesion for start Limestone production, Volume of limestone in that period, expansion of the lesion period, volume for the expansion of the limestone extraction, year of end for lesion, period of decommissioning phase and rehabilitation period etc.	The mining plan is shown in Annex - J: Process of STM Limestone Quarry and Mine Plan that demonstrate the detailed mining sequences in the limestone quarry area during the 37 years of lifespan of the limestone quarry. STC is committed to prepare the Mine and Quarry Rehabilitation Plan in Section 11.4 which will detail the decommissioning phase and rehabilitation period. Please refer Annex - K: STM Conceptual and Mine Closure and Rehabilitation Plan
	Major activities of the project Except the description of mining procedure and transportation program in page 49, and Annex G – photos of equipment and machinery at STC/STM facilities, there is no detail of process, activities and facilities of project are not described.	(2) To describe current operation phase and future phases (decommissioning, mine closure and post-closure) step by step key activities and their proponents.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	Given that this EIA has been carried out during operation phase, it was not able to describe pre-construction phase. However, the process and main components of the project for the decommissioning, mine closure and post-closure are required to be described.		ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	Alternatives The alternative ways are described in page (60). However, it is described that the Project is a brownfield extension of an existing quarry, there are no feasible alternatives for Project siting. Installation of a conveyor will reduce the use of vehicles to transport quarried material and will therefore be more efficient in terms of fuel consumption.	(1) To describe that alternatives for the limestone extraction methods (e.g. Side Hill Cut Method, Open Pit Mining Method, Semi Open Cut Mining Method, etc.), Selection of Mining method, Selection of Type of Mines should be studied and described. (2) To describe the approval of the selected method which is not concerned for the environmental impact by the comparison of alternatives' ways.	Advantage of drill and blast method and its selection is added to Section 4.2.
4.	**Description of Environment near Project**		
	In page 65 it is found out that monitoring locations are identified by aerial photography, local knowledge about villages, accessibility and security, and typical wind direction for the time of year of the monitoring. In page 66 it is found out that monitoring locations are identified by general background concentration levels, concentrations in areas of high population density, local wind conditions with locations ownwind of prevailing winds. However, there is no description of how it was measure, compare and identified.	For selection of air quality baseline monitoring locations, the methodology for selection and criteria need to be described for each method. (Eg. if based on concentration in areas of high population density, to describe the population density comparison for 7 receptor monitoring location at table 5.1)	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	Air Emission survey (1) It is found that the air emission for NO2 and SO2 was studied in 3 points for 7 days on January 2017. The air emission survey points are as follow; 1. Staff Quarter 2. Kubin Village 3. Pyni Naung Village It is found that diffusion Tubes are used for the air emission survey and the results are within NEQG standards. The value of thr NO2 is only ¼ of the standard and SO2 is less than standard. (2) It is found that PM10 and PM2.5 were measure for 14 days on January 2018. However this survey used low volume air sampler only. The dust emission survey points are as follow; 1. Kubin Village 2. Pyin Naung Village As a result of survey, PM 10 and PM2.5 in Ku Pyin Village's quality of air is within NEQG. The air quality of the Pyin Naung Village is more than NEQG standard and the highest value of the measurement is more than double value of the standard. It is described the cause of the higher of the air quality is by loading and unloading haul trucks in this village and private Lime Kilns of around the village.	(1) The worker quarter is 2 km far from the project area and during the 14 days period of the measurement, though a consideration for the 2500 to 3000 workers as affected peoples in second line operation phase, there was no measurement for PM 10 and PM2.5 at workers' quarter. So that to proceed the air emission survey for PM!0 and PM2.5 at AQ1 (near of the residents of workers) and add in monitoring plan as an impact.	Requirement to monitor at AQ1 during limestone quarry operation is added to Table 11.2.

No	Findings	Suggestion	Response
	(3) It is found that there are no measurement for PM10 and PM 2.5 in around in workers quarter although there are measured for NO2 and SO2.		
	Water quality survey (1) The surface water quality survey was measured at the following 5 points; 1. Water storage Tank of Cement factory 2. Wastewater discharged point of cannel of Coal storage area. 3. Same as No 2 4. Small creek at base of Limestone mountain. 5. Ku Pyin Creek along with Ku Pyin Village where is original water resource for cement plant. However, there is no taking the samples from the water following from the limestone quarry.	(1) Because of the no water sampling at the Limestone Quarry area, to proceed the water quality survey and add in monitoring plan as an impact. (2) According to the Figure (4.6) in page 56, it is suggested that the storm water of the project area flows to Pin Long River through Myit Tha Stream. It is also described in page 142 that the storm water from the limestone quarry flows west and south to the Myit Tha Stream and drains into STC's reservoirs, and then water discharged from the reservoir is flowing to the Pyi Nyaung River. Therefore, it must be measured for the surface water quality before following to the Pin Long River and Myit Tha Stream because residents are using water from those rivers as drinking water and add in monitoring plan as an impact.	Requirement of water quality monitoring during limestone quarry operation is added to Table 11.2.
	Natural Disaster It is described the flooding and earthquake of the country, however there are no information for that for Mandalay Region or around the project area.	(1) To describe the information of flooding and earthquake of the country, however there are no information for that for Mandalay Region or around the project area.	Pyi Nyaung area is not situated in the areas classified as most prone to flooding and cyclones in Myanmar. Record of natural disaster, namely earthquake, has been supplemented in Section 5.3.5.
	Cultural Heritage It is described the religious buildings in Thar Zi Township and there is no cultural heritage of importance identified in the vicinity of the project area. However, Pyadar Lin Cave near project area have stone age heritages and it is designated as	(1) There are cultural heritage from copper century and Iron century in Kan Thit Kone village and Ywar Kone Gyi village in Boai Char village Tract of Tharsi Township. So, to describe the distance of those cultural heritages and identify the impact whether they are affected or not. (2) To describe the distance of the project and Pyadar Lin Cave and to access whether there will be impact or not.	These villages are more than 6 km from the Project Site and thus the cultural heritage resources are unlikely to be affected by the construction and operation of the Project. Such description has been added to the 'Cultural Heritage' section of Section 6.2.

