The Environmental Management Plan

of

Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project

Clean Development Mechanism (CDM) project

Prepared

By

Environmental Quality Management (EQM) Co., Ltd

Acronyms

ASEAN	Association of Southeast Asian Nations
BOD	Bio-Chemical Oxygen Demand
CDM	Clean Development Mechanism
COD	Chemical Oxygen Demand
CER	Certified Emission Reductions
CGI	Computer-generated Imagery
CPR	Cardiopulmonary Resuscitation
CSR	Cooperate Social Responsibility
DO	Dissolved Oxygen
ECC	Environmental Compliance Certificate
ECD	Environmental Conservation Department
EIA	Environmental Impact Assessment
ELV	Exposure Limit Value
EMP	Environmental Management Plan
EMT	Emergency Management Team
EQEG	Environmental Quality (Emission) Guideline
EQM	Environmental Quality Management Co.,ltd
ERP	Emergency Response Plan
FAO	Food and Agriculture Organization
FESR	Framework for Economic and Social Reform
GCS	Gas Collection System
GHG	Greenhouse Gas
HDPE	High-density Polyethylene Pipes
HSE	Health, Safety and Environment
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBAs	Key Biodiversity Areas
KEITI	Korea Environment Industry and Technology Institute
LFG	Landfill Gas
MCDC	Mandalay City Development Committee
MESC	Mandalay Electricity Supply Corporation
MIC	Myanmar Investment Commission
MoE	Ministry of Environment, Korea
MONREC	Ministry of Natural Resources and Environmental Conservation
MSDS	Material Safety Data Sheet
MSW	Municipal Solid Waste
NAAQS	National Ambient Air Quality Standards
NCDP	National Comprehensive Development Plan
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
$PM_{10}/PM_{2.5}$	Particulate Matter
PPE	Personal Protection Equipment
SIA	Social Impact Assessment
SPSS	Statistical Package for the Social Sciences
SW	Solid Waste
TA	Technical Assistance

TDS	Total Dissolved Solid
KNK	Kyar Ni Kan
TSS	Total Suspended Solid
UK	United Kingdom
UN	United Nations
US EPA	United State Environmental Protection Agency
VOC	Volatile Organic Compound
WARM	Waste Reduction Model
WB	World Bank
WBG EHS	World Bank Group Environmental, Health and Safety Guidelines
WBV	Whole-Body Vibration
WDPA	World Database Protected Area
WHO	World Health Organization
WMP	Waste Management Plan
3Rs	Reduce, Reuse and Recycle

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အခန်း(၁)
အကျဉ်းချုပ်အစီရင်ခံစာ

၁ အကျဉ်းချုပ်အစီရင်ခံစာ

၁.၁ နိဒါန်း

မြန်မာနိုင်ငံရှိ အမှိုက်ကျင်းထွက် ဓာတ်ငွေ့ (LFG) ပြန်လည်စုဆောင်းသန့်စင်မီးရှို့ခြင်းနှင့် လျှပ်စစ်ထုတ်လုပ်ခြင်း လုပ်ဆောင်မည့် သန့်ရှင်းသောဖွံ့ဖြိုးမှုလုပ်ငန်းစဉ်စဉ်(CDM) စီမံကိန်းသည် ကိုရီးယားနိုင်ငံ၏ သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဗန်ကြီးဌာန (MoE)၊ ကိုရီးယားပတ်ဝန်းကျင်စက်မှုနှင့် နည်းပညာအင်စတီကျု(KEITI) နှင့် ကမ္ဘာ့ဘဏ် (WB)တို့အကြား နားလည်မှုစာချွန်လွှာနှင့်အတူ မြန်မာနိုင်ငံအတွင်းစွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှုကို အထောက်အပံ့ဖြစ်စေရန် ၂၀၁၇ ခုနှစ်မှစ၍ စတင်ခဲ့ပါသည်။

KEITI ၊ WB နှင့် သဘာဝသယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဗန်ကြီးဌာန (MONREC)တို့သည် မန္တလေးမြို့တော်စည်ပင်သာယာရေးကော်မတီ(MCDC) နှင့်ပူးပေါင်း၍ ၂၀၁၈ ခုနှစ်တွင် မန္တလေးမြို့၏ အစိုင်အခဲစွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲမှု စုံစမ်းလေ့လာရေးနှင့် စီမံကိန်း ဖွံ့ဖြိုးတိုးတက်မှု အတွက် လိုအပ်သောနည်းပညာအထောက်အပံ့(TA)တို့ကို ပူးပေါင်း မြှင့်တင်ပေးခဲ့ပါသည်။

ဤစီမံကိန်းသည် ***CO2တစ်တန်အလိုက် ထုတ်လွှတ်မှုလျှော့ချခြင်းခရက်ဒစ်(CER) ရရှိစေသော CDMလုပ်ငန်းစဉ်*** ကို အသုံးပြု၍ အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့ (LFG) များကို ဖမ်းယူမီးရှို့သည့် စီမံကိန်း ဖြစ်ပါသည်။

ကြာနီကန်အမှိုက်ကျင်းသည် အောင်မြေသာဇံ၊ချမ်းအေးသာဇံ၊မဟာအောင်မြေခရိုင်မှ အမှိုက်များကို လက်ခံသိမ်းဆည်းပြီး ***မန္တလေးမြို့မြောက်ဘက် (၁၇) ကီလိုမီတာအကွာတွင်*** တည်ရှိပါသည်။ ကြာနီကန်အမှိုက်ကျင်းနေရာ၏ GPS အချက်အလက်အတိအကျမှာ ***လတ္တီတွဒ် ၂၂.၀၈၆၉၆၉ နှင့်လောင်ဂျီတွဒ် ၉၆.၁၆၂၈၁ ဖြစ်ပါသည်။ အဆိုပြုထားသောစီမံကိန်း၏စုစုပေါင်းဧရိယာမှာ (၇)ဟက်တာ*** ရှိသည်။

အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်း အတွက် ***ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်(EMP)***ကို ပတ်ဝန်းကျင်အရည်အသွေးစီမံခန့်ခွဲမှုကုမ္ပဏီလီမိတက် ***Environmental Quality Management Co., Ltd*** ၏ အတိုင်ပင်ခံအဖွဲ့က MONREC၏ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန(ECD) မှ ထုတ်ပြန်ထားသော ***ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်ဆိုင်ရာ လုပ်ထုံးလုပ်နည်းများ (၂၀၁၅)***နှင့် အညီ ရေးဆွဲဆောင်ရွက်ခဲ့ပါသည်။

စီမံကိန်းနှင့် ပတ်သက်သည့် အစိုးရဌာနဆိုင်ရာ မှတ်ပုံတင်ခြင်း / ခွင့်ပြုချက်များကို အောက်ပါအတိုင်း ဖော်ပြထားပါသည်-

ဇယား ၁.၁ စီမံကိန်းအတွက် အစိုးရဌာနဆိုင်ရာ မှတ်ပုံတင်ခြင်း / ခွင့်ပြုချက်များ

၁	ပတ်ဝန်းကျင်ဆိုင်ရာ ကုမ္ပဏီမှတ်ပုံတင်အမှတ်	၂၆၉၀/၂၀၁၂-၂၀၁၃
၂	သဘာဝသယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဗန်ကြီးဌာန (MONREC)၏ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန(ECD)၏ EMP ရေးဆွဲဆောင်ရွက်ရန် ထောက်ခံချက်ပေးအပ်သည့် နေ့စွဲ	ဧရက် ဇွန်လ ၂၀၂၀ခုနှစ်

ဤအစီရင်ခံစာ၏ အဓိကရည်ရွယ်ချက်မှာ ***စီမံကိန်းရေရှည်ဖွံ့ဖြိုးတိုးတက်ပြီး ကျန်းမာရေးနှင့်ပတ်ဝန်းကျင်အပေါ် ဆိုးကျိုးသက်ရောက်မှုများ*** ဖြစ်စေသည့် စီမံကိန်း၏ အချို့သောလုပ်ငန်းစဉ်များကို ***လျှော့ချရေးနည်းလမ်း အသုံးပြု၍ ဆောင်ရွက်ရန်*** ဖြစ်ပါသည်။

၁.၂ ရည်ရွယ်ချက်

ရည်ရွယ်ချက်များ ကို အကောင်အထည်ဖော်ရန်အတွက် အောက်ပါနည်းလမ်းများကို အသုံးပြုခဲ့ပါသည်။

- နိုင်ငံတော် နှင့် နိုင်ငံတကာအဆင့် မူဝါဒများ၊ ဥပဒေများနှင့် စည်းမျဉ်းများ နှင့်သက်ဆိုင်သည့် စာရွက်စာတမ်းများအပေါ် ***စာပေပြန်လည်သုံးသပ်ခြင်း***။
- သက်ဆိုင်ရာအစိုးရများအပါအဝင် စီမံကိန်းနှင့် ***ပတ်သက်ဆက်နွယ်သူများနှင့် လူတွေ့မေး***မြန်းခြင်း။
- မူရင်းအချက်အလက်နှင့် တဆင့်ခံချက်အလက်များ ကောက်ယူစုဆောင်းခြင်း။
- ***ပတ်ဝန်းကျင်ဆိုင်ရာ ကနဦးအခြေခံစောင့်ကြည့်စစ်ဆေးမှု***။
- ***အဓိကဌာနဆိုင်ရာများနှင့် တွေ့ဆုံခြင်း*** ၊ စီမံကိန်းကြောင့် အကျိုးသက်ရောက်နိုင်သည့် ကျေးရွာလူထုနှင့် ***တွေ့ဆုံမေးမြန်းခြင်း***များအပြင် ***တစ်အိမ်တက်ဆင်း အိမ်ထောင်စုစစ်တမ်းကောက်ယူခြင်း၊ စီမံကိန်းသတင်းထုတ်ဖော်ခြင်း။***
- ***ပြန်လည်အစီရင်ခံခြင်း***။

၁.၃ မူဝါဒ၊ ဥပဒေရေးရာနှင့် ဖွဲ့အစည်းပုံမူဘောင်

သဘာဝပတ်ဝန်းကျင်စီမံခန့်ခွဲမှု အစီရင်ခံစာသည် (EMP) ကို ချမှတ်ထားသော ဥပဒေများနှင့်အညီ ပြင်ဆင်ဆောင်ရွက်ထားပါသည်။ ***သက်ဆိုင်ရာလမ်းညွှန်ချက်များ၊ စံချိန်စံညွှန်းများနှင့် ဥပဒေများ***ကို အောက်တွင်ဖော်ပြထားပါသည်။

- ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်ဖွဲ့စည်းပုံအခြေခံဥပဒေ (၂၀၀၈) မှ အပိုဒ် ၃၇ (က) နှင့် အပိုဒ် ၄၅
- ကမ္ဘာ့ကျန်းမာရေးအဖွဲ့ (WHO)၊ အမေရိကန်ပြည်ထောင်စု ပတ်ဝန်းကျင်ထိန်းသိမ်းကာကွယ်ရေးအေဂျင်စီ (USEPA) နှင့် နိုင်ငံတကာ ငွေကြေးကော်ပိုရေးရှင်း (IFC) အစရှိသည့် နိုင်ငံတကာမူဝါဒများ၊ အခြေခံ မူများနှင့် စံနှုန်းများ
- လုပ်ငန်းခွင်ကျန်းမာရေး၊ ဘေးကင်းလုံခြုံရေးတို့နှင့် သက်ဆိုင်သည့် ဥပဒေနှင့် နည်းဥပဒေများ
- သယံဇာတနှင့်ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန လက်အောက်ရှိ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာနမှ သဘောတူလက်မှတ်ရေးထိုးထားသော နိုင်ငံတကာ သဘောတူညီချက်များ
- ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဥပဒေ (၂၀၁၂)
- နိုင်ငံခြားရင်းနှီးမြှုပ်နှံမှုဥပဒေ (၂၀၁၃)
- ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးနည်းဥပဒေများ (၂၀၁၄)
- ပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်း လုပ်ထုံးလုပ်နည်းများ (ဒဝ၁၅)
- အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန်ချက် (၂၀၁၅)
- ပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်း လမ်းညွှန်ချက်မူကြမ်း (၂၀၁၅)
- မြန်မာနိုင်ငံ၏ပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်းများတွင် လူထုပါဝင်မှုဆိုင်ရာလမ်းညွှန်ချက်မူကြမ်း (၂၀၁၇)
- စီမံကိန်း၏ပတ်ဝန်းကျင်နှင့် လူမှုရေး ဆိုင်ရာ စီမံခန့်ခွဲမှုနှင့်တိုက်ရိုက် (သို့မဟုတ်) သွယ်ဝိုက်သက်ဆိုင်သော အခြားဥပဒေများအပါအဝင် စီမံကိန်းနှင့်သက်ဆိုင်သောဥပဒေများ

၁.၄ စီမံကိန်းဖော်ပြချက်နှင့် အခြားနည်းလမ်းများ

စီမံကိန်းလုပ်ငန်းစဉ်များတွင် လုပ်ငန်းခွင်လိုအပ်ချက်များအတွက် လျှပ်စစ်ဓာတ်အားထုတ်လုပ်ရန် ***မီသိန်းဓာတ်ငွေ့ဖမ်းယူသုံးစွဲမှုလုပ်ငန်းစဉ်*** ပါဝင်ပါသည်။ ထိုလုပ်ငန်းစဉ်တွင် ***စိမ့်ထွက်ရည်များအငွေ့ပျံစေရန်***လည်းအပူကို အသုံးပြုပါလိမ့်မည်။ စီမံကိန်း၏အစိတ်အပိုင်းတစ်ခုအနေဖြင့် ***အရံတပ်ဆင်ထားသည့် သန့်စင်မီးရှို့စက်စနစ်တစ်ခု*** တပ်ဆင်ထားပါသည်။ ***စွမ်းအင်ထုတ်လုပ်ခြင်း၊ စွန့်ပစ်ရည်အငွေ့ပျံခြင်းနှင့် သန့်စင်မီးရှို့စက်များမှတစ်ဆင့် အမှိုက်ကျင်းထွက်ခါတ်ငွေ့(LFG) ကို ထိရောက်စွာလောင်ကျွမ်းစေခြင်း***ဖြင့် ဖန်လုံအိမ်ဓာတ်ငွေ့(GHG)ထုတ်လွှတ်မှု လျော့ချခြင်းကို လုပ်ဆောင်သွားပါမည်။ စီမံကိန်းတွင် မီသိန်းဓါတ်ငွေ့များကို အင်ဂျင်များအတွင်း လောင်ကျွမ်းမီးရှို့ခြင်းတို့ဖြင့် ဖျက်ဆီးသွားမည် ဖြစ်ပြီး ၄င်းမှ ***ရရှိသော စွမ်းအင်များကို အမှိုက်ပုံနှင့် LFG ထုတ်လုပ်မှုလုပ်ငန်းစဉ်၏စွမ်းအင်လိုအပ်ချက်များအတွက် အသုံးပြုသွားပါမည်။***

စီမံကိန်းလုပ်ဆောင်မှုများတွင် ဓာတ်ငွေ့ထုတ်ယူမှုစနစ်၊ ***ဓါတ်ငွေ့မီးရှို့သည့်ကိရိယာများ၊ ဓါတ်ငွေ့ကြိုတင်သန့်စင်စက်ရုံနှင့် ဓါတ်ငွေ့သုံးအင်ဂျင်များ၊ အမှိုက်ကျင်းနေရာမှထုတ်လွှတ်သော အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့(LFG)သုံးအင်ဂျင်များ***လည်း ပါဝင်ပါသည်။

ဓါတ်အားထုတ်လုပ်မှုစက်ရုံကို ကြာနီကန်အမှိုက်ကျင်း၏ ပိတ်သိမ်းထားသောနေရာများတွင် တပ်ဆင်တည်ဆောက်သွားပါမည်။ ကြာနီကန်အမှိုက်ကျင်းတွင် ***သိပ်သည်းဆမြင့်မားသည့်ပိုလီအီသိုင်လင်း (HDPE)ပိုက်များအားဒေါင်လိုက်အနေအထားဖြင့်(ခန့်မှန်း)၁၁၂ချောင်းအား*** တူးသွင်းတပ်ဆင်မည်ဖြစ်ပါသည်။ စီမံကိန်းတွင် ***လေမှုတ်စက်များ၊ ရေဓါတ်ထုတ်ကိရိယာ၊ အကာအကွယ်ပါသောမီးရှို့စနစ်၊ ဂျနေရေတာစနစ်နှင့် LFG တိုင်းတာစက်၊ မှတ်တမ်းတင်စက်များနှင့်အတူ အလိုအလျောက် မီးရှို့စနစ် နှင့် ဂျနေရေတာစက်ရုံများ*** ပါရှိပါသည်။ ***သန့်စင်မီးရှို့စက်***မှာ အမြင့်ဆုံးစွမ်းအား ***၅၀၀Nm³/hr*** နှင့် ***ဂျနေရေတာ***မှာ အမြင့်ဆုံးစွမ်းအား ***၅၀၀kW တစ်စုံ*** ရှိ၍ ***မီးရှို့ဖျက်ဆီးနိုင်စွမ်းရာခိုင်နှုန်းမှာ ၉၈% နှင့် ၁၀၀%*** ကြားတွင် ရှိပါသည်။

ယေဘုယျအားဖြင့်စီမံကိန်းတစ်ခုလုံးကို အောက်ပါအဆင့်များဖြင့်ဖွဲ့စည်းထားပါသည် –
လုပ်ငန်းအဆင့် (၁) အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့(LFG) စုဆောင်းခြင်းစနစ်
လုပ်ငန်းအဆင့် (၂) အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့(LFG)များကို သန့်စင်မီးရှို့စနစ်(Flaring)
လုပ်ငန်းအဆင့် (၃) အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့(LFG)မှ လျှပ်စစ်ထုတ်လုပ်ခြင်းစနစ်

၁.၄.၁ လက်ရှိတည်နေရာအသုံးပြုမှု

အဆိုပြုထားသော ကြာနီကန်အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်း ၏ အဓိကအစိတ်အပိုင်းမှာ ခြံစည်းရိုးတံတိုင်း၊ ဝင်ပေါက်တံခါး၊ ဓာတ်အားပေးစက်ရုံ၊ အုပ်ချုပ်ရေးအဆောက်အအုံ၊ အလုပ်ရုံ၊ ကားရပ်နားရာနေရာများ၊
စွန့်ပစ်ရည်သန့်ရှင်းရေးရေလှောင်ကန်များ၊ အလုပ်သမားများအတွက် လူမှုရေးနှင့်နားနေအခန်း၊ စောင့်ကြည့်ရေတွင်းများ၊ နှင့် ရေနုတ်မြောင်းစနစ်တို့ ဖြစ်ပါမည်။

၁.၄.၂ လုပ်ငန်းလည်ပတ်မှုကာလ

(က) စွမ်းအင်လိုအပ်ချက်

အဆိုပြုထားသောယူနစ်အတွက် စုစုပေါင်းစွမ်းအင်လိုအပ်ချက်မှာ သန့်စင်မီးရှို့စက်လည်ပတ်ရန်အတွက် အများဆုံးစွမ်းအား ၅၀၀Nm3/hr ဖြစ်ပါမည်။ လုပ်ငန်းလည်ပတ်မှုအဆင့်တွင် စီမံကိန်းလုပ်ငန်းများလည်ပတ်ရန်နှင့် မီးထွန်းရန် အစရှိသည်တို့အတွက် အမြင့်ဆုံးစွမ်းအား ၅၀၀ kW ရှိသည့် ဂျင်နရေတာတစ်လုံး (***500 kW တစ်စုံ***) အသုံးပြုပါမည်။

ခ) ရေလိုအပ်ချက်

ဆောက်လုပ်ရေးကာလ၊လုပ်ငန်းလည်ပတ်မှုကာလနှင့်လုပ်ငန်းပိတ်သိမ်းမှုကာလတို့အတွက် အဓိကရေအရင်းအမြစ်မှာ ***အဝီစိတွင်းများနှင့် အများသုံးရေပိုက်များ*** ဖြစ်ပါမည်။

မန္တလေးမြို့၏ဘူမိဇလဗေဒအပေါ်အခြေခံ၍ ***ပေ၂၀၀ခန့်မှ၃၀၀ခန့်အနက်ရှိ*** အဝီစိရေတွင်းတစ်တွင်း ထားရှိနိုင်ပြီး ၄င်းအဝီစိတွင်းမှ တစ်နာရီပျှမ်းမျှ ***၈၀၀မှ၁၀၀၀ဂါလံ***အထိ ထုတ်လုပ်နိုင်စွမ်း ရှိပါမည်။ ဆောက်လုပ်ရေးကာလ၊လုပ်ငန်းပိတ်သိမ်းမှုကာလတို့အတွက် စီမံကိန်း၏***စုစုပေါင်းရေအသုံးပြုမှု***သည် ***တစ်နေ့လျှင် ၃၀m3*** (တစ်နေ့လျှင် ၇,၉၂၅ဂါလံ) ဖြစ်ပါသည်။ ဆောက်လုပ်ရေးကာလ(ဖလ)အတွက် ရေလိုအပ်ချက်မှာ ***ဖလလျှင် ၅,၄၀၀m3*** (ဖလလျှင် ဂါလံ ၁,၄၂၆,၅၀၀) ဖြစ်ပါသည်။ အဆိုပြုထားသောစီမံကိန်းကို ဆောက်လုပ်ရန်အတွက် လိုအပ်သောရေကို အများပိုင်ရေပိုက်လိုင်းများနှင့် သိုလှောင်ထားသောရေသိုလှောင်ကန်များ (၆,၄၀၀ဂါလံနှင့်၃၂၀၀၀ဂါလံ) မှတစ်ဆင့် စီမံကိန်းနေရာကို ရေထောက်ပံ့ပါမည်။

လုပ်ငန်းလည်ပတ်မှုကာလတွင် စီမံကိန်း၏ရေသုံးစွဲမှုအားလုံးမှာ ရေချိုးခန်းနှင့်အိမ်သာအတွက်သာ (လူတစ်ယောက်လျှင် တစ်ရက်ခန့်မှန်း ရေဂါလံ၁၀၀) ဖြစ်ပါမည်။ သောက်သုံးရေအတွက် သောက်ရေသန့်ပုလင်းများကို အသုံးပြုပါမည်။

(ဂ) **အလုပ်သမားလိုအပ်ချက် ဝန်ထမ်းခန့်ထားမှု**

ဆောက်လုပ်ရေးကာလအတွင်းစီမံကိန်း ဝန်ထမ်းများအားလုံးသည် ***ဆောက်လုပ်ရေးလုပ်ငန်းခွင်သို့မသွားမီ လုပ်ငန်းခွင်ဘေးအန္တရာယ်ကင်းရှင်းရေးနှင့်ကျန်းမာရေးစီမံခန့်ခွဲမှု(OSHA)*** သင်တန်းကိုပြီးဆုံးအောင်လုပ်ရမည်။ စီမံကိန်းအတွက် လိုအပ်သောလူစွမ်းအားအရင်းအမြစ်များကို အခန်း (၄) တွင် အသေးစိတ်ဖော်ပြထားပါသည်။

(ဃ) စွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှု

စီမံကိန်းသည် အမှိုက်ကျင်းနေရာတွင် တည်ရှိသောကြောင့် စွန့်ပစ်ပစ္စည်းများကို ခွဲခြားသိမ်းဆည်းပြီးနောက် အနီးအနားရှိ အမှိုက်စွန့်ပစ်နေရာသို့ အမှိုက်သိမ်းကားများဖြင့် ပြောင်းရွှေ့စွန့်ပစ်ပါမည်။

c) **လုံခြုံရေးနည်းလမ်းများ**

လုပ်ငန်းလည်ပတ်နေစဉ် ***ဝန်ထမ်း/အလုပ်သမားများအတွက် လုံခြုံရေးအစီအမံများအနေဖြင့်*** အောက်ပါ လုံခြုံရေးအကာအကွယ်ပစ္စည်းများကို အသုံးပြုဝတ်ဆင်ရပါမည် -

- နားအုပ်/နားကြပ်များ
- လက်အိတ်များ
- လုံခြုံရေးသုံးဘွတ်ဖိနပ်များ
- ဖုန်ဓာတ်ငွေ့ကာ/မျက်နှာဖုံးများ
- ဦးထုပ်များ
- ကာကွယ်ရေးယူနီဖောင်းများ

၁.၅ **အခြားရွေးချယ်စရာများ**

အခြားဖွံ့ဖြိုးတိုးတက်မှုနှင့်စပ်လျဉ်း၍ ကြာနီကန်အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်းကြောင့် သဘာဝပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာသက်ရောက်မှု ရှိနိုင်ခြေများအားလုံးကို တားဆီးကာကွယ်ပေးနိုင်သော ***အခြားရွေးချယ်စရာနည်းလမ်းမရှိပါ။*** စီမံကိန်း၏ရည်ရွယ်ချက်မှာ ***မန္တလေးမြို့ ၏စွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှုမဟာဗျူဟာနှင့် လုပ်ငန်းစီမံချက် (၂၀၁၇-၂၀၃၀) ၏ ရည်မှန်းချက်(ခ)ကို***အခြေခံ၍ မန္တလေးမြို့ရှိနောက်ဆုံးအမှိုက်စွန့်ပစ်ခြင်းနေရာအား ဆန်းသစ်တီထွင်တိုးတက်စေခြင်းဖြင့် ပတ်ဝန်းကျင်ထိန်းသိမ်းကာကွယ်ရေးကို သေချာစေရန် ရည်ရွယ်ပါသည်။

ထို့အပြင် အဆိုပြုထားသောစီမံကိန်းလုပ်ဆောင်မှုသည် **ပြည်တွင်း၌စီးပွားရေးဆွဲဆောင်မှုမရှိခြင်း၊** နည်းပညာဆိုင်ရာ ဗဟုသုတနည်းပါးခြင်း၊ ပစ္စည်းကိရိယာများမရရှိခြင်းစသော **အခက်အခဲ**များစွာနှင့်ရင်ဆိုင်**နိုင်ရပါ**သည်။ ထို့ကြောင့် **နိုင်ငံခြားနည်းပညာ အထောက်အပံ့ဖြင့်** ဤစီမံကိန်းလုပ်ငန်းများကို အကောင်အထည်ဖော်ခြင်းအားဖြင့် ***အမှိုက်ကျင်းမှ ဓာတ်ငွေ့ပြန်လည်လည်ရှုပ်ခြင်း အလေ့အကျင့်ကိုပြသရာတွင်လည်းကောင်း၊ မှန်ကန်သောအမှိုက်ကျင်းစီမံခန့်ခွဲမှုနှင့် ပတ်သက်၍ LFG*** *ပြန်လည်စုဆောင်းမှုစနစ်၊ မီးရှို့စက်၊ ဂျင်နရေတာစနစ်များ* နှင့်ပတ်သက်သည့် ဒေသဆိုင်ရာဗဟုသုတများ တည်ဆောက်ရာတွင်လည်းကောင်း ***နိုင်ငံတော်အား အထောက်အကူပြုပါမည်။***

ထို့အပြင် သန့်ရှင်းမှုမရှိသောအမှိုက်ကျင်းများကို သန့်ရှင်းသောအမှိုက်ကျင်းသို့ ပြောင်းလဲခြင်း**အတွက်** ငွေကြေးအထောက်အပံ့များစွာ လိုအပ်မည့် ***စွန့်ပစ်ရည်သန့်စင်ခြင်းစနစ်နှင့် မြေဆီလွှာအဖုံး*** အစရှိသည့် လုပ်ငန်းစဉ်များလိုအပ်ပါသည်။ **LFG**ဓာတ်အားစက်ရုံတည်ဆောက်ရန် အခြေခံလိုအပ်ချက်ဖြစ်သော

ထိုသန့်ရှင်းသောအမှိုက်ကျင်းများအပေါ် ရင်းနှီးမြှုပ်နှံခြင်းဖြင့်**လည်း** ပုဂ္ဂလိကကုမ္ပဏီများ**အနေဖြင့်** အမြတ်အစွန်းများ မရရှိနိုင်ကြောင်း တွေ့ရပါသည်။

ထို့အပြင် ***ကုလသမဂ္ဂ (UN CDM)*** သည် ***ကိုရီးယားကုမ္ပဏီများအတွက် စီးပွားရေးတွက်ချေကောင်းမွန်သော*** *LFG* ***ပြန်လည်အသုံးချရေးအလေ့အကျင့်ကို CDM CER***ခရက်ဒစ် ***များဖြင့်*** အထောက်အပံ့ပေးနိုင်ကြောင်းကိုလည်း ပြသပါမည်။

၁.၆ ပတ်ဝန်းကျင်ဖော်ပြချက်၊ သက်ရောက်မှုနှင့်ဘေးအန္တရာယ်အကဲဖြတ်ခြင်းနှင့် လျှော့ချရေးနည်းလမ်းများ

၁.၆.၁ ဒေသတွင်းရာသီဥတုနှင့်မိုးလေဝသ

မန္တလေးမြို့သည် ***ပင်လယ်ရေမျက်နှာပြင်အထက် စုစုပေါင်းတွင်*** တည်ရှိပြီး ရာသီဥတုမှာ ***ဒေသဆိုင်ရာ စတက်လွင်ပြင်ရာသီဥတု****(Steppe)* ဖြစ်သဖြင့် ***အေးသောဆောင်းရာသီ၊ ပူပြင်းခြောက်သွေ့သောနွေရာသီနှင့် မိုးရွာသွန်းမှုနည်းသော*** ရာသီဥတု ဖြစ်ပါသည်။

၁.၆.၂ ပုသိမ်ကြီးမြို့နယ်

စီမံကိန်းတည်ရှိရာ ပုသိမ်ကြီးမြို့နယ်၏ ရာသီဥတုမှာ ***အပူချိန် ၃၇ ဒီဂရီစင်တီဂရိတ်နှင့် အနိမ့်ဆုံးအပူချိန် ၂၉ ဒီဂရီစင်တီဂရိတ်***ရှိသည့် ***ပူပြင်းပြီးစိုထိုင်းသောရာသီဥတု*** ဖြစ်ပါသည်။ ပုသိမ်ကြီးမြို့နယ်သည် မုတ်သုန်မိုးနှင့်ကြုံတွေ့ရပြီး ***နှစ်စဉ်ပျမ်းမျှမိုးရေချိန် ၆၂၄ မီလီမီတာ (၂၀၁၉ ခုနှစ်)*** ရှိပါသည်။

(၁) ကွင်းဆင်းတိုင်းတာမှု မိုးလေဝသ

ကွင်းဆင်းတိုင်းတာမှုတွင် အပူချိန်၊ စိုထိုင်းဆ၊ လေတိုက်နှုန်းနှင့် လေဦးတည်ချက်တို့ကို တိုင်းတာထားပါသည်။ **ဇယား ၅.၂** တွင် ***ပျမ်းမျှအပူချိန်မှာ ၂၃ ဒီဂရီစင်တီဂရိတ်ဝန်းကျင်တွင်ရှိပြီး စိုထိုင်းဆမှာ ၄၇%*** ဖြစ်ပါသည်။ ဤအတိုင်းအတာများသည် လေထုအရည်အသွေးအခြေအနေအပေါ် အကျိုးသက်ရောက်မှု ဖြစ်စေပါသည်။

၁.၆.၃ ပတ်ဝန်းကျင်လေထုအရည်အသွေး

အဆိုပြုထားသောစီမံကိန်းအနီးအနားရှိ လေထုအရည်အသွေးကိုဖော်ပြရန်အတွက် ***ကြာနီကန်အမှိုက်ကျင်းနှင့် စီမံကိန်းနေရာ၏ ၂ ကီလိုမီတာအကွာတွင်*** ကနဦးပတ်ဝန်းကျင်လေထုအရည်အသွေးစောင့်ကြည့်စစ်ဆေးခြင်းကို ၂၀၂၀ခုနှစ် စက်တင်ဘာလတွင် လုပ်ဆောင်ခဲ့ပါသည်။

ထို့အပြင် လိုက်နာရမည့် စံချိန်စံနှုန်းများကို နှိုင်းယှဉ်ဖော်ပြထားပါသည်။

စောင့်ကြည့်လေ့လာမှုတွင် ၂၄ နာရီပျမ်းမျှ ***အမှုန် (PM10)၊ အမှုန်(PM2.5)၊ ကာဗွန်မိုနောက်ဆိုဒ် (CO)၊ ဆာလ်ဖာဒိုင်အောက်ဆိုဒ် (SO2) နှင့်နိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ် (NO2)၊ အိုဇုန်း (O3) တို့ကို မိုးလေဝသအခြေအနေများ နှင့်အတူ*** စောင့်ကြည့်လေ့လာခဲ့ပါသည်။

ကြာနီကန်အမှိုက်ကျင်းနှင့်၄င်းပတ်ဝန်းကျင် နှစ်ခုစလုံးရှိ အမှုန်နှင့်ခါတ်ငွေ့ပါဝင်မှုပမာဏသည် ပတ်ဝန်းကျင်အရည်အသွေးထုတ်လွှတ်မှုလမ်းညွှန်ချက်များ(EQEG)နှင့် ကိုက်ညီပါသည်။

ဇယား ၁.၂ ကြာနီကန်အမှိုက်ကျင်းနှင့် ၄င်းဝန်းကျင်ရှိ ကနဦးအမှုန်ထုတ်လွှတ်မှုနှုန်းနှင့်ဓါတ်ငွေ့အရည်အသွေး

အတိုင်းအတာများ	ထုတ်လွှတ်မှုနှုန်း	EQEG လမ်းညွှန်ချက်
အမှုန်များ		
PM10	$20^{a}\pm10^{b}$ $20^{c}(10^{d}–30^{e})$ (24hr)	50(µg/m^3) (24 hour)
PM2.5	$4^{a}\pm1^{b}$ $4^{c}(3^{d}–5^{e})$ (24hr)	25 (µg/m^3) (24 hour)
ဓာတ်ငွေ့များ		
ဆာလ်ဖာဒိုင်အောက်ဆိုဒ် SO2 (ပျမ်းမျှ ၂၄ နာရီ)	$6^{a}\pm5^{b}$ $6^{c}(1^{d}–10^{e})$ (24hr)	20 (µg/m^3) (24 hour)
ကာဗွန်မိုနောက်ဆိုဒ် CO (ပျမ်းမျှ ၁ နာရီ)	$115^{a}\pm48^{b}$ $0^{c}(0^{d}–884^{e})$ (1hr)	30,000 (µg/m^3) (1hr)
ကာဗွန်မိုနောက်ဆိုဒ် CO (ပျမ်းမျှ ၈ နာရီ)	$105^{a}\pm49^{b}$ $85^{c}(10^{d}–240^{e})$ (8hr)	10,000 (µg/m^3) (8hr)
အိုဇုန်း O3 (ပျမ်းမျှ ၈ နာရီ)	$33^{a}\pm6^{b}$ $32^{c}(22^{d}–47^{e})$ (8hr)	100 (µg/m^3) (8hr)
နိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ်NO2 (ပျမ်းမျှ ၁ နာရီ)	$7^{a}\pm1^{b}$ $6^{c}(0^{d}–22^{e})$ (1hr)	200 (µg/m^3) (1hour)

ဆောက်လုပ်ရေးကာလအတွင်း လေထုအရည်အသွေးသက်ရောက်မှုကို ဆန်းစစ်ခြင်း

အဆိုပြုထားသောစီမံကိန်း၏ ***ဆောက်လုပ်ရေးကာလအတွင်း လေထုအပေါ်သက်ရောက်မှု***ဖြစ်စေသော အကြောင်းရင်းများတွင် ***ဖုန်မှုန့်နှင့်ဓါတ်ငွေ့ထုတ်လွှတ်မှု၊ လောင်စာသုံး ဆောက်လုပ်ရေး ကိရိယာများမှ ထုတ်လွှတ်မှု၊ မီးပုံရှို့ခြင်း၊ ယာယီလောင်စာလွှဲပြောင်းမှုစနစ်များ***နှင့် ***ဆက်စပ်သိုလှောင်ကန်များ***စသည့် အကြောင်းရင်းများ ပါဝင်သည်။ ၄င်းတို့၏ ***ပတ်ဝန်းကျင် လေထုအပေါ် သက်ရောက်မှုအဆင့်ကို “အလယ်အလတ်(Medium Significance)”*** ဟုသတ်မှတ်ပါသည်။

လုပ်ငန်းလည်ပတ်မှုကာလအတွင်း လေထုအရည်အသွေးသက်ရောက်မှုကို ဆန်းစစ်ခြင်း

လေထုညစ်ညမ်းမှုပိုမိုထိခိုက်စေမည့်အောက်ပါလုပ်ငန်းစဉ်များမှ ***ကာဗွန်မိုနောက်ဆိုဒ်(CO)နှင့် နိုက်ထရိုဂျင်အောက်ဆိုဒ် (NOx)*** ကို ထုတ်လွှတ်ပါလိမ့်မည်။

က) ***လုပ်ငန်းအဆင့် (၂) အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့(LFG)များကို သန့်စင်မီးရှို့စနစ်(Flaring)***

ခ) ***လုပ်ငန်းအဆင့် (၃) အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့(LFG)မှ လျှပ်စစ်ထုတ်လုပ်ခြင်းစနစ်***

USEPAမှထောက်ခံသော AERMOD Model နှင့် မိုးလေဝသတွက်ချက်မှု အတွက် WRF 3D Model တို့ကို အသုံးပြု၍ စီမံကိန်းနေရာရှိလေထုအရည်အသွေးအပေါ် ကာဗွန်မိုနောက်ဆိုဒ်(CO)နှင့်နိုက်ထရိုဂျင်အောက်ဆိုဒ်(NOx) ထုတ်လွှတ်မှု၏ ပျံ့နှံ့ခြင်းနှင့်သက်ရောက်မှုများကို တွက်ချက်ခဲ့ပါသည်။

ဤလေ့လာမှုတွင် ကြာနီကန်အမှိုက်ကျင်းရှိ အဆိုပြု အမှိုက်ကျင်းထွက်ဓါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်း၏ လုပ်ငန်းအဆင့်(၂)ဆင့်အတွင်း ကာဗွန်မိုနောက်ဆိုဒ်(CO)နှင့် နိုက်ထရိုဂျင်အောက်ဆိုဒ်(NOx))ထုတ်လွှတ်မှု၏ ပျံ့နှံ့ခြင်းပုံစံများအတွက် AERMOD မော်ဒယ်ပုံဖော်ခြင်းကို လုပ်ဆောင်ပါသည် _ကြာနီကန်အမှိုက်ကျင်းတွင်

၁) လုပ်ငန်းအဆင့်(၂) – မီးရှို့သန့်စင်စက် တစ်ခု

၂) လုပ်ငန်းအဆင့် (၃) – မီးရှို့သန့်စင်စက် တစ်ခု နှင့် လျှပ်စစ်စွမ်းအင် ထုတ်ယူရန် ဂျင်နရေတာ တစ်ခု

လုပ်ငန်းအဆင့် (၂)

တိုင်းတာမှုရလဒ်များအရ လုပ်ငန်းအဆင့် (၂) တွင် ***အမျိုးမျိုးသောပျမ်းမျှအကြိမ်များ (၁ နာရီ၊ ၈ နာရီ၊ နှစ်စဉ်)၌ နိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ် နှင့် ကာဗွန်မိုနောက်ဆိုဒ်ထုတ်လွှတ်မှုများသည်*** ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဥ ီးစီးဌာနမှ ထုတ်ပြန်ထားသော သက်ဆိုင်ရာပတ်ဝန်းကျင်ဆိုင်ရာအရည်အသွေးထုတ်လွှတ်မှုလမ်းညွှန်ချက်များ ***(EQEG)***၊ ကမ္ဘာ့ကျန်းမာရေးအဖွဲ့ ***(WHO)***လမ်းညွှန်ချက်များနှင့် ယူနိုက်တက်စတိတ်ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးအေဂျင်စီ ***(US EPA NAAQS)*****၏ *လေထုအရည်အသွေး စံချိန်စံညွှန်းများ***နှင့် ကိုက်ညီပါသည်။ ***ကြာနီကန်အမှိုက်ကျင်းရှိ ဤသြစ်ညမ်းဓါတ်ငွေ့များ၏ အများဆုံး(ပထမအမြင့်ဆုံး)ထုတ်လွှတ်မှုများသည် ပင်မထုတ်လွှတ်မှုနေရာများမှ အဝေး မီတာ ၅၀-၁၀၀ ပတ်လည်အတွင် တည်ရှိပြီး လေလမ်းကြောင်းဦးတည်ရာ (ဆိုလိုသည်မှာအရှေ့တောင်လေဖြစ်သည်) အတိုင်း ပျံ့နှံ့သွားပါသည်။ ၎င်း၏လေညာဘက်(downwind)တည်နေရာကြောင့် ကြာနီကန်စီမံကိန်းမှ ထွက်လာသည့်အမှုန်ဓါတ်ငွေ့များသည် လေတင်ဘက်ရှိတောင်အင်းမြောက်အင်းစီမံကိန်းနှင့်နှိုင်းယှဉ်လျှင်*** မန္တလေးမြို့ကို ***သိသာလျော့နည်းစွာ*** သက်ရောက်မှု ဖြစ်စေပါသည်။

လုပ်ငန်းအဆင့် (၃)

ကြာနီကန်မှထုတ်လွှတ်မှုကိုပိုမိုတိုးစေမည့် ဂျင်နရေတာတစ်လုံးကို ကြာနီကန်စီမံကိန်းတွင် တပ်ဆင်ပါမည်။ ကြာနီကန်တွင် လုပ်ငန်းအဆင့်(၃)၏ နိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ်နှင့် ကာဗွန်မိုနောက်ဆိုဒ် ***အများဆုံး ထုတ်လွှတ်မှုနှုန်းသည် အမျိုးမျိုးသောပျမ်းမျှအကြိမ်များ၌ လုပ်ငန်းအဆင့်(၂)၏ အများဆုံးထုတ်လွှတ်မှုနှုန်းထက် ပိုမိုမြင့်မားနေပါသည်။*** လုပ်ငန်းအဆင့်(၃)တွင် ၁နာရီစာကာဗွန်မိုနောက်ဆိုဒ်နှင့် ၁နာရီစာနိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ် ဓါတ်ငွေ့များ၏ ပျံ့နှံ့မှုပုံစံသည် ***အရှေ့တောင်လေတိုက်ရာလမ်းကြောင်း***အတိုင်း လိုက်ပါပျံ့နှံ့ပါသော်လည်း ၄င်း၏ ပိုမိုများပြားသောထုတ်လွှတ်မှုများကြောင့် လုပ်ငန်းအဆင့်(၂)ထက် ပိုမိုကြီးမားသောဧရိယာဖြင့် ပျံ့နှံ့မှုကို တွေ့ရှိရပါသည်။ သို့သော် ပတ်ဝန်းကျင်အပေါ်တွင် နိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ်နှင့်ကာဗွန်မိုနောက်ဆိုဒ်တို့၏ ***ပထမဆုံး အမြင့်ဆုံးထုတ်လွှတ်မှုသည် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန(ECD)မှ ထုတ်ပြန်ထားသော သက်ဆိုင်ရာ ပတ်ဝန်းကျင်ဆိုင်ရာအရည်အသွေး ထုတ်လွှတ်မှုလမ်းညွှန်ချက်များ(EQEG)၊ ကမ္ဘာ့ကျန်းမာရေးအဖွဲ့ (WHO) လမ်းညွှန်ချက်များနှင့် ယူနိုက်တက်စတိတ် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးအေဂျင်စီ(USEPANAAQS)၏ လေထုအရည်အသွေး စံချိန်စံညွှန်းများအောက် များစွာ လျော့နည်းလျက်*** ရှိပါသည်။

စီမံကိန်းကာလ(ဆောက်လုပ်ရေးကာလ၊လည်ပတ်ရေးကာလနှင့်ပိတ်သိမ်းကာလ)အားလုံးတွင် ***လေထုအပေါ် သက်ရောက်မှုများကိုဆန်းစစ်ချက်အရ "အလယ်အလတ်(Medium Significance)"ဟု*** သတ်မှတ်ထားသော်လည်း ဖော်ပြထားသော***လျော့ချရေးအစီအမံများ***ကို လိုက်နာပါက ***သိသိသာသာလျော့နည်း***သွားပါလိမ့်မည်။

လေထုအရည်အသွေးတွေ့ရှိချက်များ၏ အသေးစိတ်အချက်အလက်များကို အောက်ပါခေါင်းစဉ်ခွဲများတွင် ဖော်ပြထားပါသည်။ ထို့အပြင် ဆောက်လုပ်ရေးလုပ်ငန်းစဉ်များမှ လေထုညစ်ညမ်းမှုများ အထူးသဖြင့်အမှုန်များ၏ ဘေးအန္တရာယ်ကို ကာကွယ်ရန် အဆောက်အဦး အတွင်းနှင့်အပြင်တွင် အလုပ်လုပ်နေကြသော ဝန်ထမ်းအဖွဲ့များ နှင့် အလုပ်သမားများသည် ***စီမံကိန်းလုပ်ဆောင်နေစဉ်အတွင်း ကောင်းမွန်သောလုပ်ငန်းခွင်အလေ့အကျင့်အဖြစ် သင့်လျော်သော မျက်နှာဖုံးများ***ကို ဝတ်ဆင်ရပါမည်။ အထူးသဖြင့် ***စီမံကိန်းလုပ်ငန်းစဉ်တွင် စက်ပစ္စည်းအသစ်များ တပ်ဆင်ထားပါက*** စောင့်ကြည့်စစ်ဆေးခြင်းလုပ်ငန်းစဉ်ကို နှစ်စဉ်ပြုလုပ်ရပါမည်။ စီမံကိန်းလုပ်ငန်းအဆင့်အားလုံး အတွက် ***လျော့ချရေးနည်းလမ်းများ***ကို သက်ဆိုင်ရာကဏ္ဍများတွင် အသေးစိတ် ဖော်ပြပါလိမ့်မည်။

၁.၆.၄ ကာဗွန်ထုတ်လွှတ်မှု

ဆောက်လုပ်ရေးကာလတွင် စီမံကိန်းလုပ်ငန်းစဉ် များ၏စွမ်းအင်လိုအပ်ချက်များသည် ***နိုင်ငံတော်လျှပ်စစ်ဓာတ်အားလိုင်း*** ပေါ်တွင် မူတည်ပါသည်။ သို့သော် လျှပ်စစ်ဓာတ်အားပြတ်တောက်ပါက အသုံးပြုရန် မီးစက်တစ်လုံး အရံထားရှိပါမည်။ ထို့ကြောင့် ဆောက်လုပ်ရေးကာလအတွင်း အဆိုပြုစီမံကိန်း၏ ***လျှပ်စစ်အသုံးပြုမှုကဏ္ဍမှ ကာဗွန်ဒိုင်အောက်ဆိုဒ်(CO2) နှင့် ဖန်လုံအိမ်ဓါတ်ငွေ့(GHG) တိုက်ရိုက်ထုတ်လွှတ်မှုမရှိပါ။*** အရံမီးစက်မှ ***ဖြစ်နိုင်ချေရှိသောဓါတ်ငွေ့ထုတ်လွှတ်မှု ပမာဏ သည်လည်း လျစ်လျူရှုနိုင်ဖွယ် (Negligible)*** ဟု သတ်မှတ်ပါသည်။

အဆိုပြုထားသောစီမံကိန်းတွင် လုပ်ငန်းလည်ပတ်နေစဉ်ကာလအတွင်း လျှပ်စစ်ထုတ်လုပ်ရန် ***အများဆုံးစွမ်းအား 500kW ရှိသော ဂျင်နရေတာတစ်ခု*** တပ်ဆင်ပါမည်။ ၄င်းဂျင်နရေတာအတွက် ***အရှိုက်ကျင်းထွက်ခါတ်ငွေ့ကို လောင်စာအဖြစ်*** အသုံးပြုပါမည်။

ဆောက်လုပ်ရေးကာလ(ဖြ)တွင် မော်တော်ယာဉ်များမှ စုစုပေါင်းကာဗွန်ဒိုင်အောက်ဆိုဒ်(CO2) ထုတ်လွှတ်မှုပမာဏမှာ ***မက်ထရစ်တန်ချိန် ၄၃၅.၉၉၃*** ဖြစ်ပါသည်။

လုပ်ငန်းလည်ပတ်မှုကာလတွင် အဆိုပြုစီမံကိန်း၏ ဖန်လုံအိမ်ခါတ်ငွေ့(GHG)လျှော့ချမှုနှုန်းသည် တစ်နှစ်လျှင် တန်ချိန် ၂၉,၄၉၂ CO2 နှင့်ညီမျှပြီး ၁၀နှစ်တွင် တန်ချိန် ၂၉၄,၉၁၇ CO2နှင့် ညီမျှသည်။

ထို့ကြောင့် ***ဆောက်လုပ်ရေးကာလတွင်*** အရံမီးစက်မှလျှပ်စစ်ဓာတ်အားကိုအဓိကအသုံးပြုခြင်းနှင့် မော်တော်ယာဉ် အသုံးပြုခြင်းများမှတဆင့် ***ကာဗွန်ဒိုင်အောက်ဆိုဒ်(CO2)ထုတ်လွှတ်မှုပမာဏကို လျစ်လျူရှုနိုင်ဖွယ် (Negligible) ဟု*** သတ်မှတ်ပါသည်။