No	Findings	Suggestion	Response
	Ancient Zone. Therefore it is wrong to describe as no cultural heritage places.	(3) To request comment from relevant minister of culture heritage and to include their comment in the report.	
	Biodiversity It is found that detail Biodiversity survey for Bird, Herpetofauna, Arboreal Mammal / primate and ground dwelling mammals, Flora are done from March to April in 2014 and from January to February in 2017.	(1) To explain and describe whether the camera tracking survey to monitor the biodiversity is needed or not at the place of limestone exploration drilling. (2) As the figure at page 30 in Annex D1, there can be a lot of caves near the project area. - At page 17, as the description of "Biodiversity Assessment on the limestone ranges near the Shwe Taung Cement Concession", there were taken sampling from a small cave near the project area of limestone exploration so we seem that there can be existed other bio species at this caves. - So that need to describe the caves at near the project area of limestone exploration are existed or not and revise when there taken the survey, the caves were founded or not. (3) If there are caves, the bio species of habitat and ecosystems (e.g especially for bats, aquatic ecosystem) are exist or not that need to describe with confirm and revise there can be effected or not on the bats and ecosystems due to the project.	Camera tracking was not undertaken and the rationale is added to Section 5.4.4. It is confirmed that no caves were found in the Project area in Section 5.4.5.
5.	**Impact assessment on environment, modelling and mitigation measure processes**		
	Impact assessment was not based on mining activities.	Each impact assessments are to be based upon the mining activities or to be related. These need to be re-assessed and described in the revised report.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	It is required to be in line with Since impact identification, impact prediction and impact evaluation are fundamental step by step process in conducting impact assessment, the approach and method which will be used are required to be strongly defined. Otherwise, confidence level of the impact result will be decreased. In	At page (130-157), chapter 8, the approach and methodologies are to be described under relevant sub heading used for the impact Identification on each characteristic, Impact Prediction and Impact Evaluation to expose the impacts for each scope by the project.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	Chapter 8, 'Impact and Risk Assessment and Mitigation Measures: Operational Phase', page 130-157, Table 8.9 to 8.21, impact characteristics are identified according to impact area (air quality, surface water quality, biodiversity, waste management, occupation health and safety, landscape and visual impacts, soil quality). But, the approach and method for impact identification, impact prediction and evaluation of significant impact under individual impact area are weak.		ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	According to Annex B in which ERM reported for Impact Assessment Methodology, it is found out that impact identification, impact prediction and impact evaluation are carried out base only on simple template for qualitative assessment which is overall assessment on potential impact judged by expert, baseline studies, site visits, stakeholder engagement, interaction with project planning and design. It is analysed that impact identification for Area of impact which lead significance impact (Eg, biodiversity, waste management, occupational health and safety, landscape and visual impact, soil quality) was done based on professional judgement methodology for all area, except for air quality impact assessment which is based on quantitative assessment. The weakness of that methodology (expert judgement) is no relative weighting or any cause-effect relationship are involved.	When impact identification on the AOI by the project, using instead of only simple template that based on the professional judgement for all of impact characteristics, definite results if based on the quantitative assessment, the definite scaling and weighting can outcome for each impact characteristics, the impact identification method which is mostly used in international and appropriate with the project (Eg. Significance or importance-rated matrices, weighted matrices, scaling checklist) that should be used and described for the impact by the project, and need to be described for the estimation and assessment of the impacts are make significance or not.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	Thus, it can only do rough assessment; and very generic methodology. As consequence, it is difficult to assess short and long term impacts on account of guess basis. As a result impact identification, prediction, and interpretation are so poor.		
	Followings are the findings of whether the relevant approach and methods are use or not for impact identification and analysis – (1) In chapter 8.1 assessing whether there are impact of PM 10 and PM2.5 from mining, impact prediction is done by using qualitative method which is in Annex C2 and C3, Air Quality Impact Assessment-AQIA, AERMOD air dispersion model. The significant potential impact on receptors near project area are analysed. (2) In chapter 8.2 assessing whether there are impact of surface water quality, overall impact are significance are described in page 142. However, except the fact that local people's concern on contaminated wastewater from factory which was raise during stakeholder consultation meeting in January 2017, there is no description on which approach and method are used for impact prediction of surface water quality impact assessment in table 8.10	The following facts need to be revised and described which has approach and methods are used or not for the impact identification and analysis- (1) At table 8.1 of impact on air quality, there was found the description are jumble with unneeded in the project activities, point source emission and emission inventory for unrelated activities with the project, so there need to be described in highlight related with the project. And AERMOD model make impact prediction to the impact significance on the emission by the proposed activities, then there need to be described the impact identification and impact prediction in which methods are used for the other impact characteristics of impact duration, impact extent, impact magnitude and impact nature. (2) At page 2, section 1.2.3 of Annex-E Impact Assessment Methodology, as the description of the stakeholder engagement is useful on impact prediction and evaluation, so it assumed that the surface water quality used by the stakeholder engagement to make assessment of impact prediction and evaluation, this need to be describe the more definitely assessment results (Eg. Impact prediction is identify by based on the concern of how many local people). There need to be described the approach and methods under the section 8.2, at table 8.10 surface water	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	(3) There is no description of approach and methods for other area of impact by project (Eg, biodiversity, waste management, occupational health and safety, landscape and visual impact, soil quality) in each respective chapters.	quality for the Impact identification and analysis which related with impact assessment of water quality. (3) Other residual impacts section, there also need to be described the approach and methods for the impact identification and analysis.	
	Method and Approach to Designing Mitigation Measures For mitigation of air quality impact – according to the result of AERMODE air dispersion model, the safe distance for AQ4 (worker's accommodation) was calculated systematically. However, there is no systematic calculation of high in meters of stockpile height and drop heights of transportation of material.	At table 11.1, according to the mitigation process on the air quality impact, AERMOD air dispersion model used and calculated the dispersion then impact area AQ4(Worker's accommodation) by the dispersion as the result, although the distance which is free from impacted area is described, the other project activities (storage of limestone) which can be impact on air quality, height level for stockpile and the height level in metre which can be move and lift from one place to another are need to be described.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	Out of all source of emission from mining activities in limestone quarry, loading and unloading haul trucks is mentioned in Table 8.1. And emission factor of limestone ore and waste from the aforementioned mining activities are mentioned as (1.16x10-3) and (3.23 x 10-4) in table 5.2 Limestone Quarry Emission Inventory for 5500tpd production line. But, that emission equation was not used for other mining activities such as bulldozing, drilling and blasting in Annex C3 Calculation of emissions from mining operation (p.p. 4-6). Although there is no emission equation for loading and unloading of limestone ore and waste rock, when Total fugitive TSP emission rate (2.06 g/s) are taking into consider for limestone quarry, only emission rate is there and no	In the calculation dispersion model on Total fugitive TSP emission rate (2.06g/s), it was assumed that will be calculated as total emission rate(not describe the calculated results), these emission rate are significant in the calculation of particulate matters (PM2.5 and PM10) for key substance type of limestone quarry, so there need to be described the emission equation for loading and unloading of limestone ore and waste rock which include the calculation of total fugitive TSP emission rate for limestone. At table 5.2 of Annex C3, the detail calculation results in each of emission rate for mining activities of limestone quarry are need to be revised not only in the Annex C3 but also at each related sections of EIA report.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	emission equation is there. Hence, it is analyse that emission rate (0.0870 g/s) and (2.32 x 10-3 g/s) of loading and unloading of limestone ore and waste rock were taken into consider and average value has been taken. In foot note of Table 8.5, 8.6, 8.7 and 8.8, 0.35 and 0.42 factors for PM10 and 0.053 and 0.19 factor for PM2.5 are used.	These factor values are making citation to USEPA AP-42 *Emission Factor Database Chapter 13.2.4 Aggregate Handling and Storage Piles,* so this need to be described in addition for the paragraph of resource taken and gist the content into Section 8.1 Air quality.	
	Impact assessment on the air quality (1) In the impact assessment as IFC guideline, it based on the low air quality (Degraded or Non-Degraded Airshed) surrounding the factory and based on potential air quality (Predicted Environmental Concentration-PEC) depend on the additional impact (Process Contribution-PC) from the project, AERMOD Dispersion Model of USEPA used to calculate the impact level of air quality from the project. (2) In this model, it was calculated based on the processes of the project from the cement plant, limestone mine and mud stone mine. In the estimation of emission amount, US EPA-AP (42)- (Section 11.6) publicized for Portland Cement Manufacturing from USEPA, USEPA-AP(42)- (Section 13.2.4) publicized for Aggregate Handling and	(1) Need to describe and prove the mitigation measure of particle emission from conveyor (e.g set up bag filters for particles at transfer points and sprinkling water in Conveyor) as the assuming of no emission from Conveying in modelling and other plans in details, the detail process of equipment that will be set up and the amount of filtered from them that can be enough emission from conveying. (2) The use of drill machines to make the holes for mine explosion there need to use and set up the dust collector to reduce the dust emission and need to describe in the report for this use of mitigation measure plans. (3) Need to describe and revise with the equipment that control the dust emission from the limestone crushing (e.g Bag Filters), the quality of filtering for this equipment and the amount of filtered for this equipment after setting up. (4) There need to be considered the impact assessment for Blast Fumes it comes out from mining activities, and to be described detail with the mitigation measures and management plans.	Additional mitigation related to materials handling and transportation is added to Section 8.1.3. The drill holes are only 76 mm and the location of drilling at the limestone quarry is more than 2 km from the nearest ASR. Dust impact from drilling is thus unlikely to affect the ASR. While specific mitigation is not added for drilling, it should be noted that the need of watering the works area is already included in Section 8.1.3 “Water suppression should be used on unpaved roads and work areas in dry and windy conditions”. An Air Pollution Abatement and Control Plan will be prepared by STC. This commitment is added to Section 11.4. Please note that these plans will cover both the limestone quarry, cement plant and mudstone quarry given their proximity and centralized management by STC.