၁.၆.၅ ဆူညံသံ

အဆိုပြုစီမံကိန်းပတ်ဝန်းကျင်ရှိ လက်ရှိအခြေခံဆူညံသံအရည်အသွေးကို ဖော်ပြရန် စီမံကိန်းနေရာနှင့်အနီးဆုံးရှိ ***အင်ဂျယ် ကျေးရွာတွင်*** ပတ်ဝန်းကျင်ဆူညံသံအရည်အသွေးတိုင်းတာမှုကို ၂၀၂၀ခုနှစ် စက်တင်ဘာလတွင် ပြုလုပ်ခဲ့ပါသည်။

တိုင်းတာတွေ့ရှိချက်များအရ အင်ဂျယ်ကျေးရွာရှိ ၂၄နာရီပျမ်းမျှဆူညံမှုနှုန်း(နေ့ချိန်နှင့်ညချိန်)သည် ပတ်ဝန်းကျင်အရည်အသွေးထုတ်လွှတ်မှုလမ်းညွှန်ချက်များ(EQEG)နှင့် ကိုက်ညီပါသည်။ ယေဘုယျအားဖြင့် ယာဉ်များ (ကားများ)နှင့်လူတို့၏လုပ်ဆောင်မှုများမှ အဓိကဖမ်းယူထားသော ဤဆူညံမှုများသည် ပတ်ဝန်းကျင်အရည်အသွေး

စဉ်	ဖော်ပြချက်	ဆူညံမှုပမာဏ	EQEG လမ်းညွှန်ချက်
၁	နေ့အချိန်	$53^{a}\pm0.3^{b}$ $51^{c}(27^{d}–68^{e})$ dB	55 dB
၂	ညအချိန်	$36^{a}\pm0.2^{b}$ $33^{c}(22^{d}–47^{e})$ dB	45 dB

ထုတ်လွှတ်မှုလမ်းညွှန်ချက်များ(EQEG)၏ဆူညံမှုစံချိန်စံညွှန်းများထက် ကျော်လွန်မှု မရှိပါ။

a ပျှမ်းမျှ b စံမှားကိန်း c ပျှမ်းမျှ d အနိမ့်ဆုံး e အမြင့်ဆုံး

စီမံကိန်းလုပ်ဆောင်မှုများမှတဆင့်ပတ်ဝန်းကျင်အပေါ်ဆူညံသံများသက်ရောက်မှုဆန်းစစ်ချက်အရ ယေဘုယျအားဖြင့် သက်ရောက်မှုအဆင့်သည် ***အလယ်အလတ် (Medium Significance)*** ဖြစ်ပါသည်။ ထို့အပြင် အဆိုပြုစီမံကိန်း လုပ်ငန်းစဉ်မှ ဆူညံသံကို ကာကွယ်ရန် အလုပ်သမားများနှင့်ဝန်ထမ်းများသည် ဆောက်လုပ်ရေးလုပ်ငန်းစဉ်အတွင်း ***နားကြပ်များကို ကောင်းသောလုပ်ငန်းအလေ့အကျင့်တစ်ခုအဖြစ်*** ဝတ်ဆင်ရပါမည်။ စက်ရုံတွင် စက်အသစ်များ တပ်ဆင်ထားပါက ***စောင့်ကြည့်စစ်ဆေးခြင်းလုပ်ငန်းစဉ်ကို နှစ်စဉ်ပြုလုပ်ရပါမည်။*** ဖော်ပြပါ***လျှော့ချရေးနည်းလမ်းများ*** အတိုင်းလိုက်နာပါက သက်ရောက်မှုသည် ***သိသိသာသာ လျော့နည်းသွား***ပါမည်။ လျှော့ချရေးနည်းလမ်းများကို သက်ဆိုင်ရာကဏ္ဍ များတွင် အသေးစိတ်ဖော်ပြထားပါသည်။

၁.၆.၆ တုန်ခါမှု

အဆိုပြုထားသောစီမံကိန်းပတ်ဝန်းကျင်ရှိ ***ကနဦးတုန်ခါမှုအရည်အသွေးအခြေအနေ***ကို ဖော်ထုတ်နိုင်ရန်အတွက် စီမံကိန်းနေရာနှင့်အနီးဆုံးရှိ ကြာနီကန်အမှိုက်ကျင်းတွင် တုန်ခါမှုအရည်အသွေးစောင့်ကြည့်လေ့လာခြင်းကို ၂၀၂၀ခုနှစ်၊ စက်တင်ဘာလတွင်ပြုလုပ်ခဲ့ပါသည်။

တိုင်းတာတွေ့ရှိချက်များအရ ကြာနီကန်အမှိုက်ကျင်းဝန်းကျင်ရှိ **၂၄နာရီပျှမ်းမျှတုန်ခါမှုနှုန်းသည် ကိုယ်ထည်တုန်ခါမှု (WBV)နှေ့စဉ်ထိတွေ့မှုကန့်သတ်ချက်စံနှုန်း (ELV)** ***(1.15 m/s²) A (8)*****ကို မကျော်လွန်သော တိုင်းတာမှုကန့်သတ်ချက်** ***0.5m/s² အောက်တွင် ရှိပါသည်။***

စီမံကိန်းလုပ်ဆောင်မှုများမှတဆင့် ပတ်ဝန်းကျင်အပေါ်တုန်ခါမှုသက်ရောက်မှုဆန်းစစ်ချက်အရ ယေဘုယျအားဖြင့် သက်ရောက်မှုအဆင့်သည် **အလယ်အလတ်** ***(Medium Significance)*** ဖြစ်ပါသည်။ ထို့အပြင် အဆိုပြုထားသောစီမံကိန်းလုပ်ငန်းစဉ်မှ တုန်ခါမှုသက်ရောက်မှုကိုကာကွယ်ရန်အတွက် တုန်ခါမှုဖြစ်စေသောစီမံကိန်းလုပ်ငန်းစဉ်များကို တပြိုင်နက် လုပ်ဆောင်ခြင်းကို ရှောင်ရှားရပါမည်။ အဆိုပြုထားသောစီမံကိန်းတွင် စက်အသစ်များတပ်ဆင်ထားပါက စောင့်ကြည့်စစ်ဆေးခြင်းလုပ်ငန်းစဉ်ကို နှစ်စဉ်ပြုလုပ်ရပါမည်။ ဖော်ပြပါလျှော့ချရေးနည်းလမ်းများအတိုင်းလိုက်နာပါက သက်ရောက်မှုသည် သိသိသာသာ နည်းသွားပါမည်။ လျှော့ချရေးနည်းလမ်းများကို သက်ဆိုင်ရာကဏ္ဍ များတွင် အသေးစိတ်ဖော်ပြထားပါသည်။

၁.၇ ဘူမိဗေဒ

၁.၇.၁ ဘူမိဗေဒ

ပုသိမ်ကြီးမြို့နယ်၏အပေါ်ယံမြေဆီလွှာမှာ အများအားဖြင့် ***ရွှံ့စေးမြေ*** ဖြစ်ပါသည်။ ***ကြာနီကန်အမှိုက်ကျင်းနေရာ၏ ကျောက်သားသဘာဝမှာ quaternaryအဝိုင်းအခြားရှိ pleistocene(0–2.588Ma) သက်တမ်းရှိသော အနည်ကျကျောက်အများစုကို တွေ့ရှိရပါသည်။ ထို့အပြင် အလွှာလိုက်တည်ရှိသော ကယ်လဆီယမ်ကြွယ်ဝသော ဆီလီကိတ်ကျောက်များနှင့် စကျင်ကျောက်များကိုလည်း တွေ့ရှိရပါသည်။***

ယေဘူယျအားဖြင့် **သဲနှင့်ကျောက်စကျောက်နများထက် ခံနိုင်ရည်အားနည်းသော အလွန်ပျော့သောရွှံ့မြေစေး နှင့် နုန်းမြေ** များသာ တွေ့ရပါသည်။ သို့သော် အချို့သောရွှံ့စေးများ သို့မဟုတ် နုန်းများသည် ***စက်ပစ္စည်းသုံး၍မြေသားကျစ်လစ်အောင်ပြုလုပ်ခြင်းဖြင့်*** သဲ နှင့် ကျောက်စရစ်များထက် ခံနိုင်ရည်အားပိုမိုမြင့်မားလေ့ရှိပါသည်။ မြေသားကိုဖိသိပ်ခြင်းသည် မြေသားပေါ်တွင် ဖိအားပေးပြီး လေထုသည် မြေသားအကြားအပေါက်များမှ လေကိုဖယ်ထုတ်လိုက်သဖြင့် ပိုမိုသိပ်သည်းမှုကို ဖြစ်ပေါ်စေပါသည်။

ဒေသခံများမှ ချက်ပြုတ်ခြင်း၊ သန့်ရှင်းခြင်း နှင့် သောက်သုံးခြင်းတို့အတွက် ***ရေအရင်းအမြစ်အဖြစ်အသုံးပြုနေရသော ရေအောင်းလွှာများ နှင့် မြေသားတို့၏ လက်ရှိအခြေအနေများကို အခန်း(၅)တွင်*** အသေးစိတ် ဖော်ပြထားပါသည်။

၁.၈ ကနဦးရေအရည်အသွေး

လူသားတို့၏ကျန်းမာရေးနှင့် ပတ်ဝန်းကျင်အတွက် အလွန်အရေးကြီးသော ဓာတုဗေဒဆိုင်ရာ၊ ရုပ်ပိုင်းဆိုင်ရာ နှင့် ဘက်တီးရီးယားဆိုင်ရာ သတ်မှတ်ချက်များ အပါအဝင် ***စုစုပေါင်း ရေအရည်အသွေး အတိုင်းအတာ(၁၂)ခု ကို မြေပေါ်ရေနှင့်မြေအောက်ရေနှစ်ခုစလုံးအတွက်*** ဓါတ်ခွဲစမ်းသပ်ခဲ့ပါသည်။

(က) မြေပေါ်ရေ အရည်အသွေး

အဆိုပြုထားသောစီမံကိန်းနေရာ၏ ၂ကီလိုမီတာအကွာအတွင်းတည်ရှိသော ဆည်တော်ကြီးချောင်းမှ ရေနမူနာကို ရုပ်ပိုင်းဆိုင်ရာ၊ ဓာတုဗေဒနှင့်ဘက်တီးရီးယားဆိုင်ရာ ဝိသေသလက္ခဏာများ ခွဲခြမ်းစိတ်ဖြာရန်အတွက် ကောက်ယူခဲ့ပါသည်။

ဘက်တီးရီးယားဆိုင်ရာရလဒ်များမှလွဲ၍ ကျန်မြေပေါ်ရေအရည်အသွေးရလဒ်များသည် ကမ္ဘာ့ကျန်းမာရေးအဖွဲ့၏ သောက်သုံးရေစံချိန်စံညွှန်းများနှင့် ကိုက်ညီပါသည်။ ထို့ကြောင့် ၄င်းရေကို ***သောက်သုံးရေအဖြစ် အသုံးပြုလိုပါက*** သန့်ရှင်းစင်ကြယ်အောင် ပြုလုပ်ပြီးမှသာ ***အသုံးပြုရန်*** သင့်တော်ပါသည်။

ဇယား ၁.၄ ဆည်တော်ကြီးချောင်း၏ မြေပေါ်ရေအရည်အသွေး ရလဒ်များနှင့် စံနှုန်းကန့်သတ်ချက်များ

စဉ်	စမ်းသပ်မှု အတိုင်းအတာများ	ယူနစ်	မြေပေါ်ရေ	WHO သောက်သုံးရေစံနှုန်း	US EPA သောက်သုံးရေစံနှုန်း	NEQG လမ်းညွှန်ချက်	မှတ်ချက်
၁	အရောင်	mg/L	ကြည်/၅	NA	NA	NA	ပုံမှန်
၂	နောက်ကျိမှု	NTU	–	NA	NA	NA	ပုံမှန်
၃	ချဉ်ဖန်ကိန်း pH		၈.၂	၆.၅-၈.၅	၆.၅-၈.၅	၆-၉	ပုံမှန်
၄	စုစုပေါင်းအနည်	mg/L	၂၂၅	NA	NA	NA	
၅	စုစုပေါင်းအစေးအသွက်	mg/L	၁၀၀	NA	NA	NA	
၆	စုစုပေါင်းအယ်ကာလီ	mg/L	၁၀၀	NA	NA	NA	
၇	ကယ်လစီယမ်	mg/L	၂၄	NA	NA	NA	
၈	မဂ္ဂနီစီယမ်	mg/L	၁၀	NA	NA	NA	
၉	ကလိုရိုက်	mg/L	၂၀	NA	၂၅၀	NA	ပုံမှန်
၁၀	ဆာလ်ဖိတ်	mg/L	၁၉	NA	၂၅၀	NA	ပုံမှန်
၁၁	သံ	mg/L	မရှိ	NA	၀.၃	၃.၅	ပုံမှန်
၁၂	စုစုပေါင်း ကိုလီဖောန် ဘက်တီးရီးယား	CFU/ML	၅/၅	NA	NA	၄၀၀/၁၀၀ ml	

NA= စံချိန်စံညွှန်း သတ်မှတ်ခြင်း မရှိပါ။

(ခ) မြေအောက်ရေ အရည်အသွေး

လက်ရှိမြေအောက်ရေအခြေအနေကိုဖော်ပြရန် အနီးဆုံးကျေးရွာ(၂)ရွာရှိ အိမ်ထောင်စုများမှ မြေအောက်ရေနမူနာ (၂) ခုကို ကောက်ယူခဲ့ပါသည်။

ကြာနီကန်ရွာ နှင့် အင်ဂျယ်ရွာ၏ မြေအောက်ရေအရည်အသွေး ရလဒ်များနှင့် စံနှုန်းကန့်သတ်ချက်များကို အောက်ပါဇယားများတွင် ဖော်ပြထားပါသည်။

ဇယား ၁.၅ ကြာနီကန်ရွာ၏ မြေအောက်ရေအရည်အသွေး ရလဒ်များနှင့် စံနှုန်းကန့်သတ်ချက်များ

စဉ်	စမ်းသပ်မှု အတိုင်းအတာများ	ယူနစ်	မြေပေါ်ရေ	WHO သောက်သုံးရေစံနှုန်း	US EPA သောက်သုံးရေစံနှုန်း	NEQG လမ်းညွှန်ချက်	မှတ်ချက်
၁	အရောင်	mg/L	ကြည်/၅	NA	NA	NA	ပုံမှန်
၂	နောက်ကျိမှု	NTU	–	NA	NA	NA	ပုံမှန်
၃	ချဉ်ဖန်ကိန်း pH		၇.၅	၆.၅-၈.၅	၆.၅-၈.၅	၆-၉	ပုံမှန်
၄	စုစုပေါင်းအနည်	mg/L	၁၁၅၀	NA	NA	NA	
၅	စုစုပေါင်းအစေးအသွက်	mg/L	၄၂၀	NA	NA	NA	
၆	စုစုပေါင်းအယ်ကာလီ	mg/L	၆၅၀	NA	NA	NA	
၇	ကယ်လစီယမ်	mg/L	၄၀	NA	NA	NA	

၈	မဂ္ဂနီစီယမ်	mg/L	၇၇	NA	NA	NA	
၉	ကလိုရိုက်	mg/L	၁၄၀	NA	၂၅၀	NA	ပုံမှန်
၁၀	ဆာလ်ဖိတ်	mg/L	၁၉၂	NA	၂၅၀	NA	ပုံမှန်
၁၁	သံ	mg/L	မရှိ	NA	၀.၃	၃.၅	ပုံမှန်
၁၂	စုစုပေါင်း ကိုလီဖောန် ဘက်တီးရီးယား	CFU/ML	၅/၅	NA	NA	၄၀၀/၁၀၀ ml	

NA= စံချိန်စံညွှန်း သတ်မှတ်ခြင်း မရှိပါ။

ဇယား ၁.၆ အင်ဂျယ်ရွာ၏ မြေအောက်ရေအရည်အသွေး ရလဒ်များနှင့် စံနှုန်းကန့်သတ်ချက်များ

စဉ်	စမ်းသပ်မှု အတိုင်းအတာများ	ယူနစ်	မြေပေါ်ရေ	WHO သောက်သုံးရေစံနှုန်း	US EPA သောက်သုံးရေစံနှုန်း	NEQG လမ်းညွှန်ချက်	မှတ်ချက်
၁	အရောင်	mg/L	ကြည်/၅	NA	NA	NA	ပုံမှန်
၂	နောက်ကျိမှု	NTU	–	NA	NA	NA	ပုံမှန်
၃	ချဉ်ဖန်ကိန်း pH		၇.၃	၆.၅-၈.၅	၆.၅-၈.၅	၆-၉	ပုံမှန်
၄	စုစုပေါင်းအနည်	mg/L	၉၈၅	NA	NA	NA	
၅	စုစုပေါင်းအစေးအသွက်	mg/L	၅၂၀	NA	NA	NA	
၆	စုစုပေါင်းအယ်ကာလီ	mg/L	၄၅၀	NA	NA	NA	
၇	ကယ်လစီယမ်	mg/L	၇၂	NA	NA	NA	
၈	မဂ္ဂနီစီယမ်	mg/L	၈၂	NA	NA	NA	
၉	ကလိုရိုက်	mg/L	၁၀၀	NA	၂၅၀	NA	ပုံမှန်
၁၀	ဆာလ်ဖိတ်	mg/L	၂၃၀	NA	၂၅၀	NA	ပုံမှန်
၁၁	သံ	mg/L	မရှိ	NA	၀.၃	၃.၅	ပုံမှန်
၁၂	စုစုပေါင်း ကိုလီဖောန် ဘက်တီးရီးယား	CFU/ML	၃/၅	NA	NA	၄၀၀/၁၀၀ ml	

NA= စံချိန်စံညွှန်း သတ်မှတ်ခြင်း မရှိပါ။

ဘက်တီးရီးယားဆိုင်ရာရလဒ်များမှလွဲ၍ ၄င်းရွာနှစ်ရွာ၏မြေအောက်ရေအရည်အသွေးရလဒ်များသည် ***ကမ္ဘာ့ကျန်းမာရေးအဖွဲ့၏ သောက်သုံးရေစံချိန်စံညွှန်းများနှင့် ကိုက်ညီပါသည်။*** ထို့ကြောင့် ၄င်းရေကို ***သောက်သုံးရေအဖြစ် အသုံးပြုလိုပါက*** သန့်ရှင်းစင်ကြယ်အောင် ***ပြုလုပ်ပြီးမှသာ အသုံးပြုရန်*** သင့်တော်ပါသည်။

ဆောက်လုပ်ရေး၊ လုပ်ငန်းလည်ပတ်ရေးနှင့် ပိတ်သိမ်းရေးကာလ သုံးခုစလုံးတွင် မြေပေါ်ရေနှင့်မြေအောက်ရေအရည်အသွေး နှစ်ခုစလုံးအပေါ် အဆိုပြုစီမံကိန်း၏သက်ရောက်မှုအဆင့်မှာ ယေဘူယျအားဖြင့် ***အလယ်အလတ် (Medium Significance)*** အဆင့် အဖြစ် သတ်မှတ်ပါသည်။ ***စောင့်ကြပ်စစ်ဆေးရေးလုပ်ငန်းစဉ်နှင့် လျော့ချရေးနည်းလမ်း***များအတိုင်းလိုက်နာပါက ***သက်ရောက်မှုကို လျစ်လျူရှုနိုင်ဖွယ် (Negligible)*** အဆင့် ထိ လျော့ချနိုင်ပါလိမ့်မည်။ လျော့ချရေးနည်းလမ်းများကို သက်ဆိုင်ရာကဏ္ဍ များတွင် အသေးစိတ်ဖော်ပြထားပါသည်။

၁.၉ မြေအရည်အသွေး

ပတ်ဝန်းကျင်အတွက် အလွန်အရေးကြီးသော ဓာတုဗေဒဆိုင်ရာ နှင့် ရုပ်ပိုင်းဆိုင်ရာ သတ်မှတ်ချက်အတိုင်းအတာများ အပါအဝင် **စုစုပေါင်း မြေအရည်အသွေး အတိုင်းအတာ(၁၅)ခု** ကို ခါတ်ခွဲစမ်းသပ်ခဲ့ပြီး FAO ၏မြေအရည်အသွေးစံနှုန်းများ နှင့်အညီ နှိုင်းယှဉ်ဖော်ပြခဲ့ပါသည်။

တွေ့ရှိချက်များအရ လက်ရှိမြေဆီလွှာတွင် အပင်များနှင့်သတ္တဝါများကို အန္တရာယ်ဖြစ်စေနိုင်သော ***အပြင်းစားသတ္တုများ ပါဝင်မှုမည်သည်မှ မရှိသည်ကို*** တွေ့ရပါသည်။ မြေအရည်အသွေး တွေ့ရှိချက်များ၏ အသေးစိတ်အချက်အလက်များကို အောက်ပါဇယားတွင် ဖော်ပြထားပါသည်။

ဇယား ၁.၇ ကြာနီကန်အမှိုက်ကျင်း၏ မြေအရည်အသွေး စမ်းသပ်တွေ့ရှိချက်

စဉ်	အတိုင်းအတာများ	ယူနစ်	ရလဒ်	FAO Soil Bulletin 65 နှင့် ဒတ်ချ်နိုင်ငံ စံနှုန်းများ	မှတ်ချက်
၁	မြေအစိုဓါတ်	%	၁.၇၂		
၂	ချဉ်ဖန်ကိန်း pH	(၁ : ၂.၅)	၈.၃		
၃	လျှပ်စီးကူးနှုန်း EC	mS/cm	၀.၁၂		
၄	စုစုပေါင်း နိုက်ထရိုဂျင်	%	၀.၂၅		
၅	ရရှိနိုင်သော ဖော့စဖောရက်	ppm	၇.၉၃		
၆	ရရှိနိုင်သော ပိုတက်စီယမ်အောက်ဆိုဒ်	mg/100g	၁၅.၂၅		
၇	ဖလှယ်နိုင်သောပိုတက်စီယမ်အပေါင်းအိုင်ယွန်း K^+	meq/100g	၀.၃၂		
၈	ကဒ်မီယမ်	ppm	ND	၀.၈	
၉	ခရိုမီယမ်	ppm	ND		
၁၀	ခဲ	ppm	၃.၂၄	၈၅	ပုံမှန်
၁၁	သွပ်	ppm	၁.၈၄	၁၅-၁၅၀	ပုံမှန်
၁၂	ကြေးနီ	ppm	၂.၀၆	၂၀-၃၀၀	ပုံမှန်
၁၃	သံ	ppm	၅၅.၁	၁၅-၁၅၀	ပုံမှန်
၁၄	မန်းဂနိစ်	ppm	၈၉.၈၈		
၁၅	ဖွဲ့စည်းတည်ဆောက်ပုံ				
	သဲ	%	၄၆.၇		
	နုန်း	%	၃၁.၀၃		
	ရွှံ့စေး	%	၂၂.၂၇		

ဆောက်လုပ်ရေး၊ လုပ်ငန်းလည်ပတ်ရေးနှင့် ပိတ်သိမ်းရေးကာလများတွင် မြေအရည်အသွေးအပေါ် စီမံကိန်း၏သက်ရောက်မှုအဆင့်မှာ ယေဘူယျအားဖြင့် ***အလယ်အလတ်(Medium Significance)*** အဆင့် အဖြစ် သတ်မှတ်ပါသည်။ ***စောင့်ကြပ်စစ်ဆေးရေးလုပ်ငန်းစဉ်နှင့် လျော့ချရေးနည်းလမ်း***များအတိုင်းလိုက်နာပါက ***သက်ရောက်မှုကို နည်းပါးသော (Negligible)*** အဆင့် ထိ လျော့ချနိုင်ပါလိမ့်မည်။ လျော့ချရေးနည်းလမ်းများကို သက်ဆိုင်ရာကဏ္ဍများတွင် အသေးစိတ် ဖော်ပြထားပါသည်။

၁.၁၀ အစိုင်အခဲစွန့်ပစ်ပစ္စည်း

ကြာနီကန်အမှိုက်ကျင်းသည် အောင်မြေသာဇံ၊ ချမ်းအေးသာဇံနှင့် မဟာအောင်မြေမြို့နယ်များမှ ***အိမ်သုံးစွန့်ပစ်ပစ္စည်းများကို တစ်နေ့လျှင်ပျမ်းမျှတန်ချိန် ၅၀၀ ခန့်ရှိ*** လက်ခံထားရပြီး ၄င်းအမှိုက်ကျင်းရှိ

စုစုပေါင်းအမှိုက်တန်ချိန် ၃၀၉,၆၀၀ ခန့် ဖြစ်ပါသည်။ စွန့်ပစ်ပစ္စည်းအမျိုးအစားများအနက် ***၈၀% နီးပါးသည် အော်ဂဲနစ်စွန့်ပစ်ပစ္စည်းများ*** ဖြစ်ပါသည်။