No	Findings	Suggestion	Response
	Storage Piles and based on National Pollution Inventory (NPi), Emission Estimation Technique Manual for Mining (ver: 3.1) of Australian Government that performed mitigation processes and considered the emission. (3) There considered for the worst scenario, NEQG/IFC guideline values will be emitted in latest situation. (4) Although impact assessment results calculated as modelling can access, there is not enough the description of mitigation measures.		
	Impact assessment on the water quality In the impact assessment of water quality, although there described impact from the discharge from the project, there has no considered for the impact on water quality from the discharge of the explosion things. There described for the mitigation measures for the discharge water from the limestone mine connected with the cannel to the settle reservoir and make resettlement for suspended solids and passed from the weir and the less sediments are removed and discharged to the wetland.	(1) Need to consider and revise for the type of explosion things used that can be impacted on the water quality (e.g The things generally use in mining of Ammonium Nitrate is exploded so that outcomes of Nitride, Nitrate and Ammonia compounds can be impacted to the environment. Especially this can be worse effected to water quality. Therefore, the changing of the quality of drinking water that can be impacted on the health and aquatics.) (2) We seem that the design is finished of the treatment tanks for the discharge water from the limestone mine. Need to describe in details for the design of treatment system, treatment tanks, weir and other performing with the related maps, layout plans and figures. (3) In the description of related data, the water flow lines as topography of limestone mountain and the last flow point, the map or contour map which included the management plan according to the flow line are need to described.	(1) Assessment in relation to use of explosive materials is added to Section 8.2. (2) As presented in Section 4.1.3, the stormwater management system will be designed such that any discharge will be treated to comply with Myanmar National Environmental Quality (Emissions) Guidelines for construction materials extraction (which is noted to be the same as the Myanmar National Environmental Quality (Emissions) Guidelines for site runoff and wastewater discharges). STC is committed to provide the detailed design of the stormwater management system to the ECD once it is available.
	Impact assessment on the noise level and vibration We noticed that there has no impact assessment on the noise	(1) Need to include and revise the impact on the labour camps, the villages near with the project area, the mitigation measure and monitoring plans for the noise and vibration	The NSR is located more than 2 km from the limestone quarry and is thus unlikely to be affected by noise impacts from the quarry. This is discussed in Section 7.1.

No	Findings	Suggestion	Response
	level and vibration from the limestone exploration process.	from the drilling, mine explosion, machine, vehicles operating and driving, limestone crushing and transportation with conveyors in limestone production area. (2) In vibration impact assessment, vibrate situation measurement due to the mining activities is need to be conducted and described the assessment on this measured results.	
	Impact assessment on the waste discharges There is not enough although described the impact on the waste discharges in the report from page 150 to 152. There has no impact assessment on the waste of explosion things or the explosion things that cannot be used. Although described the discharge places for the overburden wastes, waste rocks there has no systematically impact assessment. Although described in Annex F as the waste management plan will be performed for mitigation measures, there has no consider for the plan of waste discharges generally Overburden Waste from the limestone production.	(1) Need to consider and revise the impact for the waste of explosion things or the explosion things that cannot be used and their mitigation measures and management plans. (2) Need to revise and describe on the impact with estimation details for the amount of overburden wastes and their storage areas, mitigation measures and management plans. (3) In the report, Annex C-3, page 18, as considered the amount of waste rock produced will be 8.77% of total production (22667 ton/year) at modelling and the storage area for this that need to describe the mitigation measures, management plans (4) In Annex F, the description of waste management plan is not enough for the limestone production project (generally overburden waste and waste rock production) so that need to describe completely the management plans of the waste from the limestone production. (5) For the limestone production (especially for the overburden waste and waste rock) are being not enough, so the Mine Waste Management Plans are need to be described. (6) In this case, there also need to be described the Waste Rock Dump Design with the respective labels.	Handling of hazardous materials (including wastes related to explosive materials) is added in Section 8.4.2. A WMP is developed and included in the EIA. This WMP will be reviewed and updated regularly. These comments will be included in the updated WMP which will be submitted after the EIA Report.
	Impact assessment on the hazardous materials There has no impact assessment on the storage of explosion things, keeping, transportation, using for mine explosion and other management plans.	(1) Need to revise and describe in detail of the storage of explosion things, keeping, transportation, using and other management plans and their potential impact on the every operation steps. And need to include the mitigation measures and protection plans	(1) Permit and current management system on use of explosive is added to Section 8.5.2. (2) The description of performing in accordance to the guidelines and management process of MSDS has been added in Section 8.5.2.