ဆောက်လုပ်ရေး၊လုပ်ငန်းလည်ပတ်ရေးနှင့်ပိတ်သိမ်းရေးကာလတစ်လျှောက်လုံး အစိုင်အခဲ စွန့်ပစ်ပစ္စည်းအပေါ် သက်ရောက်မှု အကဲဖြတ်ချက်အရ ယေဘူယျအားဖြင့် ၎င်းကို ***အလယ်အလတ်အဆင့်****(Medium Significance)*အဖြစ် သတ်မှတ်ပါသည်။***စောင့်ကြပ်စစ်ဆေးရေးလုပ်ငန်းစဉ်နှင့် လျှော့ချရေးနည်းလမ်း***များ အတိုင်းလိုက်နာပါက ***သက်ရောက်မှုကို နည်းပါးသော***အဆင့် ***(Negligible)*** ထိ လျှော့ချနိုင်ပါလိမ့်မည်။ လျှော့ချရေးနည်းလမ်းများကို သက်ဆိုင်ရာကဏ္ဍများတွင် အသေးစိတ် ဖော်ပြထားပါသည်။

၁.၁၁ ဇီဝဗေဒပတ်ဝန်းကျင်

ဇီဝမျိုးစုံမျိုးကွဲများနှင့် ဂေဟစနစ်ဝန်ဆောင်မှုများကိုဖော်ထုတ်ရန် အခြေခံဇီဝမျိုးစုံမျိုးကွဲစစ်တမ်းကိုကောက်ယူခြင်းကို လုပ်ဆောင်ခဲ့ပါသည်။

ဤမြို့နယ်တွင် ***တောင်ကျွန်းနှင့်စခန်းကြီးအမည်ရှိ သစ်တောကြိုးဝိုင်းနှစ်ခုရှိပြီး စုစုပေါင်းဧရိယာမှာ ၃၃,၃၄၄ ဧက*** ဖြစ်ပါသည်။ ***အများပိုင်ကာကွယ်သစ်တောများဖြစ်သည့် ရန်ကင်းတောင်နှင့်မယ်ဦးတောင်တို့၏ စုစုပေါင်းဧရိယာမှာ ၁၈၃၅.၃၈*** ဖြစ်သည်။ ***၁၀၂၄.၇ကေအကျယ်ရှိသော ပုဂ္ဂလိကစီးပွားဖြစ်စိုက်ခင်းလည်း*** ရှိပါသည်။ ဤဒေသ၏ပထဝီအနေအထားအရ တောင်များအကြားတွင် သစ်တောကြိုးဝိုင်းများလည်း တည်ရှိပါသည်။ ရွှေပြောင်းတောင်ယာ၊ မြို့ပြဖြစ်မှုနှင့်မီးသွေးထုတ်လုပ်မှုကြောင့် ကာကွယ်သစ်တောများမှအပ ဤမြို့နယ်တွင် သဘာဝသစ်တောများ ဆုံးရှုံးခဲ့ရပြီး ဖြစ်ပါသည်။

ကြာနီကန်အမှိုက်ကျင်းသည် တောင်ကျွန်းသစ်တောကြိုးဝိုင်းအနီးတွင်တည်ရှိပြီး ၎င်းကြိုးဝိုင်းတွင် အပူပိုင်းခြောက်သွေ့တောနှင့် အပူပိုင်းရွက်ပြတ်ရောနှောတောများ ပါဝင်ပါသည်။ မျိုးစိတ်ဖွံ့စည်းမှု၊ သိပ်သည်းမှုနှင့်ပြန့်ပွားမှုတို့ကို ခွဲခြားသတ်မှတ်ရန် သစ်တောစာရင်းအင်းနည်းလမ်းဖြင့် သစ်ပင်ပန်းမန်စစ်တမ်း ကောက်ယူမှု လုပ်ဆောင်ခဲ့ပါသည်။

စစ်တမ်းလေ့လာမှုအတွင်း ***စုစုပေါင်းအပင်မျိုးစိတ် ၃၃ မျိုးကို*** လေ့လာတွေ့ရှိခဲ့ပါသည်။

(က) သစ်ပင်ပန်းမန်များကိုလေ့လာခြင်း

သစ်တောများ၏ထူးခြားသောလက္ခဏာများမှာ အင်း၊ ကျွန်း၊ ပျဉ်းကတိုး၊ ဝါး၊ တမလန်း၊ ကြို့ အပင်များကို မျိုးစိတ်အများစု အဖြစ် တွေ့ရှိနိုင်ပါသည်။ ပျဉ်းကတိုးအပင်များ ပြန်လည်ရှင်သန်နေမှုကို နေရာတိုင်းတွင် တွေ့ရှိနိုင်ပါသည်။

ဇီဝမျိုးစုံမျိုးကွဲစစ်တမ်းတွင် ***သစ်ပင်မျိုးစိတ် ၃၃ ခု*** ရှိပါသည်။ ကွင်းဆင်းလေ့လာမှုစဉ်အတွင်း Dipterocarpus tuberculatusနှင့်Acacia catechတို့ကို တွေ့ရှိမှတ်သားခဲ့ပါသည်။ အဆိုပြုစီမံကိန်းအနီးတွင် တွေ့ရှိရသော အဓိကအထင်ကရပန်းမန်များမှာ ပို၍သက်တမ်းရင့်သော Dipterocarpus spp ဖြစ်ပါသည်။ ဤနေရာများတွင် အဓိကကျသောပေါင်းပင်ပြဿနာများ မရှိကြောင်း မျိုးစိတ်အသစ်များမရှိကြောင်း တွေ့ရှိရပါသည်။

(ခ) သတ္တဝါများလေ့လာခြင်း

သတ္တဝါများစစ်တမ်းကောက်ယူမှုနှင့်ပတ်သက်၍ ကွင်းဆင်းလေ့လာမှုများနှင့်လူထုတွေ့ဆုံမေးမြန်းမှုများမှတဆင့် ***၄ကျော်မျိုးစိတ် ၂၀၊ နို့တိုက်သတ္တဝါ ၁၁ မျိုး၊ တွားသွားသတ္တဝါမျိုးစိတ် ၂၁ မျိုးနှင့်ငါးမျိုးစိတ် ၁၅ ခုကို*** ရှိသည်ကို တွေ့ရပါသည်။

အသေးစိတ်အချက်အလက်များကို သက်ဆိုင်ရာအခန်း (၅) တွင် တင်ပြခဲ့ပါသည်။

(ဂ) ယဉ်ကျေးမှုအမွေအနှစ်

ကြာနီကန်အမှိုက်ကျင်းပတ်ဝန်းကျင်တွင် ***ရှေးဟောင်းဘုရား***များ ရှိပါသည်။ သခင်မတောင်ရှေးဟောင်းဘုရားနှင့် ဖိုးဒိုးရှေးဟောင်းဘုရားတို့သည် မန္တလေးမြို့မှ ကြာနီကန်အမှိုက်ကျင်းသို့ သွားရာလမ်းတွင် တည်ရှိပါသည်။

၁.၁၂ ဆင့်ကဲသက်ရောက်နိုင်မှုဆန်းစစ်ခြင်း

ဤအခန်းတွင် ဒေသပတ်ဝန်းကျင်အပေါ် အဆိုပြုထားသောစီမံကိန်း၏လုပ်ဆောင်မှုများမှထွက်ပေါ်လာသော **လေထုညစ်ညမ်းမှု၊ ဆူညံသံ၊ စွန့်ပစ်ရေစွန့်ပစ်မှုနှင့်အခိုင်အခဲစွန့်ပစ်ပစ္စည်းများ**၏စုပေါင်းသက်ရောက်မှုများကို ဆန်းစစ်အကဲဖြတ်ခဲ့ပါသည်။ စီမံကိန်း၏လုပ်ဆောင်မှုအမျိုးမျိုးကြောင့် ***ဆင့်ကဲသက်ရောက်မှုများကို ဆန်းစစ်အကဲဖြတ်သည့်လုပ်ငန်းစဉ်*** ဖြစ်ပါသည်။

ဒေသဆိုင်ရာဆင့်ကဲသက်ရောက်နိုင်မှုမှာ **အလယ်အလတ်အဆင့်**တွင် ရှိပါသည်။ အဆိုပြုစီမံကိန်းသည် အမှိုက်ကျင်းထွက်မီသိန်းခါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်းဖြစ်သောကြောင့် ***နိုင်ငံနှင့်ဒေသဆိုင်ရာ ပတ်ဝန်းကျင်အပေါ် ပြင်းထန်သောဆင့်ကဲသက်ရောက်နိုင်မှုများမရှိနိုင်***ဟု ယူဆနိုင်ပါသည်။

၁.၁၃ လေထုအရည်အသွေးဆင့်ကဲသက်ရောက်နိုင်မှု

ဆင့်ကဲသက်ရောက်နိုင်မှုဆိုသည်မှာ လေထုအရည်အသွေးအပေါ် ***စီမံကိန်းတခုချင်းစီမှ သက်ရောက်မှုသေးငယ်သော်လည်း စီမံကိန်းများ/လုပ်ငန်းများအားလုံးပေါင်းစု၍ သိသာများပြားလာသော စုပေါင်းသက်ရောက်မှုကို*** ရည်ညွှန်းပါသည်။

အဆိုပြုစီမံကိန်းပတ်ဝန်းကျင်တွင် ***သုဿန်များနှင့်ဒေသတွင်းနေ့စဉ်လှုပ်ရှားမှုများ (သယ်ယူပို့ဆောင်ရေး၊ လဟာပြင်မီးရှို့မှုနှင့်လယ်ယာစိုက်ပျိုးရေး စသည်တို့) ကဲ့သို့သော အခြားလေထုညစ်ညမ်းမှုအရင်းအမြစ်များ တည်ရှိသော***ကြောင့် လေထုအရည်အသွေးအပေါ် ဆင့်ကဲဆိုးကျိုးသက်ရောက်မှုများ ရှိလာပါမည်။

ထို့အပြင် အမှိုက်ကျင်းထွက်ခါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်းနှစ်ခုသည် (ကြာနီကန် နှင့် တောင်အင်းမြောက်အင်း) မန္တလေးမြို့၏မြောက်ပိုင်းနှင့်တောင်ပိုင်းတွင် စီမံကိန်းတစ်ခုမှတစ်ခု မိုင်ပေါင်းဉဝခန့်အကွာတွင်တည်ရှိသောကြောင့် ***လုပ်ငန်းအဆင့်(၃)အတွင်း မန္တလေးမြို့အပေါ် ၎င်းစီမံကိန်းတို့၏ ဆင့်ကဲသက်ရောက်မှုများသည် ပို့မိုတိုးမြှင့်လာနိုင်ပါသည်။ ထို့အပြင် လုပ်ငန်းအဆင့်(၃)အတွင်း ထပ်မံထုတ်လွှတ်မှုများဖြစ်စေမည့်ဂျင်နရေတာတစ်လုံး ကြာနီကန်စီမံကိန်းတွင် အသုံးပြုပါမည်။ ထို့ကြောင့် ကြာနီကန်စီမံကိန်းမှ ကာဗွန်မိုနောက်ဆိုဒ်CO နှင့် နိုက်ထရိုဂျင်အောက်ဆိုဒ်NOx ထုတ်လွှတ်မှုများ ပို့မိုမြင့်မားလာမည် ဖြစ်ပြီး နှင့်ပို့မိုကြီးမားသော မီးခိုးမှုန်များ ထွက်ရှိလာပါမည်။***

သို့သော် သက်ရောက်မှုပမာဏသည် သိသာများပြားခြင်းမရှိဘဲ ၎င်း၏လေညာရပ်တည်နေရာကြောင့် ကြာနီကန်မှထုတ်လွှတ်မှုအခိုးအငွေ့များသည် လေတင်အရပ်ရှိတောင်အင်းမြောက်အင်း စီမံကိန်းနှင့် နှိုင်းယှဉ်လျှင် မန္တလေးမြို့အပေါ်သို့ အနည်းငယ်သော သက်ရောက်မှုသာ ဖြစ်စေပါမည်။

၁.၁၄ ဆူညံသံအရည်အသွေးဆင့်ကဲသက်ရောက်နိုင်မှု

အဆိုပြုကြာနီကန်အမှိုက်ကျင်းထွက်ခါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်း နှင့်အနီးအနားရှိ အခြားဆူညံမှု အရင်းအမြစ်များအတွက် ဆင့်ကဲဆူညံသံသက်ရောက်မှုများကို ထည့်သွင်းစဉ်းစားထားပါသည်။ ***ဆောက်လုပ်ရေး၊ လုပ်ငန်းလည်ပတ်ရေးနှင့် ပိတ်သိမ်းရေးကာလတလျှောက်လုံးတွင် အဆိုပြုစီမံကိန်းမှ ထွက်ပေါ်လာသောဆူညံသံများ***နှင့် ***သယ်ယူပို့ဆောင်ရေး***အပါအဝင်အခြားလုပ်ငန်းစဉ်များမှ ဆူညံသံများသည် စုပေါင်းမြင့်တက်လာပါမည်။

၁.၁၅ ရေအရည်အသွေးဆင့်ကဲသက်ရောက်နိုင်မှု

ကြာနီကန်အမှိုက်ကျင်းထွက်ခါတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်ခြင်းစီမံကိန်းသည် လက်ရှိအချိန်တွင် အဝီစိတွင်းနှင့်အများသုံးရေပေးဝေမှုစနစ်ကိုအသုံးပြုရန် မျှော်မှန်းထားပါသည်။ မည်သို့ပင်ဆိုစေကာမူ လုပ်ငန်းလည်ပတ်မှုကာလသည် ဆောက်လုပ်ရေးကာလထက် နည်းသောပမာဏကိုသာ အသုံးပြုပါမည်။ ထို့ကြောင့် ***ဆောက်လုပ်ရေးကာလ၌သာလျှင် ရေသုံးစွဲမှုအပေါ် ဆင့်ကဲသက်ရောက်နိုင်မှု တိုးမြင့်လာပါမည်။***

၁.၁၆ ယာဉ်လမ်းကြောင်းအပေါ်ဆင့်ကဲသက်ရောက်နိုင်မှု

အထူးသဖြင့် ***ဆောက်လုပ်ရေးကာလအတွင်း စီမံကိန်းနေရာအနီးအနားတွင် ကားနှင့်ထရပ်ကားသွားလာမှု လမ်းကြောင်းအပေါ် ဆင့်ကဲသက်ရောက်နိုင်မှု ပိုမိုလာပါမည်***။ သို့သော် လက်ရှိအခြေခံအဆောက်အဦးအရ ယာဉ်အရေအတွက်တိုးလာခြင်းကို ကိုင်တွယ်ရန် လုံလောက်သည်ထက် ပိုပါသည်။ ထို့ကြောင့် ***"ယာဉ်ပိတ်ဆို့မှု"***အပေါ် ***ဆင့်ကဲသက်ရောက်နိုင်မှု***သည် ***လျစ်လျူရှုနိုင်ဖွယ် အဆင့်(Negligible)*** တွင် ရှိပါသည်။

၁.၁၇ အစိုင်အခဲစွန့်ပစ်ပစ္စည်းနှင့်စွန့်ပစ်ရေအပေါ်ဆင့်ကဲသက်ရောက်နိုင်မှု

အဆိုပြုစီမံကိန်းမှအမှိုက်စွန့်ပစ်မှု၏သက်ရောက်မှုသည် အများအားဖြင့် ဆော***က်လုပ်ရေးကာလတွင် အနီးအနားရှိလုပ်ငန်းအမျိုးမျိုး၏စုပေါင်းသက်ရောက်မှုများကို အတော်အသင့် တိုးမြင့်စေမည်***ဖြစ်သော်လည်း ၎င်းသည် ***ရေတိုဆိုးကျိုးသက်ရောက်မှု***သာ ဖြစ်ပါသည်။

ရေဆိုးစွန့်ထုတ်ခြင်း၏ဆင့်ကဲသက်ရောက်မှုသည် ဆောက်လုပ်ရေးကာလထက် ***လုပ်ငန်းလည်ပတ်မှုကာလတွင် သက်ရောက်မှု ပိုလျော့နည်း***ပါမည်။

၁.၁၈ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် (EMP)

လေထု၊ ဆူညံသံ၊ တုန်ခါမှု၊ မြေဆီလွှာ၊ ရေအရင်းအမြစ်၊ အစိုင်အခဲစွန့်ပစ်ပစ္စည်း၊ ဂေဟစနစ်အရင်းအမြစ်များ ကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံမှုများအတွက် ဆောက်လုပ်ရေး၊ လုပ်ငန်းလည်ပတ်ရေးနှင့် ပိတ်သိမ်းရေးကာလ တလျှောက်လုံးတွင်ဆောင်ရွက်ရမည့် အဓိကျသောပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်ကို အကောင်အထည်ဖော်ဆောင်ရွက်ခြင်း စောင့်ကြည့်စစ်ဆေးခြင်းနှင့်အစီရင်ခံခြင်းလုပ်ငန်းစဉ်တို့နှင့်အတူ အဆိုပြုထားသောလျော့ချရေးနည်းလမ်းများတွင် အသေးစိတ်ဖော်ပြထားပါသည်။

ဇယား ၁.၈ ပတ်ဝန်းကျင်၊ လူမှုရေးနှင့်ကျန်းမာရေးဆိုင်ရာသက်ရောက်မှုများအတွက် စောင့်ကြည့်စစ်ဆေးခြင်းအစီအစဉ်

ဖော်ညွှန်းချက်	အတိုင်းအတာနှင့် လမ်းညွှန်ချက်	လုပ်ထုံးလုပ်နည်း	အဆိုပြုကြာချိန်	စောင့်ကြည့်စစ်ဆေးမှု ကြိမ်နှုန်း	တည်နေရာ
လေ အရည်အသွေး	**အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာအရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန် (EQEG)** **ဂျင်နရေတာ နှင့် မီးရှို့စက် နှစ်ခုလုံးအတွက် _** • PM (PM10, PM2.5) • NOx • SO2 • CO • VOC • O3 • Methane • H2S • CO2	<u>နည်းလမ်း</u> အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန် (EQEG)	**ကြာချိန် -** ၂၄နာရီ စဉ်ဆက်မပြတ် **ကြိမ်နှုန်း -** • လုပ်ငန်းလည်ပတ်ရေး ကာလအတွင်း ခြောက်လတစ်ကြိမ် ၊ ပိတ်သိမ်းရေး ကာလ အတွင်း တစ်ကြိမ် • လေထု အရည်အသွေးနှင့် ပတ်သတ်၍ တိုင်ကြားချက်ရှိပါက နောက်ထပ်လေထု အရည်အသွေး တိုင်းတာခြင်းကို တိုင်ကြားချက်နှင့် ကိုက်ညီစွာ ပြုလုပ်ပါ(လိုအပ်ပါက)	လေထုအရည်အသွေး ကို အနည်းဆုံး (၆)လ တစ်ကြိမ် သို့မဟုတ် အခါအားလျော်စွာ စောင့်ကြည့်စစ်ဆေးခြင်း အစီရင်ခံစာများကို ဝန်ကြီးဌာနသို့ မကြာခဏတင်ပြပါ မည်။	အနီးဆုံး ထိခိုက်လွယ်သည့် နေရာ (သို့) စီမံကိန်း၏ လေညာအရပ် (တိုင်ကြားသည့်နေရာ) (လိုအပ်လျှင်)
ဆူညံသံ	LA_{eq} 1 hr ≤ 70dBA	<u>နည်းလမ်း</u>	**ကြာချိန် -**		တစ်ကီလိုမီတာ

		အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန် (EQEG)	၂၄နာရီ စဉ်ဆက်မပြတ် **ကြိမ်နှုန်း -** • လုပ်ငန်းလည်ပတ်ရေးကာလအတွင်း ခြောက်လတစ်ကြိမ် ၊ ပိတ်သိမ်းရေး ကာလ အတွင်း တစ်ကြိမ် • စီမံကိန်းနေရာမှဆူညံသံနှင့် ပတ်သက်၍ တိုင်ကြားချက်ရှိပါကနောက်ထပ်ဆူညံသံတိုင်းတာမှုကိုပြုလုပ်ပါ (လိုအပ်ပါက)		အတွင်း (လူနေအရပ်)
LFG ပြန်လည်သန့်စင်မီးရှို့စက်ရုံမှ စွန့်ထုတ်ရေ	**အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာအရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန် (EQEG)** နေ့စဉ်အများဆုံး ပါဝင်မှုနှုန်း အတွက် • BOD5 • COD • Oil and Grease • PH • Temperature • Total Coliform • Total Phosphorus	<u>နှည်းလမ်း</u> အမျိုးသားပတ်ဝန်းကျင်ထိန်းသိမ်းရေးအရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန် (EQEG)မှ အကြံပြုထားသော စည်ပင်သာယာအမှိုက်ကျင်းများအတွက် စွန့်ထုတ်ရေကန့်သတ်ချက်စံနှုန်းလမ်းများနှင့်အညီ စမ်းသပ်လေ့လာမှုနည်းလမ်းများ	• လုပ်ငန်းလည်ပတ်ရေးကာလအတွင်း ခြောက်လတစ်ကြိမ် ၊ ပိတ်သိမ်းရေး ကာလ အတွင်း တစ်ကြိမ်	အနည်းဆုံး (၆) လ တစ်ကြိမ်သို့မဟုတ် အခါအားလျော်စွာ စောင့်ကြည့်စစ်ဆေးခြင်း အစီရင်ခံစာများကို ဝန်ကြီးဌာနသို့ မကြာခဏတင်ပြပါ မည်။	စွန့်ထုတ်ရေ အရင်းအမြစ်အနီး

	• Total Nitrogen • TSS				
ဘေးအန္တရာယ်ရှိသော/မရှိသော စွန့်ပစ်အမှိုက်	• သိသာထင်ရှားသော စွန့်ပစ်ခြင်းနှင့် ခြေရာခံခြင်းအစီရင်ခံစာ	• နေ့စဉ် စွန့်ပစ်ပစ္စည်းပမာဏ၊ အမျိုးအစား နှင့် စွန့်ပစ်သည့်တည်နေရာ	• စီမံကိန်းကာလ တလျှောက်လုံး	ပုံမှန် စစ်ဆေးခြင်း ဖြစ်စဉ် အစီရင်ခံစာ (ရှိပါက)	စီမံကိန်းနေရာ အားလုံး
လူမှုကဏ္ဍ	• မြူနီစီပယ်မှ ပူးပေါင်းပါဝင်သည့် သဘာဝပတ်ဝန်းကျင်ေ ောင့်ကြည့်ရေး ကော်မတီ • တိုင်ကြားချက်လက်ခံမှု • စောင့်ကြည့် လေ့လာခြင်း နှင့်ဖြေရှင်းခြင်း	• တိုင်ကြားချက်ကိုမှတ်တမ်းတင်ပါ။ • စုံစမ်းစစ်ဆေးပြီး သင့်လျော်သောဖြေရှင်းနည်းများကို အကောင်အထည်ဖော်ပါ။			စီမံကိန်းနေရာ၊ စီမံကိန်း တဝိုက် လူနေဇရိယာနှင့် သယ်ယူပို့ဆောင်ရေး လမ်းကြောင်း
ပြည်သူ့နှင့် လုပ်ငန်းခွင် ကျန်းမာရေး၊ လုံခြုံရေး	• မတော်တဆဖြစ်ပွားမှု စာရင်း • မတော်တဆဖြစ်မှုများ • လျှော့ချရေးအစီအမံ	မတော်တဆမှု စုံစမ်းစစ်ဆေးမှုအတွက် အကျဉ်းချုပ်အစီရင်ခံစာ ပြုလုပ်ပါ။			စီမံကိန်းနေရာ၊ စီမံကိန်း တဝိုက် လူနေဇရိယာနှင့် သယ်ယူပို့ဆောင်ရေး လမ်းကြောင်း

၁.၁၉ အရေးပေါ်တုံ့ပြန်မှုအစီအစဉ်

အရေးပေါ်တုံ့ပြန်မှုအစီအစဉ်၏ ရည်ရွယ်ချက်မှာ စီမံကိန်းလုပ်ငန်းများနှင့် သဘာဝဘေးအန္တရာယ်များကြောင့် ဖြစ်ပေါ်လာသော အရေးပေါ်အခြေအနေများနှင့် မတော်တဆမှုများကို တုန့်ပြန်ရန်အတွက် ရရှိနိုင်သော ***အရင်းအမြစ်များ (ဝန်ထမ်းနှင့်ပစ္စည်းကိရိယာများ) ကိုပြင်ဆင်ထားရန်*** ဖြစ်ပါသည်။

အဆိုပြုထားသော အမှိုက်ကျင်းထွက် ဓာတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်သည့်စီမံကိန်းတွင် ယေဘုယျအားဖြင့် ***အရေးပေါ်ဝန်ဆောင်မှု တာဝန်ခံ*** သို့မဟုတ် အရေးပေါ်အခြေအနေများအတွက် ***HSE မန်နေဂျာနှင့် တုန့်ပြန်ရေးအဖွဲ့*** ရှိသင့်ပါသည်။ အသင်းကိုအောက်ပါအတိုင်းပြင်ဆင်ထားသင့်ပါသည်။