No	Findings	Suggestion	Response
		(2) To perform with according to the guidelines and management process of Material Safety Data Sheet (MSDS) for the chemical things that used in the limestone production.	
	Impact assessment on Occupational Health and Safety From page 152 to 153, there described the impact assessment on HSE. However, the assessment is the potential impact during operation period, there has no assessment for potential impact on the limestone production.	In the impact assessment on HSE for the things production that used in the construction issues by the IFC- (1) The inhalation hazards (e.g the diseases cause by breathing long time for free crystalline silica (SiO_2) included in the limestone dust and causing silico-tuberculosis) (2) Impact on noise level (noise impact on the labours' auditory from the mine explosion and limestone crushing) (3) Physical impact (impact on the labours cause by the flying materials, the accidents from the vehicles and machines using in the site) (4) Impact on the hazardous materials (e.g Explosion things) etc., and other impacts that need to describe the mitigation measure, management plans and monitoring plans (5) To be described there will be reported to Labor Department if there has accidental or death cases in the project area.	There are no construction phase impacts of the Project since it is the expansion in production and operation of an existing limestone quarry. The EIA has thus assessed the potential impacts and proposed mitigation to reduce the level of the impact during operation. This is presented in the first paragraph of Section 8.
	Impact assessment on the Community Health and Safety There has no impact assessment on the safety plans for local people.	(1) Need to describe and revise for the assessment of limestone production that can be impacted on local people, some local people who passing near the limestone mountain, collecting firewood and hunting. (2) In the assessment there need to make assessment under the guidelines issued by IFC for the production of the equipment that used in the construction. (3) Need to describe the mitigation measure, management plans and monitoring plans. (4) To perform and describe in the report the protection plans of mine explosion and notice time to community and pile the notice board, keep the security guards around near the mine explosion area, the explosives storage placed at safe and away from the people living area, etc.	Added according in Section 8.6.

No	Findings	Suggestion	Response
	Health Impact Assessment Assessment of occupational health and safety and community health and safety in this report are not enough for the limestone mining project.	(1) In the impact assessment on the section of Occupational health and safety and Community health and safety, there need to be made assessment as above comments and provided a Health Impact Assessment then include as one of section in this revised EIA report. (2) In a complete Health Impact Assessment report, the following things are need to be included: a. Executive Summary b. Introduction c. Policy, Legislative and Institutional Framework d. Methodology e. HIA Process f. Public Health Management Plan (PHMP) g. Monitoring Plan (3) In the Public Health Management Plan (PHMP), the following facts are need to be included. a. Project Description by Project phase b. Project's Health Policy and Commitments, Legal Requirements and Institutional Arrangements c. Summary of Health Impacts and Mitigation Measures which cover OHS and CHS d. Budget for Implementation of PHMP e. Monitoring Plans and Sub-plans by project phases	
	Impact assessment on natural and emergency hazard There has no impact assessment on the natural and emergency hazard.	(1) Natural diseases (eg. Earthquake, Flooding, Landslide) and emergency hazards (eg. Accidents, the impact from hazardous materials, fire accident, explosions, spill out the chemical things, landslide and slope failure, etc.) that need to describe and make risk assessment for potential impacts and the protection plans for this issues and mitigation measures.	Relevant assessment added to Section 8.5. As presented in Section 5.3.5, Pyi Nyaung area is not situated in the areas classified as most prone to flooding and cyclones in Myanmar. Record of natural disaster, namely earthquake, has been supplemented in Section 5.3.5. Seismic design parameters have been derived and adopted for the structure at the limestone quarry based on Probabilistic Seismic Hazard Analysis of earthquake data in order to achieve a safe design of the structures. As such, impacts related to natural disaster is not expected to be significant. This is supplemented in Section 8.5.1.

No	Findings	Suggestion	Response
	Cumulated Impact Assessment (1) Section 10, at page 159 to 160, there described the impact assessment on related effect. As the description, the related potential impacts form the current project of limestone and mudstone production (air quality, bio species living things and traffic situation) are considered. Although FFI suggested to consider for the assessment on the private limestone production and other company limestone production, there has no impact assessment on air quality. (2) And then, at page 159, there described that the potential related impacts on the project and other projects near the site (construction of transmission line and substation, etc.) are not considered in the report and after confirming the development of this projects, the related impact assessment should make by consultant team.	(1) As the figure in Annex D1, at page 30, there described other limestone productions near the project area. For this fact, there should be considered air quality of the related impact assessment for the private limestone production and other company limestone production near the project site by showing separately on the map. (2) As described by the consultant team, after confirming the development of other projects, the plan to make assessment for the related impacts are need to describe in the report of EMP section. (3) In the related impact assessment, the impact on the climate changes are need to consider and monitor the loss of forests (carbon sinks) due to the production of limestone and mudstone, the emission of CO_2 from the cement plant and emission of GHGs from other project sites. Moreover, there need to be considered for performing of renewable plans (e.g Replantation) as the related project of the CSR sections. (4) After making the related impact assessment, there need to be considered mitigation measure plans and need to describe the plans of co-operate with the government, related ministries and organizations if needed.(e.g The air quality is lower than the standard points from the lime oven at Pyi Nyaung village and the parts of current project, etc so that need to control and the plan for development.) (5) After the cumulative impact assessment, the mitigation measures for that assessment need to be considered and the plans there will be conducted collaborate with government, related Ministries and organizations are to be included. (Eg. The air quality from Pyi Nyaung has lower than the standard guidelines by the limestone production and some parts of project	Section 3.8 and Section 11.2 are updated to include the commitment on undertaking a cumulative impact assessment if information is available from surrounding projects. Replantation requirements are recommended as part of the biodiversity impact assessment and in the Biodiversity Action Plan. Rehabilitation of habitat will occur within the landscape disturbed by Project operations. All rehabilitation is to occur using native indigenous species. A nursery is to be established to propagate species. All rehabilitation is to be established in a progressive basis as quarrying activities occur. All rehabilitation will be monitored to determine the success/failure of different techniques. Rehabilitation will be adapted based on the results of the monitoring. The emission of greenhouse gas is addressed in the EIA for the STC Cement Plant under a separate cover.

No	Findings	Suggestion	Response
		activities, there need to be described the control or good development plan.	
	Impact mitigation measures We noticed that the description of "If Applicable" in the summary table for impact mitigation measures.	(1) Now the propose project is started performing so we seem that impact mitigation measures will be reached to definite level. Therefore, there need to describe the actual performing of mitigation measures and suggest of not to illustrate the statement of "If Applicable".	The description of 'if applicable' has been removed from Table 11.1.
6.	**Public Consultation**		
	Public consultation section described in Section 13. As the description of Annex A (Consultation Result Summary) and Annex H (Stakeholder Engagement Meeting Minutes) we noticed that there continuously performed the public consultation meeting with relevant organizations and the villages near the project in 2017.	(1) Although the local people form the villages near the project who hoped to get the job opportunities, the getting employment is less (17 permanent labour and 100 labours during construction period) so that need to perform more opportunity for the local communities.	Section 3.8 and Section 11.4 are updated to include commitment on the Community Development Plan which will include commitment to enhance local employment.
	There has no described grievance mechanism section in the report.	(1) To perform the grievance mechanism while starting the related project and need to include completely the process grievance mechanism in the report. (2) To perform two plans with community grievance mechanism and workers grievance mechanism. (3) To perform grievance mechanism as the project needed, notice to the communities, co-operate with third party organizations if needed, the plan to receive the thing of concerns, response plans and schedules as the guidelines issued by IFC. (4) Need to describe the monitoring plans in the respective section for the performing of grievance mechanism.	Annex - N is added to include the stakeholder grievance mechanism in Stakeholder Engagement Plan and Annex – O Worker Grievance Mechanism.
	There has no description for the development activities to local performed by the project owner.	(1) In the statement of public consultation meetings, we noticed that the presentation of some CSR activities so that need to describe the CSR actions by STC if planned to isolate and the future plans of CSR activities with the budget, performed time, schedules and records.	Section 3.8 and Section 11.4 are updated to include commitment on the Annex P: Community Development Plan.

No	Findings	Suggestion	Response
		(2) To perform the CSR activities and co-operate with the relevant departments and township development plans (3) To describe the plans of monitoring for the local development activities. (4) The project proponent is same company for three projects(Cement, Limestone and Mudstone), there need to be clearly described the CSR activities (Budget, Cost, etc.) cover to all three projects.	
7.	**Environmental Management Plan (EMP)**		
	Impact assessment and mitigation measures are not enough	(1) To include the mitigation measures and EMP after re-do impact assessment according to the preliminary comments.	Noted.
	In the report, there is no description of the budgets to perform the EMP, the amount of expenditures for the monitoring process	(1) To describe the mitigation measures, monitoring plans, creation the labour to develop, training, the employees for conservation of environment, the budgets and costs for the vehicles and equipment.	Budget is added to Section 11.3. Detailed breakdown of cost is not provided as it is considered as sensitive financial information which cannot be released to public. The description of providing training to workers is presented in Section 11.7.
	Although describe in summary the plan for training to the labours in Section 11.7, page 172, there has no enough for the limestone production.	(1) To describe in the report for the training to the labours of holding the explosive things in limestone production, HSE and emergency hazards response plans training during the mine explosion and limestone crushing and the process of this performing.	The description of providing training on limestone production for workers has been added in Section 11.7.
	Although the EMPs as sub-plans are attached, it is not enough.	In order to permit ECC, the following sub-plans are to described: (1) Disaster Management Plan and Emergency Response Plan base on Risk Assessment (2) A separate hazardous materials management plan inclusive of handling, storage, transportation and use of explosive material (that hazardous materials management plan is already in detailed management plan in pg. 11.4. Thus, to revise according to that list). (3) Traffic and access control plan which inclusive of the management plan of vehicles, machinery inside project area and the incoming ones from outside project area.	As presented in Section 11.3, STC is developed and implementing the following plans which would cover emergency response, including event related to natural disaster, and management of hazardous materials • Annex Q: Stormwater Management Plan • Annex R: Incident Reporting and Investigation Procedure; • Annex S: Occupational Health and Safety Plan; • Annex T: Community Health and Safety Plan; and • Annex U: Emergency Response Plan.

No	Findings	Suggestion	Response
		(4) Mine waste management plan which is in accordance with the waste material from own project. (5) Noise and Vibration Management Plan for the noise and vibration from the project (6) Air pollution combatant and control plan related to project. (7) Conservation plan of water, energy and borrow materials (8) Community health and safety plan related to project (9) Cultural heritage management plan as the Padaline cave near project area is identified as ancient zone for the wall pain since from stone age. The management plan which is already prepared, but to amend with the comments given her: (1) Surface water management plan (2) Solid and hazardous waste management plan (3) Mine closure plan (4) Occupational health and safety plan (5) Community engagement plan (6) Community development plan (7) Environmental quality monitoring plan	
	Mine Closure Plan Although rehabilitation plan is described in annex J, just only that plan is not covering the mine restoration and closure plan and no description on mine closure plan.	Although described the Rehabilitation Plan in Annex J, this is not cover to the mine restoration and closure plan so there need to be described the following facts- <u>Mine Closure</u> - The mine closure is the important stage in the limestone production activities, when it is disclose, the need to be included the mine restoration and closure plan as a separate section in the report. - There need to be provided Conceptual plan during the mine closure plan then to detailed closure plan by making periodic	

No	Findings	Suggestion	Response
		review with 3 or 5 years, so the schedule plan for this activities to be described. - When making review, local authorities and local community to be collaborate and to describe the activities such as Final land use and Final land formation as the feedback from local people. - In mine closure plan, the post closure plan are to be described in summarise. - The management plan for the parts such as pit and quarries, waste rock dumps, solid, waste rock dumps, solid waste disposal facilities, roads, electrical structures, water conveyance and treatment structures during mine closure, resettlement plans for the project step by step, the time schedule and budget, etc are to be described in summarise. - When these plans are revising, there need to be considered according to the guidelines from EIA guidelines (Draft) for mining sector. - When rehabilitation, the species (especially for EN) as the survey results taken in the project area of Flora Report (Feb 2017) and Flora Report (Aug 2017), there need to be described the plan of fairly plantation - For the rehabilitation activities, the conducting the engagement with the community, meeting with the forestry department and the estimated schedule plan or numbers of the engagement are need to be described - At page 13 of rehabilitation plan, the monitoring plans to be described in period (year) that continue to monitor after mine disclose.	
8.	**Environmental Monitoring Plan (EMoP)**		
	EMP requirements are described at page (167), table (11.2) however, this is not sufficient for limestone mining.	(1) According to this comments, after doing the additional assessments, EMP for those assessments are need to be developed and included too.	Revised accordingly except for the following: Drinking water quality standard is not adopted as water purification units are provided to the communities at Kubyin

No	Findings	Suggestion	Response
		(2) EMP should be developed with the following comments. a. Air quality i. As guideline from NEQG, Ambient Quality of the project area is need to be surveyed at least twice a year (Rainy season and dry season) at the following locations. 1. Labor housing near the project area. 2. Ku Pyin Village 3. Pyi Nyaung Village b. Water quality i. For water quality monitoring, water before entrance of Myitha Stream into the Pin Laung River is need to be surveyed. (It is also used as drinking water so parameters for drinking water are also need to be tested.) ii. Monitoring plan for "out flow water from limestone mine which will be treated for the last time and disposed location " is need to be added into EMP. c. Noise and vibration Noise and vibration impact assessment should be done and monitoring actions have to be done at possible impact locations. d. Hazardous and non-hazardous waste materials management i. Necessary monitoring plans are needed for especially waste released from over	and Pyi Nyaung by STC for access to safe drinking water, instead of using water directly from the creek/river No noise monitoring is recommended. The NSR is located more than 2 km from the limestone quarry and is thus unlikely to be affected by noise impacts from the quarry. This is discussed in Section 7.1. Residual impact to soil quality due to dust deposition is considered to be of negligible significance as discussed in Section 8.8.3 and thus no monitoring is proposed for soil quality. Impacts to community health and safety are related to air quality, water quality and waste management impacts. As such, the monitoring of community health and safety is covered under the monitoring of air quality, water quality and waste management. A Stakeholder Grievance Mechanism is developed and included in Annex N which contain monitoring of grievance from local community. Incident related to emergency event will be monitored under the occupational health and safety monitoring.