- ***အဖွဲ့ဝင်များအား*** အရေးပေါ်ပစ္စည်းများ အသုံးပြုကာ ၎င်းတို့၏ တာဝန်နှင့် သက်ဆိုင်သည့် ***သင်တန်းများပေးခြင်း***
- ***အရေးပေါ်လုပ်ထုံးလုပ်နည်းများ*** ဖော်ဆောင်ရေးသားခြင်း နှင့် ပြဋ္ဌန်းခြင်း
- ***အရေးပေါ်တုံ့ပြန်မှုအစီအစဉ် (ERP)*** ဖော်ပြချက် နှင့် ရရှိနိုင်မှုအား ***ဝန်ထမ်းအားလုံး*** နှင့် ***စက်ရုံအလုပ်သမားများ*** အား***သိရှိနားလည်စေပြီး စာရွက်ဖြင့် ထုတ်ကာ ကြေညာထားသင့်ပါသည်***။
- ***အရေးပေါ်ကယ်ဆယ်ရေး Muster points*** များ၏ တည်နေရာများကို သတ်မှတ်ထားခြင်း
- ***အချက်ပြစနစ်နှင့် မီးငြိမ်းသတ်ကိရိယာများ*** ပံ့ပိုးပေးထားခြင်း
- ***ရှေးဦး သူနာပြု ပစ္စည်းကိရိယာများ*** ထောက်ပံ့ပေးထားခြင်း
- ***မတော်တဆမှု သို့မဟုတ် အရေးပေါ်အခြေအနေ***ဖြစ်သည့် အခါ ***ထိရောက်စွာ အကျိုးရှိစေသော အရေးပေါ်စီမံခန့်ခွဲမှု*** များဖြင့် လူ့အသက်၊ ပတ်ဝန်းကျင်၊ ပိုင်ဆိုင်မှုများ နှင့်စီးပွားရေးလုပ်ငန်းများ ထိခိုက်နိုင်မှုကို လက်တွေ့ကျကျ လျှော့ချခြင်း
- ***ကောင်းမွန်သော ဆက်သွယ်ရေးစနစ်တစ်ခု*** ဖြင့်***အရေးပေါ် အခြေအနေများ*** တွင် လုံလောက်သော သတင်းအချက်အလက်ရရှိမှု သေချာစေခြင်း
- ***အရင်းအမြစ်များအားလုံး*** ကို***ထိရောက်ပြီး အကျိုးရှိသော တုံ့ပြန်မှု*** ဖြင့် ထိရောက်သော အရေးပေါ်စီမံခန့်ခွဲမှုကို သေချာစေခြင်း
- ***ဆက်သွယ်ဆောင်ရွက်ရန်*** အတွက် ***ဖော်ပြထားသော လမ်းစဉ်များအား ဆောင်ရွက်ရန် အဓိုးရအာဏာပိုင်များ၊ မီဒီယာများ*** နှင့်***အခြားသက်ဆိုင်သူများ***ကို သတ်မှတ်ထားခြင်း

အဆိုပြုထားသောစီမံကိန်းတွင်ဖြစ်ပေါ်နိုင်ဖွယ်ရှိသောအရေးပေါ်အခြေအနေများမှာ

- မီး / ပေါက်ကွဲခြင်း
- ဓာတုပစ္စည်းများ၊ အဆိပ်အတောက်ပစ္စည်းများ နှင့် ဆီများယိုဖိတ်ခြင်း
- လူများ အမြင့်မှ လိမ့်ကျ ခြင်း
- အမြင့်စင်များ၊ အဆောက်အအုံများ၊ အဓိုးအကာများ ပြိုကျခြင်း
- ယာဉ်မတော်တဆမှုများ နှင့် ထိခိုက်ဒဏ်ရာများရရှိခြင်း တို့ဖြစ်ပါသည်။

ဤအခန်းတွင် စီမံကိန်းလုပ်ငန်းစဉ်အတွင်း ပေါ်ပေါက်လာနိုင်သည့် အရေးပေါ်အခြေအနေများကို တုန့်ပြန်နိုင်ရန်အတွက် ဖြစ်နိုင်ချေရှိသော အရေးပေါ်အခြေအနေများအားလုံးကို ကိုင်တွယ်ရန် လိုအပ်သော အရေးပေါ်ဆောင်ရွက်မှုများနှင့်အတူ လုပ်ထုံးလုပ်နည်းများကို ဖော်ပြထားပါသည်။
၎င်းသည်အရေးပေါ်အခြေအနေတွင် လုပ်ဆောင်ရန်များနှင့် ဆက်သွယ်ရေးလမ်းကြောင်းများအတွက် လမ်းညွှန်ချက်ပေးခဲ့ပြီး အဆိုပြုထားသောစီမံကိန်း အတွက် သက်ဆိုင်ရာတာဝန်များကို ဖော်ပြထားပါသည်။
ထို့အပြင် ဆေးဘက်ဆိုင်ရာ အရေးပေါ်တုံ့ပြန်မှုအစီအစဉ်တွင် အထွေထွေပြဋ္ဌာန်းချက်များ အပါအဝင် ရှေးဦး သူနာပြုစုကုသမှုနှင့်တကွ ဖုန်မှုန့်နှင့် ဓာတုပစ္စည်းထိတွေ့မှုအတွက် အရေးပေါ်တုန့်ပြန်မှုများ ကို ဖော်ပြထားပါသည်။

၁.၂၀ လူထုတွေ့ဆုံဆွေးနွေးခြင်းနှင့် အများပြည်သူအား ထုတ်ဖော်ပြောကြားခြင်း

လူထုတွေ့ဆုံဆွေးနွေးခြင်းနှင့် လူမှုစီးပွားအချက်အလက်များ ကောက်ယူခြင်း၏ အဓိကရည်ရွယ်ချက်မှာ စီမံကိန်းအနီးရှိနေထိုင်သူများ၏ ***လူမှုစီးပွား အချက်အလက်များ နှင့် အခြေအနေများ***အား သိရှိရန်၊ စီမံကိန်းအပေါ် ***သဘောထားအမြင်များ*** နှင့် ***စီမံကိန်းကြောင့် လူမှုဘဝနေထိုင်မှု အပေါ် သက်ရောက်မှုများကို လေ့လာရန်*** ဖြစ်ပါသည်။

စီမံကိန်းလုပ်ဆောင်မှုများကြောင့် ထိခိုက်နိုင်သော ရပ်ရွာလူထု၏အမြင် နှင့် ၎င်းတို့၏ လူမှုရေးဆိုင်ရာ သက်ရောက်မှုများကို ဖော်ထုတ်ရန် ကြာနီကန်အမှိုက်ကျင်းထွက်ဓာတ်ငွေ့မှစွမ်းအင်ထုတ်လုပ်သည့် ***စီမံကိန်း အနီးတစ်ဝိုက်ရှိ အင်ဂျယ်ကျေးရွာ***တွင် လူမှုစီးပွားအချက်အလက်များ ကောက်ယူခဲ့ပါသည်။

ရှေးဦးစွာ ***ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ MCDCမှ တာဝန်ရှိသူများ*** အပါအဝင် ***သက်ဆိုင်ရာ အိမ်ထောင်စုဝင်အချို့***နှင့် တွေ့ဆုံခဲ့ပြီး စီမံကိန်းနယ်ပယ်နှင့် ***CDM ၏ရည်ရွယ်ချက်အား*** ရှင်းပြခဲ့ပါသည်။

အနီးဆုံးကျေးရွာမှ အိမ်ထောင်စုများ သာမက ***စီမံကိန်းနှင့် အနီးစပ်ဆုံးနေထိုင်သူများဖြစ်သော ဝင်ငွေအတွက် စွန့်ပစ်ပစ္စည်းစွန့်ပစ်ရာနေရာကို မှီခိုနေရသောအိမ်ထောင်စုများ*** အတွက်အပါအဝင် ***စစ်တမ်းနှစ်ခု*** အား ကောက်ယူခဲ့ပါသည်။ စစ်တမ်းကောက်ယူသော မေးခွန်းသည် ***အရေအတွက် သတ်မှတ်ခြင်း*** အတွက် သာမက ***အရည်အသွေး လေ့လာခြင်း*** အတွက်ပါ ရည်ရွယ်သော ***မေးခွန်းအမျိုးအစားများ ရောနှောဖွဲ့စည်းထားသည့်ပုံစံ*** ဖြစ်ပါသည်။

၁.၂၁ အဓိက သတင်းအချက်အလက်ပေးသူများ နှင့်ဒေသခံအသိုင်းအဝိုင်း အတွက် လူမှုစီးပွားရေးစစ်တမ်း ကောက်ယူခြင်း ရလာဒ်များ (အင်ဂျယ်ကျေးရွာ)

လူမှုစီးပွားဆိုင်ရာ စစ်တမ်းများကောက်ယူခဲ့သော အင်ဂျယ်ကျေးရွာတွင် အိမ်ထောင်စုစုစုပေါင်း ***၂၅၂ စု*** ခန့်ရှိပါသည်။ ကျေးရွာ၏ သတင်းအချက်အလက်နှင့် အဆိုပြုထားသည့်စီမံကိန်းအပေါ် ထားရှိသည့်သဘောထားအမြင် များကို ကိုယ်စားပြုဖြေဆိုနိုင်သော ***စုစုပေါင်းအိမ်ထောင်စု ၄၀ စု*** (***အင်ဂျယ် ကျေးရွာ***မှ အိမ်ထောင်စု ***၃၀*** နှင့် ***အမှိုက်ကျင်း အနီးတွင်နေထိုင်သည့်*** အိမ်ထောင်စု ***၁၀*** စု) ထံမှ စီမံကိန်းအတွက် လူမှုစီးပွားဆိုင်ရာစစ်တမ်းကောက်ယူမှုများ ကောက်ယူရန် ***ကျပန်းရွေးချယ်ခဲ့ခြင်း*** ဖြစ်ပါသည်။

ကောက်ယူခဲ့သော စစ်တမ်းအရ အင်ဂျယ် ကျေးရွာသည် ဖွံ့ဖြိုးတိုးတက်ပါသည်။ ဖြေဆိုသူအားလုံးသည်***ဗမာများ*** ဖြစ်ကြပြီး ကိုးကွယ်သော ***ဘာသာတရားမှာ ဗုဒ္ဓဘာသာ*** များ ဖြစ်ကြပါသည်။

အသက်အပိုင်းအခြားကိုကြည့်လျှင် အများစုဖြစ်သော ***၃၂ ရာခိုင်နှုန်း***သည် ***အသက် ၄၀နှစ် မှ ၅၀နှစ်*** ကြားဖြစ်ပြီး ***၃၀နှစ် မှ ၄၀နှစ်*** ကြားသည် ***(၁၈%)*** ရှိပါသည်။ ***၂၀နှစ် မှ ၃၀နှစ်*** နှင့် ***၅၀-၆၀နှစ်*** တို့သည် ***(၁၄%)*** အသီးသီးဖြစ်ပြီး အသက် ***၇၀ နှစ်အထက်သည် (၃%)*** ဖြစ်ပါသည် ။

စုစုပေါင်းစစ်တမ်းကောက်ယူမှုအရ အများစုဖြစ်သော ***(၈၇%) အိမ်ထောင်စုများသည် ကိုယ်ပိုင်အိမ်ရှိ*** ပြီး ၁၃%သည် အိမ်မပိုင်ဆိုင်ကြပါ။ ထို့အပြင် စစ်တမ်းကောက်ယူထားသည့်အိမ်ထောင်စု ***၉၃%*** သည် အိမ်ခေါင်မိုးအဖြစ် "***CGI***" ကို အသုံးပြုထားပြီး ***၇ ရာခိုင်နှုန်း***သာလျှင် "***ဝါး***" ဖြင့်မိုးထားပါသည်။

စစ်တမ်းဖြေဆိုသူ ***(၆၃%)*** ၏ အလုပ်အကိုင်မှာ ***လယ်သမားများ*** ဖြစ်ကြပါသည်။
နှစ်စဉ်ဝင်ငွေနှင့်ပတ်သက်၍ ဖော်ပြရလျှင် အိမ်ထောင်စု ***၃၂ %၏ ဝင်ငွေသည် ကျပ် ၅၀၀,၀၀၀ ထက်နည်း*** ၍ ***(၂၈%)*** သည် တစ်နှစ်လျှင် ***၅၀၀,၀၀၁ မှ ၁၀၀၀,၀၀၀ ကျပ်*** ကြား ဝင်ငွေရှိကြပါသည်။

ပညာရေးရှုထောင့်မှကြည့်လျှင် ***ဖြေဆိုသူအများစု၏ ၄၄ ရာခိုင်နှုန်း***သည်“ ***မူလတန်းကျောင်း***” ပညာရေးအဆင့်ဖြစ်ပြီး ***၃၇%*** သည် ***အလယ်တန်းအဆင့်***ရှိပါသည်။

မိသားစုတွင်အမြင့်ဆုံးပညာရေးအဆင့်နှင့် ပတ်သက်၍ဖော်ပြရလျှင် အိမ်ထောင်စုအများစု (၄၁%) သည် “***အလယ်တန်း***” ပညာရေးအဆင့်ဖြစ်ပြီး (၂၄%)မှာ “***အထက်တန်း***”အဆင့် ရှိပါသည်။

ရောဂါအမျိုးအစားများနှင့်စပ်လျဉ်း၍ဖော်ပြရလျှင် ***အဖြစ်အများဆုံး ရောဂါများ*** မှာ ***တုပ်ကွေးရောဂါ (၂၂%)*** ၊ ***အအေးမိခြင်း (၂၀%) နှင့် သွေးတိုး (၁၀%)*** တို့ဖြစ်ကြပါသည်။
အိမ်ထောင်စုအများစု (၅၇%) သည် “***ပုဂ္ဂလိကဆေးခန်းမှဆရာဝန်များ***” နှင့် ကုသမှုခံယူကြပါသည်။

ဖြေဆိုသူ ၉၀ ရာခိုင်နှုန်းသည် “***အမျိုးသား ဓာတ်အားလိုင်းမှ လျှပ်စစ်ဓာတ်အား***”ကို အသုံးပြုကြပါသည်။
ဖြေဆိုသူများမှ အိမ်ထောင်စု ***၈၁ ရာခိုင်နှုန်း***သည် သောက်သုံးရေကို “***အဝိစိရေတွင်း***”မှ ရယူကြပါသည်။

အင်တာနက် ဆက်သွယ်မှုရှုထောင့်တွင် ဖြေဆိုသူများမှ အိမ်ထောင်စု ***၈၇%*** သည် ***ဖုန်းများမှ တစ်ဆင့် အင်တာနက်***ကို အသုံးပြုကြပါသည်။

အက်ပလီကေးရှင်းများတွင် “***Facebook***” (***၉၆%***) သည် ***အသုံးအများဆုံး*** ဖြစ်ပြီး ထိုဖော်ပြပါ ရာခိုင်နှုန်းတွင် ***ဖေစ်ဘွတ်ခ်နှင့် Viber နှစ်ခုစလုံး***ကို အသုံးပြုသောဖြေဆိုသူ ***၁၄%*** ပါဝင်ပါသည်။

အဆိုပြုထားသော စီမံကိန်းအပေါ် ရပ်ရွာလူထု၏အသိအမြင်နှင့် ပတ်သက်၍ ***အိမ်ထောင်စုအများစု (၆၂%)*** သည် စီမံကိန်းအကြောင်း ***အနည်းငယ်သာသိ*** သော်လည်း ဖြေဆိုသူ ***၃၈%သည် စီမံကိန်းအကြောင်းမသိကြပါ***။

စီမံကိန်းအကြောင်း သတင်းအချက်အလက်များကို စစ်တမ်းဖြေဆိုသူများအနက်မှ ***(၄၆%)*** သည်“***အစိုးရဝန်ထမ်းများ***” မှတစ်ဆင့် ရရှိကြပါသည်။

စီမံကိန်းသည် ရပ်ရွာအတွက် “***အရေးကြီးသည်***” ဟု ***ဖြေဆိုသူအများစု (၆၀%)*** ကဆိုပါသည်။ ***ဖြေဆိုသူ၈%*** က စီမံကိန်းသည် “***အလွန်အရေးကြီးသည်”*** ဟုဆိုသော်လည်း ***၁၆%*** ကမူ ရပ်ရွာအတွက် “***အရေးမကြီး*** ” ဟုဖော်ပြခဲ့ပါသည်။

အဆိုပြုထားသောစီမံကိန်းကြောင့် ***အပြုသဘောသက်ရောက်မှု*** များနှင့်စပ်လျဉ်းသော မေးခွန်းတွင် ***စစ်တမ်းဖြေဆိုသူ ၃၈ရာခိုင်နှုန်း***က “***တိုးတက်လာသောပတ်ဝန်းကျင်***” ကိုဖော်ပြခဲ့ကြပါသည်။

အဆိုပြုထားသော ***စီမံကိန်းကြောင့် ဆိုးကျိုးသက်ရောက်မှုများ*** နှင့် စပ်လျဉ်း၍ ***အိမ်ထောင်စုအများစု (၈၂%)*** က ***စီမံကိန်းကြောင့်ဆိုးကျိုးသက်ရောက်မှုများမရှိ*** ဟုတုံ့ပြန်ခဲ့ကြသည်။ သို့သော် အိမ်ထောင်စု ၄% သည် “သဘာဝပတ်ဝန်းကျင်နှင့်ကျန်းမာရေးအပေါ်အကျိုးသက်ရောက်မှုများ” အား ဖော်ပြခဲ့ပြီး “ကျန်းမာရေးအပေါ် ဆိုးကျိုးသက်ရောက်မှုများကြောင့် ကုန်ကျစရိတ်တိုးမြှင့်ခြင်းအပေါ် ဆိုးကျိုးသက်ရောက်မှု” အပေါ် ၅ ရာခိုင်နှုန်းမှ တုန့်ပြန်ခဲ့ပါသည်။

ရပ်ရွာအတွက်လိုအပ်သောဖွံ့ဖြိုးမှုများ နှင့် စပ်လျဉ်း၍ ဖြေကြားသူအများစု(၇၅%) သည် “***ပညာရေး***” ကိုပထမ ဦး စားပေးအဖြစ်၊ စစ်တမ်းဖြေဆိုသူ (၂၅%)သည် “ ***အစိုင်အခဲစွန့်ပစ်ပစ္စည်းစွန့်ပစ်ခြင်း***” ကိုဒုတိယ ဦး စားပေးအဖြစ်၊ (၄၁%)သည် "***သယ်ယူပို့ဆောင်ရေး*** " ဖွံ့ဖြိုးတိုးတက်မှု နှင့် (၃၆%) သည်“ ***အလုပ်အကိုင်အခွင့်အလမ်းများ***” အား တတိယဦးစားပေး အဖြစ် သတ်မှတ်ခဲ့ကြပါသည်။

လယ်ယာလုပ်ငန်းနှင့်စပ်လျဉ်း၍ စစ်တမ်းဖြေဆိုသူ အများစု ***(၇၁%) သည် ကိုယ်ပိုင်လယ်ယာမြေများ ပိုင်ဆိုင်ကြ သည်*** ။ မြေအများစု ***(၈၆%)*** သည်“***သီးနှံမြေ***” ဖြစ်ပြီး အခြား ***(၁၄%)*** သည် “***နှစ်ရှည်စိုက်ခင်း***” များ ဖြစ်ပါသည်။ အများဆုံးစိုက်ပျိုးသောသီးနှံ သည် ***ဆန်*** (၉၅%) ဖြစ်ပါသည်။

စစ်တမ်းဖြေဆိုသူ ***၇၀ ရာခိုင်နှုန်း***သည် ***တိရိစ္ဆာန်များကိုမွေးမြူပြီး*** ရပ်ရွာအတွင်း အများဆုံးမွေးမြူသော တိရစ္ဆာန်မှာ “***နွား***” (၆၀%) ဖြစ်ပါသည်။

စီမံကိန်းဖွံ့ဖြိုးတိုးတက်မှုအပေါ် ***ဖြေကြားသူများ၏သဘောထား*** ကိုကြည့်လျှင် ***၇၆ ရာခိုင်နှုန်း***သည် ***စီမံကိန်း၏ဖွံ့ဖြိုးတိုးတက်မှုကို သဘောတူညီကြောင်း*** ၊ ***အိမ်ထောင်စု ၄ ရာခိုင်နှုန်း***က ***သဘောမတူကြောင်း***နှင့် ***၂၀ ရာခိုင်နှုန်းကမူ*** စီမံကိန်းဖွံ့ဖြိုးတိုးတက်မှုအတွက် ***သဘောတူမတူအား သေချာမသိကြောင်း***ပြောကြားခဲ့ပါသည်။

၁.၂၂ ဝင်ငွေအတွက် အမှီကိုကျင်း နေရာကိုမှီခိုကြသည့် အနီးဆုံး အိမ်ထောင်စုများ၏ လူမှုစီးပွား စစ်တမ်းများ ကောက်ယူခြင်း ရလာဒ်များ

ကြာနီကန်တွင် ဝင်ငွေအတွက် အမှိုက်ကျင်း နေရာကိုမှီခိုကြသည့် အနီးဆုံး အိမ်ထောင်စု (၂၀) ခန့်ရှိပါသည်။ စစ်တမ်းကောက်ယူမှုအရဖြေဆိုသူအားလုံးသည် ကြာနီကန် အမှိုက်ကျင်းနေရာရှိ “***ကျပန်းအလုပ်သမားများ***” ဖြစ်ကြပါသည်။ ဖြေဆိုသူအများစု(***၇၀%***) ၏နှစ်စဉ်ဝင်ငွေ သည် ***ကျပ် ၂,၀၀၀,၀၀၀*** မှ ***၃,၀၀၀,၀၀၀*** ကြားဖြစ်ပါသည်။

ဖြေဆိုသူအများစုသည် ***ပြန်လည်အသုံးပြုနိုင်သောအမှိုက်များကိုကောက်ယူခြင်း***ဖြင့် ***တစ်နေ့လျှင်ကျပ် ၅၀၀၀ (သို့) တစ်သောင်းကျပ်*** ရရှိကြပါသည်။

ပညာရေးရှုထောင့်မှကြည့်လျှင်ဖြေဆိုသူ ***၅၀ ရာခိုင်နှုန်း***သည်“ ***ဘုန်းတော်ကြီးသင်ပညာရေး***”၊ ***၄၀ ရာခိုင်နှုန်း***သည် “***မူလတန်းကျောင်း***” ပညာရေးအဆင့် နှင့် ***၁၀%*** သည် “***လုံးဝ ကျောင်းမတက်ခဲ့ကြ***” သူများဖြစ်ပါသည်။ မိသားစု အတွင်း အမြင့်ဆုံးပညာရေးအဆင့်မှာ အိမ်ထောင်စုအများစု ***(၄၀%)*** သည် “***မူလတန်းကျောင်း***” ပညာရေးအဆင့်ကိုဖြစ်ပြီး ***(၃၀%)*** မှာ “***အလယ်တန်းကျောင်း***”အဆင့် ဖြစ်ပါသည်။

စစ်တမ်းကောက်ယူမှုအရ ***အိမ်ထောင်စုဝင်အများစု(၆၀%)*** သည် “ ***ကြွက်သားနာကျင်မှု***” အား ခံစားကြရပါသည်။ စစ်တမ်းဖြေဆိုသူအားလုံးသည် ဖျားနာမှုများအတွက် “***ပုဂ္ဂလိကဆေးခန်းမှ ဆရာဝန်များ***” ဖြင့် ကုသမှုခံယူကြပါသည်။

အိမ်ထောင်စုဖွဲ့စည်းပုံနှင့် ပတ်သက်၍ စစ်တမ်းကောက်ယူသည့်အိမ်ထောင်စုအားလုံးသည် အိမ်များကိုပိုင်ဆိုင်ခြင်းမရှိဘဲ “***တဲများ***” တွင် “***တာပေါ်လင်အိမ်း***” ဖြင့်မိုး၍ နေထိုင်ကြပါသည်။

ကျန်းမာရေးစောင့်ရှောက်မှုရရှိမှုနှင့် ***ပညာရေးလက်လှမ်းမီမှု***တွင် ဖြေဆိုသူအားလုံးသည် ကျန်းမာရေးစောင့်ရှောက်မှု ဝန်ဆောင်မှုများရရှိခဲ့သော်လည်း စစ်တမ်းကောက်ယူထားသည့် ***အိမ်ထောင်စုအများစု (၅၆%)*** သည် စီးပွားရေးကျပ်တည်းမှု အခြေအနေကြောင့် ၎င်းတို့၏သမီး / သားများသည် ***ကျောင်းတက်နိုင်ခြင်းမရှိ***ဟု ဖြေကြားခဲ့ကြပါသည်။

ဖြေဆိုသူအားလုံးသည်အလင်းရောင်အတွက်“ ***နေရောင်ခြည်သုံး စွမ်းအင်***” ကိုအသုံးပြုကြပြီး ထမင်းဟင်းချက်ပြုတ်ရာတွင် “***ထင်း***”အား အသုံးပြုကြပါသည်။ အများစု ***(၆၀%)*** သည် အဆိုပါထင်းများအား “***အမှိုက်ပုံအဟောင်း***”မှ ရယူကြပါသည်။