No	Findings	Suggestion	Response
		burden and waste rocks, explosive materials to manage these. e. Soil quality (pollution) i. Monitoring plan to prevent the soil pollution (example – explosive materials, chemicals and transportation, storing and handling of fuel) are need to be included. f. Occupational health and safety i. For Occupational health and safety of workers, medical checkup for impact affected workers (example – dust, noise) are to be done and carrying out the monitoring actions. g. Social, environment, health and safety of local people in the project area i. Environmental monitoring plans for social, environment, health and safety impact of local people in the project area are to be developed. h. Emergency hazard management plan (including natural hazard) i. Response plans for emergency hazard management (including natural hazard) and their status are to be included in the monitoring plan. i. Monitoring plan are to be developed for proposed action for priority section 3 received from ecosystem service assessment. j. Monitoring of biologics	

No	Findings	Suggestion	Response
		As described in Annex – D (4) Biodiversity Clearance Protocol, management plans are to be included at monitoring plan, do the record keeping and monitoring actions are to be carried out during the project implementation phase. As describe in Annex – E Injured Wildlife Protocol, Annex – F Wildlife Shepherding Protocol, Annex – G Community Engagement Protocol, Annex – H Wildlife Survey Protocol, management plans are to be included at monitoring plan, do the record keeping and monitoring actions are to be carried out during the project implementation phase. k. Monitoring and publicizing For the transparency of monitoring and to prevent any mis-understanding of publications from the project, informing, involving and publicizing of the results to the locals at monitoring actions. Those plans are to be included in the report. Monitoring plans are described in Annex but not in the monitoring requirement at table 11.2, page 167, these need to be included.	
9	**Conclusion and Recommendation**		
	The clause mentioned in Conclusion and Recommendation of chapter 13, page 194-195 is only for social and environmental residual impact perspective. It is generic and more complete point of view (Eg. Positive impact, cause and effective of project) whether this project is good to implement or not are considered.	In the suggestion, there need to be described not only social and environmental residual impacts but also the positive impacts by the project activities, the budget and the profit of project and the limitations that related with the EIA report. For the Section 13 of EIA report, the conclusion suggestions are to be revised as related with in each section.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.

No	Findings	Suggestion	Response
	Moreover, there is no review on limitation faced by project proponent and third party reviewer such as technical/information/knowledge limitation. The conclusion of each respective for the conclusion in chapter 13 of this EIA is poor.		ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
10	**Reporting**		
	In section 3.1, local policy, legal and institutional framework are described in page 15-38. However, there is no table number there.	To be described the table name and number	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	Structure of EIA report/outline of chapters for project description is not there.	According to the structure of EIA report (or) outline of chapter, the data which related with the project are to be described in the project description.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	Annex are attached in EIA report with separating page numbering which lead difficulty in searching information. No abbreviations lists and reference.	If the Annexes are not separate as document from the main body of EIA report, the pages numbers to be provided as follow that can be easy reviewers when finding the data- 1. Table of contents are to be in small roman number (i, ii, iii) 2. From the Executive summary to the end of EIA report (Annex I), should be described as the number (1, 2, 3, 4, …) Abbreviations, meanings and references are to be included.	ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
		The response table are to be included in second revised report. The following facts are to be included in the response table- - Section, Paragraph, Suggestion, Revised and second report page number • The posters which described in Annex C and D are need to be added the posters in Myanmar language. • The information which are not related with the limestone project (Coal and Cement project info) are not to be described.	Please refer Annex V: ECD Comments and Responses to Comments Table (2024)

No	Findings	Suggestion	Response
		• The mitigation measures for environmental impact for the operation period and disclosure period are to be included in the list of commitments then described in the conclusion of the report	
11	**General comment**		
	Project Description ➢ Marking on boundary inside project area, the notice board for the conservation of environment and wildlife, the warning board and awareness program should be carried out in collaboration with Forest Department and it should be described in the report ➢ The activities for the prevention of Illegal logging, poaching, trading should be carried out in collaboration with Forest Department and it should be described in the report		Noted.
	Impact on Biodiversity and Mitigation Measures ➢ To add the invasive species management plan and usage of herbicides (if necessary) in the monitoring table in page 167, Table 11.2. ➢ Since the project is at the habitat of biodiversity and endangered species, Biodiversity Offset Plan/Action Plan in the project area and outside the project area (offset) should be clearly described. Regarding Biodiversity Action Plan in Annex E ➢ If there is any update in Biodiversity Action Plan, it should be add in Table 7.1 and amend in this upcoming submission report ➢ The budget amount should be mentioned in the budget table 7.3 and 6.4 in the Biodiversity Action Plan ➢ Add the pledge about "Monitoring KPI at Table (5.5), BMOP at table (6.1) and (7.1), description of table (8.1) and (8.2), results from the monitoring will be reported to ECD regularly", "To include as separate Biodiversity Action Plan in this monitoring report of the limestone project". ➢ In BMP18 and BMP19 at table (6.1), specific action plans for Chinese Pangolin addressed at the Annex H - Critically Endangered specie for the Flora and Fauna Survey during operation phase are not included. That specie is very rare and almost extinct. So not only survey for specie, but also their feeding ground and nature research planning are to be included. Conservation and relocation, such separate planning in case animal is found should be developed. ➢ Annex – D1 Mammal Survey Report of page 19, there is suggestion for collaboration with the four companies of limestone productions near the project area for the conservation activities to the biodiversity. It is to add in the report that there is any plan of such collaboration and if there, the updated condition of it.		The BAP in Annex E is a detailed management plan developed following recommendation of the EIA. As such, details on monitoring and management related to biodiversity should be referred to the BAP in Annex E. Detailed breakdown of cost is not provided as it is considered as sensitive financial information which cannot be released to public.

No	Findings	Suggestion	Response
	➢ In table 10, the survey of biodiversity was base on interview result. Hence, it is unknown for the numbers of biodiversity species, abundant/endangered status, habitat conditions. So, it is assumed that the condition of relocated biodiversity are difficult to assess when relocating of biodiversity during offset implementation. That is why it is to clearly state the preliminary survey is need or not necessary needed. ➢ It is assumed that the relocation detail program for critically endangered Chinese Pangolin should be done by conducting preliminary survey		
	<u>Commitment</u> (1) List of commitment from each chapter of the report should be described in the commitment. (the reason is that the list of commitment from each chapter to be taken out)		ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
<u>Environmental Management Plan</u>	(2) <u>Environmental Management Plan</u> ➢ EMP in chapter 11 are generic and the information on separated activities has to be added in this EMP ➢ Environmental fund or budget for EHHS should be added		ERM terminated the EIA consultancy service for STM on December 2022. Comments will be addressed accordingly after STM appointing the 3rd party EIA Consultant.
	<u>Public Consultation and Local Development Plan</u> ➢ The disclosure of social issued related to project, and the consideration and solution of the issue raised or will raise by community should be added in the report ➢ Community development plan by the project should be added ➢ Project has much impact on eco system services. Hence, livelihood development and income generation program (by the project) based on those impact should be taken into consider.		Annex N: Stakeholder Engagement Plan Annex P: Community Development Plan