သောက်သုံးရေရရှိနိုင်မှုနှင့်စပ်လျဉ်း၍ စစ်တမ်း ကောက်ယူသော အိမ်ထောင်စုအားလုံးသည်“ ***သောက်ရေသန့်***” ကိုသောက်သုံးကြပါသည်။

ဖြေဆိုသူအားလုံးသည် အဆိုပြုထားသောစီမံကိန်း အကြောင်းနှင့် ပတ်သက်၍ လုံးဝမသိရှိကြပါ။
ထို့ကြောင့်ဖြေဆိုသူ ***၈၀ ရာခိုင်နှုန်း***မှာ ဤစီမံကိန်းသည် ***ရပ်ရွာလူထုအတွက် မည်မျှအရေးကြီးကြောင်း*** နှင့် ပတ်သက်သည့် မေးခွန်းအား ***မဖြေဆိုနိုင်ပါ***။
အဆိုပြုထားသောစီမံကိန်းကြောင့် အပြုသဘောသက်ရောက်မှုများနှင့်စပ်လျဉ်း၍ ဖြေဆိုသူ အများစုသည် "မသိရှိ" ကြပါ။ ဖြေဆိုသူ ***၂၀%*** သည်" ***အလုပ်အကိုင်အခွင့်အလမ်းတိုးလာရန်***" မျှော်လင့်ပြီး ***၁၀%*** ကမူ "***တိုးတက်လာသောပတ်ဝန်းကျင်***" ကို မျှော်လင့်နေကြပါသည်။

အဆိုပြုထားသော စီမံကိန်း၏ဆိုးကျိုးသက်ရောက်မှုများအတွက် ***ဖြေဆိုသူအများစု (၆၀%)*** သည် "***အလုပ်အကိုင်နှင့် ဝင်ငွေပြေတ်တောက်ခြင်း***" အတွက်စိုးရိမ်ပူပန်ကြပြီး ကျန် ၄၀% သည် ဆိုးကျိုးသက်ရောက်မှုများကို မသိရှိကြပါ။

ရပ်ရွာတွင် လိုအပ်သောဖွံ့ဖြိုးတိုးတက်မှု နှင့်စပ်လျဉ်း၍ ဖြေကြားသူများသည် " ***အလုပ်အကိုင်အခွင့်အလမ်း***" နှင့် " ***ကျန်းမာရေးဝန်ဆောင်မှု***" တို့အား ဖော်ပြခဲ့ကြပါသည်။

ဖြေကြားသူများအားလုံးသည် ***ပြန်လည်အသုံးပြုနိုင်သောစွန့်ပစ်ပစ္စည်းများကို လက်ရှိစွန့်ပစ်နေသော အမှိုက်ပုံမှ*** စုဆောင်းကြပြီး ***အမှိုက်ပုံဟောင်းမှ မကောက်ယူကြတော့ပါ***။

ပြန်လည်အသုံးပြုနိုင်သောစွန့်ပစ်ပစ္စည်းများကို ကောက်ယူကြသည့်စစ်တမ်းဖြေဆိုသူများထဲမှ ***၁၀၀ ရာခိုင်နှုန်း***သည် "***သတ္တုများ၊ သတ္တုပုလင်းများနှင့်ခွက်များ***" ၊ ***၇၀%*** သည်"***ပလပ်စတစ်အိတ်နှင့်ပစ္စည်းများ***" နှင့် "***ဆောက်လုပ်ရေးစွန့်ပစ်ပစ္စည်း***" များ ကောက်ယူပြီး ***၅၀%*** သည်" ***စက္ကူ၊စာအုပ်နှင့် ဂျပ်***" များအားကောက်ယူကြပါသည်။

ကျန်းမာရေးအတွက် မကောင်းသောအလေ့အထများနှင့် ပတ်သက်၍ အိမ်ထောင်စု ***၃၀ ရာခိုင်နှုန်း***သာ "***ဆေးလိပ်သောက်ခြင်းနှင့်အရက်သောက်ခြင်း***" ပြုလုပ်ကြပါသည်။
သို့သော်လည်း ***ရပ်ရွာလူထုအများစု***သည်" ***ကွမ်းဝါးခြင်း***" အလေ့အထရှိကြပါသည်။

ဖြေကြားသူများ၏ရလဒ်များအရ စီမံကိန်း နေရာဝန်းကျင်တွင် ***ငါးဖမ်းခြင်းနှင့် အပင်စိုက်ပျိုးခြင်း***မရှိသော်လည်း ကြက်အချို့အား မွေးမြူထားပါသည်။

စစ်တမ်းကောက်ယူထားသည့် ဖြေဆိုသူအားလုံးသည် ***လက်ရှိအမှိုက်ကျင်း နေရာတွင်အနံ့ဆိုး၊ ကြွက်နှင့်ယင်ကောင်များရှိသည်*** ဟုဖြေကြားခဲ့ကြသည်။

အလုပ်အကိုင်နှင့် ဝင်ငွေအပေါ်သက်ရောက်မှု မေးခွန်းတွင် ***ဖြေဆိုသူအများစု (၈၀%) သည်အဆိုပြုထားသော စီမံကိန်းကြောင့်ဆိုးကျိုးသက်ရောက်မှုများရှိမည်***ဟု ယူဆကြသည်။

ဖြေဆိုသူ ***၆၀%*** သည် အဆိုပြုထားသောစီမံကိန်းကြောင့် ***လူနေမှုပုံစံနှင့်ဘဝနေထိုင်မှု အရည်အသွေး***အပေါ် အပျက်သဘောသက်ရောက်မှုများရှိလိမ့်မည်ဟု ယူဆကြောင်း ဖော်ပြကြသည်။

သို့သော် ***၉၀%*** သည် ***ကျန်းမာရေးအခြေအနေ***အပေါ်သက်ရောက်မှုများနှင့် ပတ်သက်၍ မျှော်လင့်မထားကြသော်လည်း ***၁၀%***က စီမံကိန်းကြောင့် ***ကျန်းမာရေးအပေါ် ကောင်းကျိုးသက်ရောက်*** နိုင်လိမ့်မည် ဟုမျှော်လင့်ကြသည်။

ယေဘုယျအားဖြင့် ***ရပ်ရွာလူထု၏ သဘောထားအမြင်များအပေါ်*** ဆန်းစစ်ချက်အရ အဆိုပြုစီမံကိန်းကြောင့် စီမံကိန်းနှင့် အနီးတဝိုက်ဒေသရှိ ***လူမှုစီးပွားရေးကဏ္ဍများအပေါ် အနည်းငယ်သောသက်ရောက်မှုသာ*** ရှိပါမည်။

ရပ်ရွာလူထု၏အမြင်အပေါ် အခြေခံရာ တွင် ***ရုပ်ပိုင်းဆိုင်ရာအရင်းအမြစ်များဖြစ်သော မြေဆီလွှာအရည်အသွေး၊ မြေပေါ်ရေအရည်အသွေး နှင့်မြေအောက်ရေအရည်အသွေး၊ လေထုအရည်အသွေးနှင့်ဆူညံသံ***တို့သည် အဆိုပြုထားသောစီမံကိန်းကြောင့် ***ဆိုးကျိုးသက်ရောက်မှုနည်းပါး***ပါသည်။ ***လူ့အသုံးပြုမှု၊ ဘဝအရည်အသွေးနှင့် ယဉ်ကျေးမှုအမွေအနှစ်အပေါ် ဆိုးကျိုးသက်ရောက်မှု*** မှာ အလွန် နည်းပါး ပါသည်။

နိဂုံးချုပ်အနေဖြင့် မန္တလေး ကြာနီကန် အမှိုက်ကျင်းထွက်ဓာတ်ငွေ့ (LFG) ပြန်လည်စုဆောင်းသန့်စင်မီးရှို့ခြင်းနှင့် လျှပ်စစ်ထုတ်လုပ်ခြင်း စီမံကိန်းအတွက် ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီရင်ခံစာသည် နိုင်ငံတကာရှိ သက်ဆိုင်ရာ အဖွဲ့အစည်းများမှ တရားဝင်ထုတ်ပြန်ထားသော စာပေစစ်တမ်းများကို အခြေပြုလေ့လာပြီး လက်ရှိပတ်ဝန်းကျင်ဆိုင်ရာ အခြေခံ အချက်အလက်များ ကောက်ယူခြင်း အပါအဝင် အုပ်ချုပ်ရေးဝန်ထမ်းများ၊ ဒေသခံပြည်သူများ၊ စီမံကိန်းအကြောင်း စိတ်ဝင်စားသူများ နှင့်တိုင်ပင်ဆွေးနွေးမှုများပြုလုပ်ပြီး လူမှုစီးပွား စစ်တမ်းကောက်ယူမှုများ အပေါ် အခြေခံ၍ ရေးဆွဲထားခြင်း ဖြစ်ပါသည်။

ဤအစီရင်ခံစာသည် စီမံကိန်းလုပ်ငန်း အကောင်အထည်ဖော်နေစဉ်ကာလအတွင်း သဘာဝ ပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာ ဆိုးကျိုးသက်ရောက်မှုများကို လျှော့ချနိုင်မည့် နည်းလမ်းများကို လိုက်နာကျင့်သုံး ဆောင်ရွက်ရန် လိုအပ်ပြီး ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာနမှ ချမှတ်ထားသော စည်းမျဉ်းစည်းကမ်းများ၊ အပြည်ပြည်ဆိုင်ရာ လုပ်ထုံးလုပ်နည်းများနှင့်အညီ လုပ်ဆောင်ရပါမည်။

ထို့အပြင် သတ်မှတ်ထားသော ကြိုတင်ကာကွယ်ရေးနှင့် လျှော့ချရေးအစီအမံများသည် ပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာ ဆိုးကျိုးသက်ရောက်မှုများကို ကာကွယ်ခြင်း သို့မဟုတ် အနည်းဆုံးဖြစ်စေရန် သင့်လျော်သော ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုစနစ်ကို ထောက်ပံ့ပေးနိုင်ပါသည်။

Chapter 1

Executive summary

1. Executives summary

1.1 Introduction

The proposed project has started with the Memorandum of Understanding between ***the Ministry of Environment, Korea (MoE), Korea Environment Industry and Technology Institute (KEITI) and the World Bank (WB) Group*** to support waste management in Myanmar since 2017. In 2018, KEITI, WB and the ***Ministry of Natural Resources and Environmental Conservation (MONREC)*** jointly ***promoted the Technical Assistance*** (TA) for Mandalay's ***solid waste management*** investigation and project development collaborating with ***Mandalay City Development Committee (MCDC).***

In principle, the project will be the ***LFG recovery Clean Development Mechanism (CDM) project*** in Myanmar. The project is to capture and flare the landfill gas (LFG) generated from the landfill site applying the (CDM) which allows ***emission-reduction to earn certified emission reduction (CER) credits***, each equivalent to one tonne of CO2.

The ***Kyar Ni Kan landfill site*** receiving wastes from the townships of the Aung Mye Thar Zan, Chan Aye Thar Zan, Maha Aung Myea is situated ***approximately 17 km north part of Mandalay***. The exact GPS information of Kyar Ni Kan landfill site is ***Latitude: 22.086969 and Longitude: 96.162812.*** The proposed project covers the ***total area of 7 ha***.

The ***Environmental management Plan (EMP)*** of the Kyar Ni Kan Landfill Gas to Energy project has been conducted by the consultant team of ***Environmental Quality Management Co., Ltd*** in accordance with the ***EMP procedures (2015)*** stated by the Environmental Conservation Department (ECD), MONREC.

In terms of the ***government registration/approvals*** for the project is as shown below:

Table 1.1: The government registration/approvals for the project

1	Environmental Company Registration Number	2690/2012-2013
2	Date of Recommendation from Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation to conduct the EMP.	9th June 2020

The main aim of this work is ***to reduce adverse impacts*** of the proposed project and its activities on the health and environment together with the promotion of ***the project sustainable development.***

1.2 Objective

In order to implement the objective, the following materials and methods were used:

- ***Literature review*** on the documents related to policies, laws and regulations of both national

and international level
- ***Interviews with people concerned*** with the project as well as the respective government bodies
- Both ***primary and secondary data*** collection
- ***Environmental baseline*** monitoring
- **Stakeholders consultation and disclosure** through focus group meetings, Key Informant Interviews and door to door household surveys
- Reporting back

1.3 Policy, legal and institutional framework

The EMP has been prepared in accordance with the ***respective laws*** accordingly.

These are the ***relevant guidelines, standards and regulations***:
- The article 37 (a) and 45 of the Constitution of the Republic of the Union of Myanmar, (2008)
- International policies, principles and standards such as WHO guidelines USEPA, IFC Standards
- Relevant local Occupational Health and Safety related laws and regulations
- International conventions, treaties and agreements ratified by Environmental Conservation Department (ECD), Ministry of Natural Resource and Environmental Conservation (MONREC)
- Environmental Conservation Law (2012)
- Foreign Investment Law (2013)
- The draft of Environmental Impact Assessment Rules (2013)
- Environmental Conservation Rules (2014)
- Environmental Impact Assessment Procedure (2015)
- National Environmental Quality (Emission) Guideline (2015)
- Draft Administrative Instruction of Environmental Impact Assessment Procedure, (2015)
- Draft Guideline on Public Participation in Myanmar's EIA Processes (2017)
- Project-Relevant Laws including a number of other laws exists which, either directly or indirectly, relate to environmental and social management of the project

1.4 Project description and alternatives selection

The project activities involve the ***capture of methane to produce electricity for the on-site needs***. In the process, ***heat*** will also be used to ***evaporate leachates***. A ***back-up enclosed flaring unit*** will also be part of the project. GHG emission reductions will result from the ***efficient combustion of*** otherwise ***flared LFG***, in the ***power generation, leachate evaporation, and flaring equipment.***

The project involves methane destruction through burning and combustion in internal-combustion engines, while generating ***energy that will be used internally in the landfill***. Other activities also include a gas extraction system, equipment for ***gas burning, a gas pre-treatment plant and gas***

reception engines, as well as the ***engines for burning the Landfill Gas (LFG) generated*** at dumping zone.

The Power Plant will be installed comprehensively over the closed areas of the landfill. Installations will include initially approximately ***112 (vertical extraction wells of high-density polyethylene pipes (HDPE***). The plant also includes an ***automatic flare & generator plant composed by blowers, moisture separator and enclosed flaring & generator plant, and the LFG measuring and recording equipment***. The ***flaring plant*** will have a maximum capacity of ***500 Nm^3/hr*** and ***generator plant*** will have a maximum capacity (***500kW X 1 set***) and ***destruction efficiency*** between ***98% and 100%.***

In general, the whole project comprised of the following phases:
Phase (1) LFG Collection Facility
Phase (2) Flaring System

Phase (3) LFG Generation

1.4.1 Current use of the location

The main part of the proposed Kyar Ni Kan landfill gas recovery project will be occupied by the perimeter fence, entrance gate, power station, administration building, workshop, parking areas, leachate treatment reservoirs, social and changing room for workers, monitoring wells, drainage system.

1.4.2 Operation phase

(i) Power requirement

The total power required for the proposed unit will have a maximum capacity of 500 Nm^3/hr for the flaring plant. There is ***one generator in the operation site*** (generator plant will have a maximum capacity 500 kW (***500 kW X 1 set***) which are for ***lighting and operation process***, etc.

(ii) Water requirement

The main sources of water are assumed that ***tube wells*** and ***public supply*** will be utilized for the ***construction phase, operation phase*** and **decommissioning phase**.

There may be one tube well having approximately ***200-300 feet depth*** based on Mandalay hydrogeology information and capacity of producing average 800-1,000 gallons per hour from the tube well will be settled. The ***total water usage*** of the project site during the construction phase and decommissioning phase would be ***approximately 30 m^3/day*** (7,925 gallons/day). The total water requirement for construction period (6 months) ***is 5,400 m^3 /6 months*** (1,426,500 gallons/6 months). The required water for construction of proposed project is being supplied from the public

supply through water pipelines and stored water storage tanks (6,400 gallons and 32,000 gallons) in the project site.

The ***total water usage*** of the project site during the operation phase would be only for shower and toilet which can be assumed as 100 gallons per day per person. For drinking water, purified drinking water bottles are being used.

(iii) Workforce requirement and staff categories

During the construction phase, all the staff members of the project have to finish ***Occupational Safety and Health Administration (OSHA) training before*** going to the construction site. The required human resources of the project are detailed in the chapter (4).

(iv) Waste management

Being situated at the waste disposal site, the various kinds of wastes released from the project site will be transferred after waste segregation by using tipper trucks to the waste disposal site nearby.

(v) Safety measures

As ***safety measures for staff / workers*** during operation, employees will be equipped with:

- Ear plugs
- Gloves
- Boots
- Dust Masks
- Helmets
- Protective uniform

1.5 Alternatives selection

Concerning the alternative development, there is ***no alternative option*** that would prevent all potential environmental and social impacts due to the Landfill Gas Recovery and Generation Project at the Kyar Ni Kan landfill site. Objective of the project is intended to ensure environmental conservation through innovation and improvement of final waste disposal site in Mandalay city based on ***the Goal (B) of Mandalay City Waste Management Strategy and Action Plan (2017-2030).***

Furthermore, the proposed project activity faces a number of barriers of which the economic unattractiveness, lack of technical know-how, lack of availability of equipment. Thus, the implementation of this project activity will ***assist the Government of Myanmar*** in demonstrating the practice of landfill gas recovery, in building of local know-how about LFG recovery and flaring & generator system about ***correct landfill site management*** plan.

In addition, the ***conversion of unsanitary landfills to sanitary landfills*** requires additional equipment, such as leachate treatment and soil cover, which requires significant financial support.

The private companies may not earn the profits by investing on such sanitary landfills which are a prerequisite for an LFG power plant.

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Furthermore, the implementation of the project activities will also demonstrate how the ***UN CDM process could assist in making the practice of LFG recovery economically viable*** for ***only the Korean companies with the strongest sales revenue of UN CDM CERs.***

1.6 Description of the surrounding environment, impact and risk assessment, and mitigation measures

1.6.1 Local climate and meteorology

The Mandalay lies on ***83m above the sea level*** and its climate is ***a local steppe climate***. A steppe climate, with ***cold winters and hot, dry summers, and little rainfall*** throughout the year.

1.6.2 Patheingyi Township

The Patheingyi township where the project site located has a ***hot and humid climate with opinion temperature 37°C and minimum temperature 29°C (2019).*** The Patheingyi township experiences ***monsoon rains*** and is considered to be a tropical savannah, ***averaging 624 mm of rain annually (2019).***

(i) Onsite meteorology

The onsite meteorology data measured indicated temperature, relative humidity, and wind speed and wind direction. Table 5.2 shows the average temperature was ***around 23° C and relative humidity was 47%.*** These parameters do effect on the air quality status.

1.6.3 Ambient air quality

The baseline ambient air monitoring was carried out ***at the Kyar Ni Kan landfill site*** as well as the ***vicinity located within 2 km of the project site*** in September, 2020 in order to reveal the existing air quality status at and around the proposed project.

Additionally, applicable standards are presented and used for comparison.

The monitoring includes 24-hour average of ***Particulate Matter (PM10), Particulate Matter (PM2.5), Carbon Monoxide (CO), Sulphur Dioxide (SO2) and Nitrogen Dioxide (NO2), Ozone (O3) along with meteorology*** condition at the monitoring site.

Both The 24 hr average of particulates and gases level at and around the Kyar Ni Kan landfill site met the EQEG guidelines.

Table 1.2: Baseline particulates concentration and gases quality at and around Kyar Ni Kan landfill site

Parameters	Concentration	EQEG Guideline
Particulates		
PM10	**$20^{a}\pm10^{b}$** **$20^{c}(10^{d}\text{-}30^{e})$** **(24hr)**	**50(µg/m^3) (24 hour)**
PM2.5	**$4^{a}\pm1^{b}$** **$4^{c}(3^{d}\text{-}5^{e})$** **(24hr)**	**25 (µg/m^3) (24 hour)**
Gases		
SO2 (24hr average)	**$6^{a}\pm5^{b}$** **$6^{c}(1^{d}\text{-}10^{e})$ (24hr)**	**20 (µg/m^3)** **(24 hour)**
CO (1 hr average),	**$115^{a}\pm48^{b}$** **$0^{c}(0^{d}\text{-}884^{e})$ (1hr)**	**30,000** **(µg/m^3) (1hr)**
CO (8-hour average)	**$105^{a}\pm49^{b}$** **$85^{c}(10^{d}\text{-}240^{e})$ (8hr)**	**10,000** **(µg/m^3) (8hr)**
O_3 (8-hour average)	**$33^{a}\pm6^{b}$** **$32^{c}(22^{d}\text{-}47^{e})$ (8hr)**	**100 (µg/m^3)** **(8hr)**
NO_2 (1 hr average),	**$7^{a}\pm1^{b}$** **$6^{c}(0^{d}\text{-}22^{e})$ (1hr)**	**200** **(µg/m^3) (1hour)**

a Average b SE c Median d Min e Max

Air quality impact assessment during the construction phase

Air quality ***impacts associated with construction*** of the proposed project would include ***fugitive dust*** and ***gases emissions*** from fossil-fuel-fired construction equipment, open burning and temporary fuel transfer systems and associated storage tanks. The ***impact significance*** is rated as "***Medium".***

Air quality impact assessment during the operation phase

The ***NOx and CO gases*** will be emitted from the following process that will further escalate air pollution issues:

a) ***Phase (2) Flaring System***
b) ***Phase (3) LFG to electricity generation***

The ***USEPA preferred AERMOD model*** was run to assess the dispersion and impacts of the gases (CO & NOx) emissions on the ambient air quality in the project area.

This study run AERMOD simulation for the dispersions of CO and NO_x emissions from the proposed landfill gas recovery and Generation at Kyar Ni Kan landfill sites in two phases: ***1) Phase 2 with one flare, and 2) Phase 3 with 2 flares (same as phase 2) plus and 1 generator in Kyar Ni Kan.***

Phase (2)
The results show that in Phase 2, the levels of ***NO2 and CO with different averaging times (1h, 8h, annual) are well below*** the respective Environmental Quality Emission Guideline ***(EQEG)*** stated by ECD, World Health Organization ***(WHO) guidelines*** and ambient air quality standards of United State Environmental Protection Agency (***US EPA NAAQS***). The ***maximum (first highest) concentrations*** of these pollutants founded ***within 50-100 m from the point emission sources at Kyar Ni Kan landfill site and dispersed following the prevailing wind direction, i.e. southeasterly wind.***

Due to its ***downwind location, Kyar Ni Kan emission plume will less significantly affect*** the ***Mandalay city*** comparing to the ***upwind- located Taung Inn Myauk Inn.***

Phase (3)
A generator will be installed in KNK site which would ***increase the emissions at KNK***. The pollution levels in the KNK site in Phase 3 which show ***higher maximum concentrations of NO2 and CO in different averaging time than those in Phase 2***. The plume dispersion patterns of 1h CO and 1h NO2 in Phase 3 which also follow the main ***southeasterly wind direction***, but the KNK plumes spread over larger area than that in Phase 2 due to the increase in the emission rate. However, the ***first highest concentrations of NO2 and CO over the domains*** are ***well below the EQEG (ECD), WHO GV and US EPA NAAQS, respectively.***

Although the ***impacts of all air pollutants emissions*** throughout the project phase (construction, operation and decommission) were rated as ***medium according to the impact assessment***, it will become ***less significant*** if the ***mitigation measures stated*** are followed accordingly.

The detail information of air quality findings is presented in the following section. Moreover, to protect air pollutants mainly in particulates from construction process, the workers and a group staff working both outdoor and indoor must wear ***appropriate masks*** *as a* ***good working practice during the project activities. Monitoring process must be conducted annually*** particularly if the new machineries are installed in the project process. ***Mitigation measures*** for all phases will be detailed in the respective sections.

1.6.4 Carbon emission

In terms of the CO_2 emission from the proposed project, the electricity sector does not directly produce the emission of CO2 and GHG. The ***potential gas emissions source from generator*** which are only standby has been considered as negligible.
During the construction phase, the power requirements for the project activities will be depending on the national grid line but one generator will be standby if there is electricity failure. Thus, there will be no CO_2 emission from power requirements during the construction phase.

During the operation phase the proposed project will have a generator plant with a maximum capacity of 500kW to generate electricity. The proposed project will use landfill gas fuel for generator.

In the construction phase (6 months), total emission of CO2 from vehicles usages is 435.993 metric tons of CO2.

In the operation phase, GHG reduction rate of proposed project is 29,492 tCO_2-equivalent per year and 294,917 tCO_2-equivalent per 10 years.

Thus, the potential CO_2 emissions of the main use of electricity from standby generator and vehicle usage during in construction phase, can be assumed as ***negligible.***

1.6.5 Noise

The baseline ambient noise quality monitoring was carried out at the Inn Jal village which is located nearest to the proposed project site in September, 2020 in order to reveal the existing baseline noise quality status around the proposed project.