Annex W

Limestone Quarry Extraction Contract

သစ်တောမြေအတွင်း ထုံးကျောက်အကြီးစားတူးဖော်ထုတ်လုပ်ခွင့် စာချုပ်

ပြည်ထောင်စုသမ္မတ မြန်မာနိုင်ငံတော်အစိုးရ၊ သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန၊ သစ်တောဦးစီးဌာန၊ ညွှန်ကြားရေးမှူးချုပ်နှင့် ရွှေတောင်သတ္တုတူးဖော်ရေးကုမ္ပဏီလီမိတက်မှ ဤစာချုပ်ကို ၂၀၂၂ ခုနှစ်၊ ဒီဇင်ဘာလ(၁၆)ရက်နေ့တွင် သာစည်မြို့နယ်ရှိ ကူပြင်ကြိုးဝိုင်းအတွင်း **ထုံးကျောက်အကြီးစားတူးဖော်ထုတ်လုပ်ခွင့်နှင့်** စပ်လျဉ်း၍ ပူးတွဲပါ စည်းကမ်းချက်များအတိုင်း ဆောင်ရွက်ရန် အောက်ဖော်ပြပါ အသိသက်သေများ ရှေ့မှောက်တွင် နှစ်ဦးနှစ်ဖက် သဘောတူလက်မှတ်ရေးထိုးကြပါသည်-

(က)	တိုင်းဒေသကြီး/ ခရိုင်	- မန္တလေးတိုင်းဒေသကြီး၊ မိတ္ထီလာခရိုင်
(ခ)	သစ်တောမြေ	- ကူပြင်ကြိုးဝိုင်း၊ အကွက်အမှတ်(၁၅၊၂၂၊၂၃၊၂၅၊၂၆)
(ဂ)	ဧရိယာ(ဧက)	- မြေဧရိယာ(၆၀၀)ဧက
(ဃ)	နယ်နိမိတ်	- ခန့်မှန်းမြေပုံညွှန်း ၉၃-ဒီ/၅ (၉၁၂၃၁၆, ၉၂၇၃၁၆, ၉၂၇၂၉၆, ၉၁၂၂၉၆)
(င)	စာချုပ်သက်တမ်း	- (၂၂-၁၂-၂၀၂၂) မှ (၂၁-၁၂-၂၀၂၃)အထိ (သက်တမ်းတိုး)

(သစ်တောဦးစီးဌာန၊ ညွှန်ကြားရေးမှူးချုပ်ရုံး၏ (၂၃-၉-၂၀၂၂) ရက်စွဲပါ စာအမှတ်၊ စီမံကိန်း/သတ္တု/(၁၇၂၃၂-၃၄/၂၀၂၂)အရ ဘဏ်ချလန်အမှတ်(၁၈)၊ နေ့စွဲ(၅-၁၀-၂၀၂၂)ဖြင့် မြေငှားခ(၁၈,၀၀၀,၀၀၀ိ/) (ကျပ် သိန်းတစ်ရာ ရှစ်ဆယ် တိတိ)၊ ဘဏ်ချလန်အမှတ်(၁၇)၊ နေ့စွဲ(၅-၁၀-၂၀၂၂)ဖြင့် ကုန်သွယ်ခွန်(၉၀၀,၀၀၀ိ/) (ကျပ် ကိုးသိန်း တိတိ)နှင့် မိတ္ထီလာမြို့၊ ရိုးမဘဏ်တွင် ပီဂျီအမှတ်- BG0001/019 (2022-2023)၊ နေ့စွဲ(၁၈-၁၀-၂၀၂၂)ဖြင့် လုပ်ငန်းဆောင်ရွက်မှုအာမခံငွေ (၆၀,၀၀၀,၀၀၀ိ/-) (ကျပ် သိန်းခြောက်ရာ တိတိ)ကို ပေးသွင်းပြီး။)

(ခွင့်ပြုသူ)			(လုပ်ကိုင်ခွင့်ရသူ)		
လက်မှတ်	-	၁၆-၁၂-၂၂	လက်မှတ်	-	
အမည်	-	(ဝေ[illegible]အောင်)	အမည်	-	(နန်းမော်မော်အေး)
ရာထူး	-	ညွှန်ကြားရေးမှူးချုပ်	ရာထူး	-	လက်ထောက်ဒါရိုက်တာ
ဌာန	-	သစ်တောဦးစီးဌာန	မှတ်ပုံတင်အမှတ်	-	၁၃/သပန(နိုင်)၀၁၄၅၉၅
			နေရပ်လိပ်စာ	-	Junction Center Office ဇ[illegible]ဖုန်၊ နေပြည်တော်။

(အသိသက်သေ)			(အသိသက်သေ)		
လက်မှတ်	-		လက်မှတ်	-	
အမည်	-	(မောင်မောင်ကျော်-၂)	အမည်	-	(နိုင်ဇော်သန်း)
ရာထူး	-	ညွှန်ကြားရေးမှူး	မှတ်ပုံတင်အမှတ်	-	၉/မထလ(နိုင်) ၂၇၀၂၉၆
ဌာန	-	စီမံကိန်းနှင့်စာရင်း[illegible]ဌာန သစ်တောဦးစီး[illegible]	နေရပ်လိပ်စာ	-	Junction Center Office ဟိုတယ်ဇုန်၊ နေပြည်တော်။

Annex X

Explosive permit

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ

ပြည်ထဲရေးဝန်ကြီးဌာန

မူးယစ်ဆေးဝါးနှင့်စိတ်ကိုပြောင်းလဲစေတတ်သောဆေးဝါးများအန္တရာယ်

တားဆီးကာကွယ်ရေးဗဟိုအဖွဲ့

ပြည်နယ်/တိုင်းဒေသကြီးမူးယစ်ဆေးဝါးနှင့်စိတ်ကိုပြောင်းလဲစေတတ်သောဆေးဝါးများအန္တရာယ်

တားဆီးကာကွယ်ရေးအဖွဲ့

မန္တလေးတိုင်းဒေသကြီး

ထိန်းချုပ်ဓာတုပစ္စည်း သိုလှောင်ထိန်းသိမ်းခြင်းလုပ်ငန်းလုပ်ကိုင်ရန်

ခွင့်ပြုချက်

(နည်းဥပဒေ ၃၆)

ရက် စွဲ ၊ ၂၀၂၀ ပြည့်နှစ်၊ နိုဝင်ဘာလ ၁၀ ရက်

ခွင့်ပြုချက်အမှတ်၊ (၁၄/၂၀၂၀)။

မန္တလေးတိုင်းဒေသကြီး မူးယစ်ဆေးဝါးနှင့် စိတ်ကိုပြောင်းလဲစေတတ်သော ဆေးဝါးများအန္တရာယ်တားဆီးကာကွယ်ရေးအဖွဲ့သည် ထိန်းချုပ်ဓာတုပစ္စည်း သိုလှောင်ထိန်းသိမ်းခြင်းလုပ်ငန်းလုပ်ကိုင်ရန် ထိန်းချုပ်ဓာတုပစ္စည်းကြီးကြပ်ရေးဆိုင်ရာ နည်းဥပဒေများ၏ နည်းဥပဒေ ၃၆ အရ အောက်ပါလုပ်ငန်း၊ ဌာန၊ ကုမ္ပဏီ၊ အဖွဲ့အစည်း၊ ပုဂ္ဂိုလ်အား ခွင့်ပြုချက်ကို ထုတ်ပေးလိုက်သည်-