Based on the findings, the 24hr average noise levels (both day and night time) at the Inn Jal village compound met the EQEG. Generally, these levels were mainly captured from vehicles (Cars), and human activities did not exceed the noise standard level by Environmental Quality (Emission) Guideline (EQEG).

Table 1.3: The baseline noise level of the Inn Jal village

Sr	Description	Concentration	EQEG Guideline
1	Day time	53[a]±0.3[b] 51[c](27[d]-68[e]) dB	55 dB
2	Night time	36[a]±0.2[b] 33[c](22[d]-47[e]) dB	45 dB

a Average b SE c Median d Min e Max

According to the ***impact assessment of noise on surrounding throughout the project activities***, generally it is rated as ***medium.*** Moreover, to protect noise from the proposed project process, the workers and staff must wear ***ear muffs as a good working practice during construction process***.

Monitoring process must be conducted for annually particularly if the new machineries are installed in the factory. it will become ***less significant*** if the mitigation measures stated are followed accordingly. Mitigation measures are detailed in the respective sections.

1.6.6 Vibration

The baseline ambient vibration quality monitoring was carried out at the Kyar Ni Kan landfill site which is located nearest to the proposed project site in September, 2020 in order to reveal the existing baseline vibration quality status around the proposed project.

Based on the findings**,** the ***24hr average vibration level*** of around the Kyar Ni Kan landfill site is ***below the detection limit <0.5m/s^2*** which ***do not exceed the whole-body vibration (WBV) Daily exposure limit value (ELV) (1.15 m/s^2) A (8).***

According to the *impact assessment of vibration on surrounding throughout the project activities,* generally it is rated as *medium*. Moreover, to protect vibration impact from the proposed project process, the project activities must avoid combined of vibrating machines at the same time. *Monitoring process must be conducted for annually* particularly if the new machineries are installed in the proposed project, it will become less significant if the mitigation measures stated are followed accordingly. Mitigation measures are detailed in the respective sections.

1.7 Geology and hydrogeology

1.7.1 Geology

The ***topsoil type of Patheingyi township*** is mostly **clay soil**. The ***lithology of Kyar Ni Kan landfill*** site is ***a pleistocene (0 - 2.588 Ma)*** and ***most quaternary sedimentary rocks*** are found. There are ***outcrops of scheelite-bearing calc-silicate rocks and marbles***.

In general, very fine soils (***clays and silts***) typically have ***lower capacities than coarse granular*** soils (***sands and gravels***). However, some clays or silts have higher bearing capacity than the values.

Mechanically compacting the soil can also ***raise its bearing capacity***. The soil compaction is the process in which stress is applied to a soil causes densification as air is displaced from the pores between the soil grains.

The ***existing condition of soil and aquifer layers*** where many ***local inhabitants*** use as their source ***of water for cooking, cleaning, and drinking*** are presented in detail in the chapter (5).

1.8 Baseline water quality

The total (12) water parameters including chemical, physical and bacteriological parameters which are significantly important for the human health and surrounding environment were analyzed from both surface and ground water accordingly.

(i) Surface water

The water sample from the Se Taw Gyi creek which is located within 2km of the proposed project site was collected for physical, chemical and bacteriological characteristics analysis.

According to the ***WHO drinking water standards***, the parameters more or less ***met the standards except bacteriological result*** indicating that the surface water is needed to be ***disinfected for drinking purpose***.

Table 1.4: The Surface water results along with the permissible limits of Se Taw Gyi Creek

No.	Test Parameters	Unit	Surface Water	WHO Drinking Standard	US EPA Drinking Standard	NEQG Guideline	Remark
1	Color	mg/L	Clear/5	NA	NA	NA	Normal
2	Turbidity	NTU	-	NA	NA	NA	Normal
3	pH		8.2	6.5-8.5	6.5-8.5	6-9	Normal
4	Total solids	mg/L	225	NA	NA	NA	
5	Total Hardness	mg/L	100	NA	NA	NA	
6	Total alkalinity	mg/L	100	NA	NA	NA	
7	Calcium	mg/L	24	NA	NA	NA	
8	Magnesium	mg/L	10	NA	NA	NA	
9	Chloride	mg/L	20	NA	250	NA	Normal
10	Sulphate	mg/L	19	NA	250	NA	Normal
11	Iron	mg/L	Nil	NA	0.3	3.5 mg/L	Normal
12	Total Coliform	CFU/ML	5/5	NA	NA	400/100ml	

NA= Not Available

(ii) Ground water

Two ground water samples were taken from the households which are located form the nearest two villages in order to reveal the existing ground water status.

The Ground water results along with the permissible limits of Kyar Ni Kan village and Inn Jal village are as follows:

Table 1.5: The Ground water results along with the permissible limits of Kyar Ni Kan village

No.	Test Parameters	Unit	Ground Water (Tube Well)	WHO Drinking Standard	US EPA Drinking Standard	NEQG Guideline	Remark
1	Color	mg/L	Clear/5	NA	NA	NA	Normal
2	Turbidity	NTU	-	NA	NA	NA	Normal
3	pH		7.5	6.5-8.5	6.5-8.5	6-9	Normal
4	Total solids	mg/L	1150	NA	NA	NA	
5	Total Hardness	mg/L	420	NA	NA	NA	
6	Total alkalinity	mg/L	650	NA	NA	NA	
7	Calcium	mg/L	40	NA	NA	NA	
8	Magnesium	mg/L	77	NA	NA	NA	
9	Chloride	mg/L	140	NA	250	NA	Normal
10	Sulphate	mg/L	192	NA	250	NA	Normal
11	Iron	mg/L	Nil	NA	0.3	3.5	Normal
12	Total Coliform	CFU/ML	5/5	NA	NA	400/100ml	

NA = Not Available

Table 1.6: The Ground water results along with the permissible limits of Inn Jal village

No.	Test Parameters	Unit	Ground Water (Tube Well)	WHO Drinking Standard	US EPA Drinking Standard	NEQG Guideline	Remark
1	Color	mg/L	Clear/5	NA	NA	NA	**Normal**
2	Turbidity	NTU	-	NA	NA	NA	**Normal**
3	pH		7.3	6.5-8.5	6.5-8.5	6-9	Normal
4	Total solids	mg/L	985	NA	NA	NA	

5	Total Hardness	mg/L	520	NA	NA	NA	
6	Total alkalinity	mg/L	450	NA	NA	NA	
7	Calcium	mg/L	72	NA	NA	NA	
8	Magnesium	mg/L	82	NA	NA	NA	
9	Chloride	mg/L	100	NA	250	NA	Normal
10	Sulphate	mg/L	230	NA	250	NA	Normal
11	Iron	mg/L	Nil	NA	0.3	3.5 mg/L	Normal
12	Total Coliform	CFU/ML	3/5	NA	NA	400/100ml	

NA = Not Available

According to the WHO drinking water standards, the ground water of the selected villages ***more or less met the standards except bacteriological*** result indicating that the ***ground water is needed to be disinfected for drinking purpose.***

According to the ***impact assessment of the proposed project on both surface and ground water quality during the three phases including construction, operation and decommissioning phase,*** generally it is rated as ***medium***. If the ***monitoring process and mitigation measures*** are carried out accordingly, the ***impact significance*** will be reduced to ***negligible***. . Mitigation measures are detailed in the respective sections.

1.9 Soil Quality

The ***total (15) soil parameters*** including chemical and physical parameters which are significantly important for the environmental health were analyzed and compared with the FAO soil standards accordingly.

Based on the findings, the existing soil ***is not polluted with heavy metals*** which are harmful to the plants and animals. The detail information of soil quality findings is presented in the following section.

Table 1.7: Soil analysis of Kyar Ni Kan landfill site

Sr.no	Parameters	Unit	Results	FAO Soil Bulletin 65 & Dutch Standards	Remark
1	Moisture	%	1.72		
2	pH	(1:2.5)	8.3		
3	EC	mS/cm	0.12		
4	Total N	%	0.25		
5	Available P	ppm	7.93		
6	Available K_2O	mg/100g	15.25		
7	Exchangeable cations K^+	meq/100g	0.32		
8	Cadmium	ppm	ND	0.8	
9	Chromium	ppm	ND		
10	Lead	ppm	3.24	85	**Normal**
11	Zinc	ppm	1.84	15-150	**Normal**
12	Copper	ppm	2.06	20-300	**Normal**
13	Iron	ppm	55.1	15-150	**Normal**
14	Manganese	ppm	89.88		
15	Texture				
	Sand	%	46.7		
	Silt	%	31.03		
	Clay	%	22.27		

According to the ***impact assessment of the project on soil quality*** throughout the construction, operation and decommissioning phase, generally it is rated as ***medium.*** If the ***monitoring process and mitigation measures*** are carried accordingly, the ***impact significance will be reduced*** to ***less significanc***e. Mitigation measures are detailed in the respective sections.

1.10 Solid Waste

The Kyar Ni Kan land fill site is receiving ***domestic wastes approximately 500 tons/day*** average from the townships of Aung Mye Thar Zan, Chan Aye Thar Zan and Maha Aung Myay and it has been approximately ***total 309,600 tons of MSW. Among the various kinds of wastes, nearly 80% is organic wastes.***

According to the impact assessment on solid waste throughout the construction, operation and decommissioning phase, generally it is rated as ***medium.*** If the ***monitoring process*** and ***mitigation measures*** are carried accordingly, the impact significance will be reduced to ***less significance***. Mitigation measures are detailed in the respective sections.

1.11 Biological environment

The baseline biodiversity survey was conducted in order to identify biodiversity as well as ecosystem services.

There are ***two Reserved Forest*** in this township named **Taung Kyun and Sa-Khan-Gyi and the total area is 33,344 Ac.** ***Another*** total ***two areas*** which are ***Protected Public Forest named Yan-Kin-Taung and Mae-U-Taung is 1835.38 Ac. The private commercial plantation*** is about 1***,024.7 Ac.*** The geomorphology of the area comprises of reserved forests between mountains. Due to shifting cultivation, urbanization and charcoal production, the natural forest had been lost in this township except the protected forest.

The Kyar-Ni-Kan site is located near the Taung Kyun Reserved Forest which comprises the Dry Hill Forest and the Deep Tropical Mixed Deciduous forest. The flora survey was carried out by the forest inventory method to identify the species composition, density and distribution.

A total of 33 plant species were observed during the survey.

(i) Observation of flora

The unique features of the forests are the ***In, Kyun, Pyin-ka-doe, Bamboo, Tamalan, and Kyoe*** which are the dominant species in this site. The regeneration of ***Pyin-ka-doe*** trees are found everywhere in the forests.

There were ***33 tree species*** noted during the biodiversity survey. During the field reconnaissance, the endemic ***Dipterocarpus tuberculatus, Acacia catechu*** were noted. The main iconic floras found near the proposed project site are the more mature ***Dipterocarpus spp***. ***It was found out that there is no major weed problem,*** and ***no new species*** in the areas.

(ii) Observation of fauna

Regarding the fauna survey area, according to both field surveys and community interviews, 20 species of bird, 11 species of mammal, 21 species of reptile/amphibian, and 15 species of fish were identified.

The detail information was presented in the respective chapter (5).

(iii) Cultural Heritage

There are ***ancient pagodas*** around the Kyar Ni Kan Landfill Site**.** Tha Khin Ma Taung ancient pagoda and Phoe Doe ancient pagoda are situated on the way from Mandalay to Kyar Ni Kan Landfill Site.

1.12 Cumulative impact assessment

This section assessed the cumulative impacts of ***air emissions, noise, waste water discharge*** and ***solid wastes*** resulting from the activities of the proposed project on the local environment. It is the process of ***assessing the incremental effects of various actions of the project.***

At the ***local level,*** cumulative impacts identified were of ***medium significance.*** It was assumed that there will be ***no significant cumulative impacts*** on the environment were found at the ***national and regional levels*** as the proposed project *is* Landfill Methane Recovery Project.

1.13 Cumulative impact on air quality

Cumulative impacts refer to the ***incremental effect of several projects/activities*** that may have ***an individually minor***, but ***collectively significant, impact on air quality.***

There will be ***cumulative negative impact on air quality*** as other air pollution sources such as ***cemeteries and local daily human activities*** (transportation, open burning and farming etc.) located in the surrounding area of the proposed project.

In addition, as the ***two landfill gas recovery projects*** (Kyar Ni Kan and the Thanung Inn Myauk Inn) which are about 30 km apart respectively locate in the North and the South of the Mandalay city

There are *some increases in the cumulative effects of KNK and TIMI* over the Mandalay city for *CO in Phase 3*. Furthermore, in Phase 3, there will be *one more generator in KNK* which would contribute *additional emissions* at this site. Therefore, there will be *higher concentrations and larger plumes of CO and NOx from KNK.*

However, the *magnitude of the effects* was *not significant* and due to its *downwind location.* KNK emission plume will less significantly affect the Mandalay city comparing to the upwind- located TAMA.

1.14 Cumulative impact on noise quality

Cumulative noise impacts are considered for the proposed KNK landfill gas recovery project and other existing sources in the vicinity. The ***noise generated from the proposed project during the construction, operation and decommissioning phases*** and the process of other activities including transportations would increase noise level.

1.15 Cumulative impact on water quality

The KNK landfill gas recovery project is currently assumed to use the water from both tube wells and public supply. Nevertheless, the operation phase will be using the amount lesser than the

construction phase is. Thus, there will be ***a cumulative impact will be increased in water usage*** would be ***only in the construction phase***.

1.16 Cumulative impact on traffic

There will be ***a cumulative increase in automobile and truck traffic*** in the vicinity nearby the project site particularly during ***the construction phase***. However, based on the existing infrastructure, it is more than adequate to handle the increased number of vehicles. Therefore, the cumulative impact in terms of "***congestion" is negligible.***

1.17 Cumulative impact on solid waste and waste water

The impact of waste disposal from the proposed project would likely to be ***moderately contribute*** the incremental effects of various activities nearby ***mainly in the construction phase but it will be only short term impact..***

The cumulative effect of ***wastewater disposal*** is ***less impact during*** the ***operation*** phase of the project than of the construction phase.

1.18 Environmental Management Plan (EMP)

Major environmental management plan to be conducted ***throughout construction, operation and decommission phase*** were detailed in ***proposed mitigation measures*** along with ***monitoring implementation, supervision and report*** system for ***air pollution control, noise, vibration, soil, water resource, solid waste, wastewater, ecological resource and health and safety*** accordingly.

Table 1.8 Monitoring plan for environmental, social and health impact

Factors	Parameter & Guideline	Procedure	Proposed Duration	Frequency of Monitoring	Location
Air Quality	**National Environmental Quality (Emission) Guideline (EQEG)** For both Generator and Flare, • PM (PM10, PM2.5) • NOx • SO2 • CO • VOC • O3 • Methane • H2S • CO2	Method Myanmar National Environmental Quality (Emission) Guidelines	**Duration:** 24hr continuously **Frequency:** • Every six months during operation and once during decommissioning phase • In case of any complaint regarding air quality, an additional air quality measurement may be conducted in response to specific complaints (if necessary)	Will submit monitoring reports to the Ministry not less frequently than every six (6) months or periodically as prescribed by the Ministry.	Nearest sensitive receptor or downwind of the project (complaint area) (if necessary)
Noise	LA_{eq} 1 hr ≤ 70dBA	Method Myanmar National Environmental Quality (Emission) Guidelines, Effective since 2015 in	**Duration:** 24hr continuously **Frequency:**		Within 1km of a community

		accordance with The Environmental Conservation Law, 2012	• Every six months during operation and once during decommissioning phase • In case of a complaint regarding noise from project site, an additional noise measurement may be conducted (if necessary)		
Factors	**Parameter & Guideline**	**Procedure**	**Proposed Duration**	**Frequency of Monitoring**	**Location**
Effluent from the LFG recovery flaring plant	**National Environmental Quality (Emission) Guideline (EQEG)** For Daily Maximum Concentration, • BOD5 • COD • Oil and Grease • PH • Temperature • Total Coliform • Total Phosphorus • Total Nitrogen	<u>Method</u> Analytical Methods followed to Standard Methods for effluent levels for municipal landfills, recommended by National Environmental Quality (Emission) Guideline (NEQG)	Every six months during operation and once during decommissioning phase	Will submit monitoring reports to the Ministry not less frequently than every six (6) months or periodically as prescribed by the Ministry.	Near effluent source

	• TSS				
Hazardous and Non-hazardous waste	• Manifest Disposal and Tracking Report	• Track waste volume by type and disposal location daily	• Throughout all phases	Regular Check-up If any, Incident Report	At all project locations
Social	• Environmental watch committee collaborated by the Municipality • Complaint • Monitoring and solving	• Record complaint Monitor, investigate and implement suitable solutions			Project area, community around project area, and transportation route
Public and Occupational health and safety	• Accidental statistics • Cause of accidents • Mitigation measures	Conduct summary report for accident investigation			Project area, community around project area, and transportation route

1.19 Emergency response plan

The objective is ***to prepare the resources (personnel and equipment)*** available to respond emergency situations and accidents which can be resulted by the project activities and major disasters as well.

In the proposed Landfill Gas to Energy project, in general, there should be either ***Emergency service in charge*** or ***HSE manager*** and ***Response Team*** for the emergencies. The team should be prepared as follows:

- ***Training of the team members*** along with their responsibility and equipped with the emergency materials
- Establishment and provision of the ***written emergency procedures***
- Description and Availability of the ***Emergency Response Plan (ERP) in all employees*** and ***factory workers*** and there should be ***documented and posted***
- Identification of the locations of the ***emergency evacuation Muster points***
- Provision of ***alarm system and firefighting equipment***
- Supporting of ***first aid equipment***
- Minimizing that should be reasonably practicable the risk to human life, the environment, assets and business in the event of an ***accident or emergency situation*** by ***ensuring effective and efficient intervention***
- Ensuring the availability of adequate information on the ***emergency situations through a good communication system***
- Ensuring efficient management of the emergency through the ***effective and efficient response of all dedicated resources***
- Identification of the ***governmental authorities, media and other relevant stakeholders*** to be notified and production of a ***description of the procedures for communicating with them.***

The ***potential emergencies*** that likely occur at the proposed project.

- Fire/ Explosion
- Toxic release, Oil spill
- Person(s) falling from the height
- Collapse of lifting appliances, buildings, sheds
- Cement Dust
- Vehicles accidents and injuries

Thus, this chapter described the strategy how to manage all possible emergencies along with actions required and written procedures to be carried out in order to respond the emergency situations that may arise during the production process. It provided guidance on actions and lines of communication in the event of an emergency and outlined the respective responsibilities of the proposed project. Furthermore, Medical emergency response plan including general provisions and first aid emergency treatment and Emergency response plan for dust and chemical exposure were described.

1.20 Public consultation and disclosure

The main objectives of the ***public consultation and socio-economic surveys*** are to know the ***current socio-economic situation*** in the region, to investigate ***people perception*** on the proposed project and how it can affect for their lifestyles.

The survey conducted at the ***In Jal village which is the immediate vicinity*** to the proposed project, Kyar Ni Kan Landfill Gas to Energy project in order to identify the perception of community likely affected by the project activities as well as their social impacts.

Firstly, a meeting with the ***village head, MCDC officials and some respective household members*** was held and the scope of the project along with ***the aim of the CDM approach*** was briefly explained.

There are ***two sets of surveys*** for the ***households from the nearest village*** and the ***people who are living closely as well as relying on the waste disposal site for their incomes***. The survey was carried out using the ***preformed questionnaire comprising a mixture of quantitative and qualitative question types.***

1.21 Socio-Economic Surveys on Key Informants and local community (Inn Jal Village)

Total households at the In Jal village is approximately 252 in numbers.

Total 40 households (30 households from In Gel village and 10 households nearby landfill site), who are representative about the information of village and attitude towards the proposed project were randomly selected in order to conduct socio-economic surveys for the proposed project in Kyar Ni Kan.

Regarding the demographic feature, the common facilities of the In Jal village community are quite improved. The survey identified that all respondents are "***Burmese***" and religion is "***Buddhist***".

Looking at the age ranges, majority 32% is 40-50 yrs old and then followed by 30-40 is (18%), 20-30 and 50-60 are (14%) each and the least is 70 above which is (3%).

Out of total survey, Majority (87%) households have their own house while 13% households do not own a house. Moreover, "***CGI***" is used as roof for 93% of houses and only 7% of surveyed households is roofed with "***Bamboo***".

Regarding the occupation, , Mostly (63%)of the surveyed respondents are "***Farmers***".
Concerning income for surveyed respondents, ***32% is less than 500,000 kyats*** followed by (***28%***) which is between ***500,001 to 1,000,000*** per year.

In the education aspect, it is observed that ***Majority 44% of respondents*** are "***Primary school***" education level and 37% have "***Middle school***" level.

Regarding highest education level in family, most households (41%) have "***Middle school***" education level followed by "***High school***" level (24%).

Concerning the type of diseases, the ***common sickness*** of household members is ***flu (22%)*** and catching a cold (20%) followed by hypertension (10%).

The ***majority (57%)*** get treatment from "***Private clinic with doctor***".

It is observed that the **90%** of the respondents use "***Electricity from National Grid*****".**
For drinking water, 81% of respondents obtain from "***deep well***".

For the aspect of online communication, ***87%*** of respondents are using ***internet via their phones***. **"*Facebook"*** application is ***most common (96%)*** among them including ***14%*** of those respondents who use both application which are "***Facebook and Viber***".

Regarding awareness of the community on the proposed project, ***Majority*** (***62%)*** of the total households ***know a little*** but ***38% of respondents do not know*** about the project. Among surveyed respondents, ***(46%)*** obtain the information through "***Government Agencies***".

Then, ***Majority (60%)*** of respondents mentioned that Kyar Ni Kan Landfill Gas to Energy Project is "***Important***", ***8%*** stated that the project is "***Very important***", but ***16%*** mentioned that it is "***Not important***" for the community.

Regarding positive impacts by the proposed project, ***38% of surveyed respondents*** mentioned "***improved environment***".

Regarding ***negative impacts by the proposed project, majority (82%)*** responded that there are ***no negative impacts*** by the project. However, 5% pointed the negative impact on increased cost due to impact on environment and health while 4% are on health negative impact.

Concerning ***necessary development for the community, majority*** of respondants metioned about improvement of "***education sector***" (75%) as first priority, "***solid waste disposal***" (25%) as second priority, and improvement for "***transportaion***" (***41%***) followed by "***employment oppotunities***" ***(36%) as third priority***.

Regarding farming activities, majority of them (***71%) possess own farmlands***.
Majority of lands ***(86%)*** are "***crop land***" and other (***14%***) is for "***perennial plantation***".
Rice (95%) is the most common crop, grown in the community.

It is observed that ***70% of respondents*** breed animals and "***cow***" (60%) is most common animal for breeding in the community.

Looking at the ***attitudes of the respondents*** towards the development of the project, **76%** of the respondents said that ***they agree with the development*** of the project, 4% of the households do not agree whereas 20% are not sure for the development of the project.

1.22 Socio-Economic Surveys on nearest community relying on the landfill site for their income

There are approximately (20) households in the nearest community The survey identified that all respondents are "***Casual workers***" at the current Kyar Ni Kan landfill site. The ***annual income for majority*** of respondents (***70%) is between 2,000,000 to 3,000,000.*** Majority of respondents earns 5***,000 kyats or 10,000 kyats per day by collecting recyclable wastes.***

In the ***education*** aspect, ***50%*** of respondents have "***Monastic education***", ***40%*** have "***Primary school***" education level and ***10***% have "***Never attended a school***".
For Highest ***education level*** in family, most households (***40%***) have "***Primary school***" education level followed by "***Middle school***" Level (***30%).***

According to the survey, the ***common sickness of household members*** is "***Muscle Pain***" (60%).

All of surveyed respondents get treatment from "***Private clinic with doctor***" for any sickness.

Regarding ***household structure***, all surveyed households do not own their houses and they all are living in "***huts***" with "***tarpaulin roof***".

Concerning ***healthcare availability*** and ***access to education***, all respondents have access to healthcare services but ***majority*** of the surveyed households (56%) responded that their daughters/sons are ***not able to attend the school*** due to "***poor economic status***".

It was observed that ***all respondents*** use "***Solar***" for ***lighting*** purposes and use "***Firewood***" for ***cooking***. ***Majority*** of them (60%) get *the firewood* from "***old landfill site".***

Concerning to ***drinking water availability***, all households living nearby landfill site drinks "***Purified drinking water***".

Regarding ***awareness about the proposed project***, ***all respondents do not know*** about the project at all and get information from nowhere. Thus, ***80% of respondents cannot answer the question concerning about the importance to community by this project.***

Concerning respondents' attitudes about positive impacts by the proposed project, most of them unaware about that while ***20% anticipates*** for "***increased employment***" and ***10% expects*** for "***improved environment***".