၁။ ခွင့်ပြုချက်ရရှိသည့် လုပ်ငန်း၊ ဌာန၊ ကုမ္ပဏီ၊ အဖွဲ့အစည်း၊ပုဂ္ဂိုလ်၏အမည်နှင့်လိပ်စာ ဦးကျော်နိုင်စိုး၊ ဒုတိယ အုပ်ချုပ်မှုဒါရိုက်တာ၊ ရွှေတောင်သတ္တုတူးဖော်ရေးကုမ္ပဏီလီမိတက်၊ အပါအဝင်ဘိလပ်မြေစက်ရုံ၊ ပြည်ညောင်ကျေးရွာ၊ သာစည် မြို့နယ်။

၂။ သိုလှောင်ထိန်းသိမ်းရန် ခွင့်ပြုသည့် ထိန်းချုပ်ဓာတုပစ္စည်းများ

အမှတ်စဉ်	အမျိုးအမည် (ဓာတုအမည်)	တံဆိပ်အမှတ်အသား	ပုံသဏ္ဌာန် (အရည်၊ အခဲ၊ အမှုန့်)	ထုပ်ပိုးပုံအထုပ်အရေအတွက်	တစ်ယူနစ်အလေးချိန်ပမာဏ	စုစုပေါင်းအလေးချိန်ပမာဏ	မှတ်ချက်
၁	Ammonium Nitrate	TNC	Prill	-	50 Kg	504 Tons	

မှတ်ချက်။ တစ်နှစ်ပြည့်ကသက်တမ်းတိုးတင်ပြရန် ။

၃။ သိုလှောင်ထိန်းသိမ်းမည့် သိုလှောင်ရုံ၏ အဆောက်အအုံ၊ အမျိုးအစား၊ တည်နေရာ လိပ်စာနှင့် အကျယ်အဝန်း <u>အမိုနီယမ်နိုက်ထရိတ်အတွက် အလျား (၉၆)ပေ၊ အနံ (၄၀)ပေ၊အမြင့်(၁၄)ပေရှိ သွပ်မိုး၊ အုတ်ကာ၊ အုတ်ခင်း ဂိုဒေါင်အဆောက်အဦ၊ ကူပြင်ဒေသ၊ ပြည်ညောင်ကျေးရွာ၊ သာစည်မြို့နယ်၊</u>

၄။ သိုလှောင်ရုံ၏ အဆောက်အအုံကို စီမံခန့်ခွဲသူ မန်နေဂျာ၏ အမည်နှင့်လိပ်စာ၊ <u>ဦးအောင်ကိုသိုက်၊ Drill & Blast Manager ကူပြင်ဒေသ၊ ပြည်ညောင်ကျေးရွာ၊ သာစည်မြို့နယ်၊</u>

၅။ ထိန်းချုပ်ဓာတုပစ္စည်း သိုလှောင်ထိန်းသိမ်းခြင်း ခွင့်ပြုချက်ရရှိသူက လိုက်နာရမည့် စည်းကမ်းချက်များ-

(က) ခွင့်ပြုချက်ကို သိုလှောင်ထိန်းသိမ်းထားသည့် သိုလှောင်ရုံ၏ အဆောက်အအုံတွင် ချိတ်ဆွဲထားရမည်။

(ခ) သိုလှောင်ထိန်းသိမ်းခြင်းလုပ်ငန်းနှင့် စပ်လျဉ်း၍လစဉ်မှတ်တမ်းကိုပုံစံ(၂၂)ဖြင့် ပြုစုထားရှိရမည်။

(ဂ) လစဉ်မှတ်တမ်းများကို (၃)လတစ်ကြိမ် စုစည်းပြီး ပုံစံ(၅)ဖြင့် ထိန်းချုပ်ဓာတုပစ္စည်း ကြီးကြပ်ရေးကော်မတီသို့ တင်ပြအစီရင်ခံပြီး မိတ္တူကို ပြည်နယ်၊ တိုင်း၊ ခရိုင်၊ မြို့နယ် မူးယစ်ဆေးဝါးနှင့်စိတ်ကိုပြောင်းလဲစေသော ဆေးဝါးများအန္တရာယ် တားဆီးကာကွယ်ရေး အဖွဲ့သို့ပေးပို့ရမည်။

(ဃ) လစဉ်မှတ်တမ်းများ၊ (၃)လတစ်ကြိမ် အစီရင်ခံစာများ၊ ပြေစာဘောက်ချာများ၊ စာရင်းဇယားများကို အနည်းဆုံး(၂)နှစ်အထိ ထိန်းသိမ်းထားရှိရမည်။

(င) ထိန်းချုပ်ဓာတုပစ္စည်းကို တရားမဝင်သော လမ်းကြောင်းသို့ပြောင်းလဲပြီး အသုံးပြုခြင်း မရှိစေရန် အထူးဂရုပြု၍ သိုလှောင်ထိန်းသိမ်းထားရမည်။

(စ) သိုလှောင်ထားရှိရာတွင် အကြောင်းတစ်ခုခုကြောင့် ပျက်စီးခြင်း၊ ပျောက်ဆုံးခြင်း၊ လိုအပ်သည်ထက်ပို၍ လျော့နည်းခြင်းဖြစ်ပါက ချက်ချင်း ထိန်းချုပ်ဓာတုပစ္စည်း ကြီးကြပ်ရေးကော်မတီနှင့် သက်ဆိုင်ရာ ပြည်နယ်၊ တိုင်း၊ ခရိုင်၊ မြို့နယ်မူးယစ်ဆေးဝါး နှင့်စိတ်ကိုပြောင်းလဲစေသော ဆေးဝါးများအန္တရာယ် တားဆီးကာကွယ်ရေးအဖွဲ့များသို့ သတင်းပို့ရမည်။

(ဆ) မူးယစ်ဗဟိုအဖွဲ့ကဖြစ်စေ၊ ထိန်းချုပ်ဓာတုပစ္စည်းကြီးကြပ်ရေးကော်မတီကဖြစ်စေ အခါအားလျော်စွာ သတ်မှတ်သော စည်းကမ်းချက်များကို လိုက်နာရမည်။

ရုံးတံဆိပ်
စာအမှတ်၊ ၂၀
ရက်စွဲ၊ ၁၀.၁၁.၂၀၂၀

၁၀.၁၁.၂၀၂၀

ဥက္ကဋ္ဌ
တိုင်းဒေသကြီးမူးယစ်ဆေးဝါးနှင့်စိတ်ကိုပြောင်းလဲ
စေသောဆေးဝါးများအန္တရာယ် တားဆီးကာကွယ်ရေးအဖွဲ့
မန္တလေးတိုင်းဒေသကြီး

မှတ်ချက်။ မလိုသည့်စာသားကိုပယ်ဖျက်ရန်။