For negative impacts by the proposed project, ***majority*** of respondents (60%) are worried for the "***employment and income disruption***" while other 40% is unaware about any negative impacts.

Regarding ***necessary development of community***, respondents mentioned about "***employment opportunity***" followed by "***medical service***".

Based on their information, all respondents answered that they ***collect recyclable wastes from current dumping area at Kyar Ni Kan landfill site*** and do ***not collect from old dumping*** area.

Among surveyed respondents who collect recyclable wastes, ***100%*** of them collect "***Metal, empty metal bottles and container***", ***70%*** "***Plastic bag and stuffs***" and "***construction wastes***" and ***50%*** of them collect "***Paper, books and paper board***".

Regarding unhealthy habits among community, there are only ***30% of responded households*** for "***smoking and alcohol consumption***". However, ***majority*** of community has habit of "***Betel chewing***".

Among the outcomes of the respondents, there is ***no fishing and plantation*** but there have some chickens around landfill site.

All surveyed respondents answered that there are ***bad odors, rodents and flies at the current landfill*** site.

For impact on their ***job and income***, ***majority of respondents (80%) anticipates*** about ***negative impacts due to proposed project.***

There are ***60% of respondents*** who anticipates about ***negative impacts on lifestyle and quality of life due to the proposed project.***

However, ***90% of them*** do ***not anticipate*** about the impacts on ***health status*** while ***10% expects positive impact on health*** by Landfill Gas to Energy project.

Based on the community's perception, in general, the negative impact on socio-economy is low., the ***physical resources such as soil quality, surface water quality and ground water quality, air and noise quality*** have ***less negative impact*** due to the proposed project. There will be ***very low negative impact on human use, quality of life and cultural heritage.***

In conclusion, this report provides the EMP for the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project based on the ***extensive literature surveys, existing baseline environmental monitoring, public consultation meetings with the respective stakeholders including administrative personnel, local community, interested persons etc. and socioeco surveys*** along with consultation with the community.

The EMP report provides the ***framework for the compliance auditing and monitoring programmes*** that will lead the proposed LFG recovery project to carry out its operation activities in accordance with the ***Myanmar environmental rules*** and ***regulations; International practices,*** and ***Health*** and ***safety regulations.***

Furthermore, the ***prevention and mitigation measures defined*** are capable of providing the appropriate environmental management system to ensure that ***environmental and social negative impacts are prevented or minimized.***

Chapter 2

Introduction

2. Introduction

2.1 Background

The Environmental Management Plan (EMP) has been prepared for the Kyar Ni Kan Landfill Gas Recovery and Flaring & Generator Plant which will be operated by the KOREA EAST-WEST POWER CO., LTD. and the HANATEC CO., LTD based on the site assessment of the proposed project in cooperating with environmental and socieco aspects.

The proposed project has started with the Memorandum of Understanding between Korea's the Ministry of Environment (MoE), Korea Environment Industry and Technology Institute (KEITI) and the World Bank (WB) Group to support waste management in Myanmar since 2017. In 2018, KEITI, WB and the Ministry of Natural Resources and Environmental Conservation (MONREC) jointly promoted the Technical Assistance (TA) for Mandalay's solid waste management investigation and project development collaborating with Mandalay City Development Committee (MCDC).

In principle, the project will be the LFG recovery CDM project in Myanmar. The project is to capture and flare the landfill gas (LFG) generated from the landfill site applying the Clean Development Mechanism (CDM) which allows emission-reduction to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO2.

The Kyar Ni Kan landfill site receiving wastes from the district of the Aung Mye Thar Zan, Chan Ayethar Zan, Maha Aung Myea is situated approximately 10 km north part of Mandalay. The exact GPS information of Kyar Ni Kan landfill site is Latitude: 22.086969 and Longitude: 96.162812. The proposed project covers the total area of 7 ha. The outcome of the project is to reduce emission of methane, a greenhouse gas (GHG) which contributes to global warming and climate change.

According to the Myanmar Environmental Conservation Law (2012), it requires that the proponents of every development project in the country to conduct either Environmental Management Plan (EMP), Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA), to the Ministry of Natural Resource and Environmental Conservation (MONREC) depending upon the nature of the project which can impact on the environment.

Furthermore, Myanmar prepared the National Energy Policy Paper (NEMC) in 2014 to ensure the development of energy and power sectors. In addition, the government of Myanmar has adopted the expansion of bioenergy as a renewable energy policy and one of energy mix.

The proposed project requires an EMP to meet the environmental assessment requirements of Myanmar Environmental Conservation Law. Therefore, Korea East-West Power Company Limited and HANATEC Company Limited commissioned Environmental Quality Management (EQM) Co., Ltd to conduct the Environmental Management Plan (EMP).

This EMP report is prepared to initially assess the potential negative impacts of the proposed project on environmental components and communities nearby. It is also necessary to develop

adequate and feasible management plan together with monitoring plan including budget plan for environmental mitigation measures according to the project proposal as well as cooperate social responsibility (CSR) plan.

The consultant team of Environmental Quality Management Co., Ltd had carried out the EMP for this Kyar Ni Kan landfill project in accordance with the appropriate procedures stated by Environmental Conservation Department (ECD), Ministry of Natural Resources and Environmental Conservation (MONREC).
This EMP is formulated in accordance with the existing environmental policy, laws, rules, regulations and instructions. It is submitted in order to receive the Environmental Compliance Certificate (ECC) from the Environmental Conservation Department (ECD).

In terms of the ***government registration/approvals*** for the project is as shown below:

Table 2.1: Company registration details

1	Environmental Company Registration Number	2690/2012-2013
2	Date of Recommendation from Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation to conduct the EMP.	9th June 2020

The contact details of the project proponent are as follows:
• Company name : Korea East-West Power Company Limited and HANATEC Company Limited
• Investor name : Korea East-West Power Company Limited and HANATEC Company Limited
• Registration No : (EWP) 120-86-19199
(HNT) 134-86-11819
• Registration Date : (EWP) 2001.04.02
(HNT) 2004.02.19
• Expiry Date : (EWP) N/A
(HNT) N/A
• Address : (EWP) 395 Jongga-ro, Jung-gu, Ulsan 44543 Korea (**Korea East-West Power Company Limited**) and (HNT) 36 Namdongdon-ro, 138 beon-gil, Namdong-gu, Incheon, Korea (**HANATEC Company Limited**)
• Type of Business : Mandalay Kyar Ni Kan Landfill Methane Recovery Project
• Investment location : Kyar Ni Kan Landfill Site

The investment and operation period of this project (10 years) will be made with 100% investment by Korean companies. Therefore, unlike other similar projects, it will be a sustainable project for the operation period, as there is no additional budget of Myanmar central government or local government after 2-3 years of installation.

Regarding the EIA consultancy firm, it is based in Yangon, Myanmar and has got strong background and knowledge in the area of Environmental Assessment, and a track record of

over 7 years for conducting studies of Environmental, Social and Health Impact Assessment (ESHIA) for development projects across the country.

The contact detail of the environmental survey team is as follows:
• Environmental Quality Management Co., Ltd
• Dr. Ohnmar May Tin Hlaing, Managing Director & Environmental Consultant
• Ph: (951) 2330291, (951) 2331417, (951) 2332182, (959) 50 16606
• Fax: (951) 23339942-1
• Email – contact@eqmmyanmar.com, ohnmarmay@gmail.com
• www.eqm-myanmar.com
• No 233, Block 23, Sayee Pin Lane, Thuwunna, Thingungyun, Yangon, Myanmar
• Company registration no: 2690 Expiry date: 2.11.2020

2.2 Objectives of the EMP on the project

In order to be sustainable development, the environmental and social impacts shall be necessarily reduced accordingly together with the project development. Moreover, along with resources which become limited and polluted, environmental assessment has become of ever-increasing importance as a tool for development and decision making. This role is formally recognized in principle 17 of the Rio Declaration on Environment and Development (UNCED 1992).

As a national instrument, this proposed project needs "Social Impact Assessment (SIA) along with Environmental Management Plan (EMP)" although the project is less likely to have adverse impact on the environment.

This EMP can be applied not only to prevent or minimize the adverse effects of major development project but also used as a planning tool to promote sustainable development by integrating environmental considerations.

There are two categories in this EMP objective.
1. To identify the potentially significant environmental impacts likely affected by the landfill gas recovery and generation project
2. To promote sustainable development by ensuring that the project activities do not undermine critical resource and ecological functions or the wellbeing, lifestyle and livelihood of the communities and people who depend on them. (Long-term aim)

The main objectives of this project are the following:
1. To reveal the **existing environment and activities** in the area of the project
2. To detect the **impacts of the project activities on neighboring environment including** air atmosphere, noise, water bodies, soil, people and infrastructure
3. To propose the **mitigation measures** where adverse effects may have occurred
4. To set up **an environmental management plan together with the monitoring plan** that will govern all activities of the project for the better protection of the environment.
5. To reveal the community perception and impacts by conducting socio-eco surveys.

2.3 Methodology for the study

Based on the EMP procedures issued by the Environmental Conservation Department (ECD), MONREC, the methodology used by the consultants consisted of the followings below:

a) **Literature review**: Documentation on the existing and relevant policies, laws, regulations and guidelines related to environmental assessment process and management, factory service, waste management, land use etc. at the national level as well as the international level have been done.
b) **Interviews**: The consulting team has interviewed the community residing near the proposed project as well as in the administrative personnel related to this project.
c) **Data collection**: Through site visit, required qualitative and quantitative data have been collected
d) **Stakeholder consultation**: the consultants conducted stakeholder meetings and door to door household questionnaire surveys on the neighboring communities, to find out their perception on this project.
e) **Environmental baseline monitoring** on air, noise, water, waste and soil
f) **Environmental impacts assessment along with the mitigation measures on the issues including** air, noise, visual, potable water, wastewater, waste, etc.
g) **Environmental Management plan** on the environment likely affected by the project activities was developed accordingly.
h) **Reporting**: the data and information collected were organized and compiled in a report.

Chapter 3

Policy, legal and institutional framework

3. Policy, Legal and Institutional Framework

This section lists all legislation relevant to the undertaking of industrial projects in Myanmar. The legislation & policy framework can be divided into the categories as follows:

- Policy & Legal Framework (**Section 3.1**)
- Contractual and other Commitments (**Section 3.2**)
- Institutional Framework (**Section 3.3**)
- Project's Environmental, Social & Health Standards (**Section 3.4**)

3.1 Policy and Legal Framework

3.1.1 Environmental Policy & Framework

Environmental legislation and arrangements for environmental conservation in Myanmar are developing rapidly. As part of Myanmar's reform process that involves the updating and enforcing environmental policy and legislation. The Framework for Economic and Social Reform (FESR 2013) and the National Comprehensive Development Plan (NCDP 2011-2030) continue Myanmar's goal of environmental conservation.
At present, all laws relating to the environment are being formulated and administered by the sectorial ministries and departments concerned. **Section 3.1.2** provides a list of environmental legislation relevant to the Project activities.

3.1.2 National Environmental Legislation

3.1.2.1 Overview

The national legislation applicable to the Project comprises the following sources of law, listed hierarchically in accordance with the Constitution and other laws of Myanmar:

- The Constitution of the Republic of the Union of Myanmar (2008);
- The Myanmar Investment Law (2016);
- Myanmar Environmental Conservation Laws (2012);
- Environmental Conservation Rules (2014);
- Environmental Impact Assessment Procedure (2015);
- National Environmental Quality (Emission) Guideline (2015).

The Constitution of the Republic of the Union of Myanmar (2008);
The latest enacted Constitution of the Republic of the Union of Myanmar (May 2008) provides the most up to date information on governing laws and regulations in Myanmar. The Constitution prevails over any other national legislation or international agreements. The key sections are 21 (a, d), 37 (a, b), 45, Section 347, Section 390.

The Myanmar Investment Law (2016);
The Myanmar Investment Law, enacted in 2016, vastly simplified the process for investment applications and offers a number of tax breaks, incentives, guarantees, rights and protections for business ventures. The Myanmar Investment Commission (MIC) is a government-appointed body formed under the Myanmar Investment Law.
The law includes provisions to restrict or prohibit investment activities which affect public health, the environment and ecosystems, which produce toxic waste or which engage with toxic chemicals; duties of investors to conduct business in such a way as to avoid environmental damage, air and water pollution, in accordance with existing laws as per the following sections.

The key sections are 50 (d) 51 (a to f), 65 (e, f, g, i, j, k, l m, o, p, q).**Myanmar Environmental Conservation Laws (2012);**
The Environmental Conservation Law (Pyidaungsu Hluttaw Law No. 9 / 2012) Key sections of importance are 7 (o), 14, 15, 24 and 29 related to pollution control and penalties (if) the proponent causes any pollution.
Environmental Conservation Rules (2014);
The Environmental Conservation Rules relating to the Environmental Conservation Law, were enacted on 5 June 2014, contain specific items relating to IEE, EIA and pollution prevention which fall under the powers of the Ministry Natural Resources and Environmental Conservation. The key sections of importance are 69.

Environmental Impact Assessment Procedure (2015);
Environmental Impact Assessment Procedures have been prepared by MONREC under the Environmental Conservation Law, 2012. It requires that the Project proponent has to include in its evaluation environmental, social and health aspects of the environment, and has to identify and assess all adverse impacts and risks for environment, social issues and, if relevant, health that potentially could arise from the Project. Therefore, this law will be effectively considered an EIA procedure framework. The key sections are paragraphs 87, 102 – 110, 113, 115, and 117.

National Environmental Quality (Emission) Guideline (2015)

MONREC has established environmental quality standards, the National Environmental Quality Standard [Legal Reference: ECL 2012 (Section 2c) and EQEG 2015]. These Guidelines are noted to be the same as that recommended by the IFC General EHS Guidelines (2007) (World Bank Group, 2007) and the IFC sector specific guidelines (World Bank Group, 2015). The key relevant sections are 1, 4, 5, 6, 7, 9, 12 and 13.

3.1.2.2 Environmental Impact Assessment Procedure (2015)

The EIA Procedure for Myanmar was promulgated on 29th December 2015. The Ministry of Natural Recourses and Environmental Conservation (MONREC) implements the procedure. The EIA Procedure sets 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).
Under Myanmar's EIA Procedure, there is a requirement for the undertaking of an IEE or an EIA in order to obtain an ECC for certain development projects.
The project proponent has to comply with CHAPTER VIII. Environmental Compliance Certificate, Conditions and Revisions to Conditions as follows:
Paragraph 87. Upon receipt of the written approval from the relevant authority, the Project Proponent has to commence implementation of the Project strictly in accordance with the conditions attached to the ECC and including the EMP, within such time as may be prescribed by the Ministry.
The project proponent has to comply with the Responsibility for all Adverse Impacts as follows:
Paragraph 102. The Project Proponent has to 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 will 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.

Paragraph 103. The Project Proponent has to 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.

Paragraph 104. The Project Proponent has to be responsible for, and will fully and effectively implement, all requirements set forth in the ECC, applicable Laws, the Rules, this Procedure and standards.

Paragraph 105. The Project Proponent has to timely notify and identify in writing to the Ministry, providing detailed information as to the proposed Project's potential Adverse Impacts.

Paragraph 106. The Project Proponent has to during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure), engage in continuous, proactive and comprehensive self-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.

Paragraph 107. The Project Proponent has to 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.

Paragraph 108. The Project Proponent has to 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.

Paragraph 109. The project proponent has to submit the report according to paragraph 109 of Environmental Impact Assessment Procedure (2015).

Paragraph 110. 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.

The project proponent has to comply with Paragraph 113. For purposes of monitoring and inspection, the Project Proponent:

a) has to 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, has to 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.

Paragraph 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 has to grant full and immediate access to the Ministry at any time as may be required by the Ministry.

Paragraph 117. The Project Proponent has to further ensure that the Ministry's rights of access hereunder will extend to access by the Ministry to the Project's contractors and subcontractors.

3.1.2.3 National Environmental Quality (Emission) Guideline, 2015

The project proponent has to comply with Paragraph 5.
The project proponent has to ensure emissions comply with General and industry-specific Guidelines as set out in Annex 1 – Emissions Guidelines for any project subject to EIA Procedure, as adopted by the Ministry, in order to protect the environment and to control pollution in the Republic of the Union of Myanmar.
The project proponent has to comply Paragraph 7
The project proponent recognizes that these Guidelines are intended to prevent pollution through reducing the mass of pollutants emitted to the environment, dilution of air emissions and effluents to achieve maximum permitted values is not acceptable. The specified guideline values have to be achieved, without dilution, at least 95 percent of the time that a project is operating, to be calculated as a proportion of annual operating hours.
The project proponent has to comply Paragraph 12.
As specified in the EIA Procedure, project proponent will engage in continuous, proactive and comprehensive self-monitoring of the project and comply with applicable guidelines and standards. For purposes of these Guidelines, the project proponent will be responsible for the monitoring of their compliance with general and applicable industry-specific Guidelines as specified in the project EMP and ECC.
The project proponent has to comply Paragraph 13
The project proponent will ensure that Air emissions, noise, odor, and liquid / effluent discharges will be sampled and measured at points of compliance as specified in the project EMP and ECC.

3.1.3 Project-Relevant Laws

The Myanmar Environmental Conservation Law, Environmental Conservation Rules, Environmental Quality (Emission) Standards are the first step to address all the complex environmental and social management issues faced by Myanmar. A number of other laws exists which, either directly or indirectly, relate to environmental and social management of the project. The other relevant Myanmar government agencies/ requirements applicable to the Project are summarized below:

- Environmental Conservation Law, 2012, Section 14,15, 16(a, b, c), 29, 30
- Environmental Conservation Rule, 2014, Rule 69
- Myanmar Investment Law, 2016, Section 50 (d), 51 (a to f), 65 (e, f, g, i, j, k, l, m, o, p, q), 73, 82, 83, 84(a, b)
- Electricity Law, 2013, Section 35,36,37,38,39,40,41,42,43,44
- Private Industrial Enterprise Law, 1990, Section 3 (a, b, c, d, e, f, g)
- The Factories Act, 1951, Section 23,30,2,33,35,37,39,40
- State-Owned Economic Enterprises Law, 1989, Section 3
- The Petroleum and Petroleum Product Law, 2017, Section 10 (a, d), 11, 13, 15, 16,17,18 and 31 (a, d)
- The Underground Water Act, 1930, Section 1,3,4,5
- The Freshwater Fisheries Law (1991) Section 3, 40
- Farm Land Law (2012), Section 9,14,30,113,114,115,116
- Forest Law, 1992
- The Protection of Biodiversity and Conservation Areas Law, 2018, Section 39 (d, e) and

41 (a, b)
- The Protection of Wildlife and Wild plant and Conservation of Natural Area Rule (2002)
- Land Acquisition Act 1894
- The Vacant, Fallow and Virgin Lands Management Law, 2012, Section 16 and 19
- Conservation of Rivers, Creeks and Water Resources Law, 2006 (Section 24 (b), 21(a)(b), 19, 11(a) (b))
- The Protection and Prevention of Cultural Heritage Area, 2015, Section 20, 23 and 29(b)
- The Protection and Prevention of Antique Objective Law, 2015, Section 12, 13(a)
- The Protection and Prevention of Ancient Monument Law, 2015, Section 12, 15 and 20
- The Protection and Preservation of Cultural Heritage Regions Law, 2019, Section 32(b), 46 (a, b)
- The Protection of Rights of National Race Law, 2015, Section 5
- Import and Export Law, 2012, Section 7
- Ward and Village Tract Administration Law, 2012
- Public Health Law, 1972, Section 3 and 5
- The Prevention and Control of Communicable Disease Law, 1995, Section 3, 4, 9, 11
- The Control of Smoking and Consumption of Tobacco Product Law, 2006, Section 9
- The Myanmar Fire Force Law, 2015, Section 25
- Shops and Establishments Law, 2016, Section 13 to 17, 21 and 24
- The Employment and Skill Development Law, 2013, Section 5, 14 and 30 (a and b)
- The Workmen Compensation Act, 1923, Section 10 (a, b) and 11
- The Labour Organization Law, 2011, Section 17 to 22
- The Settlement of Labour Disputes Law, 2012, Section 23, 38, 39, 40, 41, 42, 43, 44, 45 and 51
- Minimums Wages Law, 2013, Section 12, 13 (b, c, d), 43 (e, f, g)
- Payment of Wages Law, 2016, Section 3, 4, 5, 7, 13, and 14
- Social Security Law, 2012, Section 11(a), 15, 18(b), 48(b), 49 and 75
- Leaves and Holidays Act, 1951
- The Motor Vehicles Law, 2015 and Rules, 1987
- Myanmar Insurance Law, 1993, Section 15 and 16Forest Law, 2018, Section 12 (a)
- The Prevention of Danger of Hazardous Chemical and related Substances Law, 2013, Section 16,17,23 and 27
- Health the Care Waste Management Guidelines by Ministry of Health and Sports

The project relevant laws are detailed in **Table 3.3**.

3.1.4 International Environmental Conventions, Protocols and Agreements

Myanmar has ratified several international and regional conventions. Those relevant to the project are provided **3.1.**

Table 3.1: International and Regional Agreements and Conventions

No.	Conventions	Year (Ratified/ Acceded/Accepted)	Relation to Project
Environment			
1	Vienna Convention for the Protection of the Ozone Layer, Vienna 1985	Accession 16th Sep 1998 (Vienna) & Accession 24th Nov 1993 (Montreal)	Limit the use of ozone depleting substances
2	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal	Entered into force 6th April 2015	Restrict the movement of hazardous materials
3	Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987	1993 (Ratification)	Limit the use of ozone depleting substances
4	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London 1990	1993 (Ratification)	Limit the use of ozone depleting substances
5	United Nations Framework Convention on Climate Change (UNFCCC), New York 1992	1994 (Ratification)	Reduction in GHG emissions
6	Convention on Biological Diversity, Rio de Janeiro 1992	1994 (Ratification)	Protection of International Biodiversity
7	The Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris 1972	1994 (Acceptance)	Protection of World Heritage Areas
8	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington DC 1973; and as amended in Bonn, Germany 1979	1997 (Accession)	Protection of Endangered Species of Wild Fauna and Flora

No.	Conventions	Year (Ratified/ Acceded/Accepted)	Relation to Project
9	ASEAN Agreement on Conservation of Nature and Nature Resources, Kuala Lumpur, 1985	1997 (Signatory)	Conservation of Natural Resources
10	Kyoto Protocol to the Convention on Climate Change, Kyoto 1997	2003 (Accession)	Reduction in GHG emissions
11	ASEAN Agreement on Trans-boundary Haze Pollution	2003 (Ratification)	Restrict the movement of hazardous materials
12	Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	2004 (Accession)	Restrict the use of POPs
13	Ramsar Convention on Wetlands of International Importance	2005 (Accession)	Conservation of Important Bird Areas
14	Establishment of ASEAN Regional Centre for Biodiversity	2005 (Signatory)	Conservation of Biodiversity
15	Declaration on ASEAN Heritage Parks	2003 (Signatory)	Protected Areas
Social, Labour and Health			
16	Universal Declaration of Human Rights (UNDHR)	signed	International Labour Law Requirements
17	Convention on the Rights of the Child	1991 (acceded)	
18	Convention on Elimination of All Forms of Discrimination against Women (CEDAW)	1997 (acceded)	

No.	Conventions	Year (Ratified/ Acceded/Accepted)	Relation to Project
19	Relevant ILO Conventions in force in Myanmar: • C1 Hours of Work (Industry) • C14 Weekly Rest (Industry) • C2 Unemployment Convention, 1919 (No. 2) • C6 Night Work of Young Persons (Industry) Convention, 1919 (No. 6) • C11 Right of Association (Agriculture) Convention, 1921 (No. 11) • C14 - Weekly Rest (Industry) Convention, 1921 (No. 14) • C17 Workmen's Compensation (Accidents) • C18 - Workmen's Compensation (Occupational Diseases) Convention, 1925 (No. 18) • C19 Equality of Treatment (Accident Compensation) • C21 - Inspection of Emigrants Convention, 1926 (No. 21) • C26 - Minimum Wage-Fixing Machinery Convention, 1928 (No. 26) • C29 Forced Labour Convention		
	• C42 Workmen's Compensation (Occupational Diseases) Revised 1934 • C52 Holidays with Pay • C63 Convention concerning Statistics of Wages and Hours of Work, 1938 (No. 63) Excluding Parts III and IV • C87 Freedom of Association and Protection of the Right to Organize C182 - Worst Forms of Child Labour		

3.1.5 International Standards and Guidelines

The Project will also follow International Environmental guidelines and standards including World Bank /IFC (International Finance Corporation) Guidelines & Industry Standards as detailed in **Table 3.2**.

Table 3.2: International Guidelines

Applicable International Standards & Guidelines	
1	Equator Principles (2013)
2	International Financial Cooperation/ World Bank General Environmental Health and Safety (EHS) Guidelines (April 30, 2007)

3.2 Contractual and other Commitments

The project proponent and EMP consultant (EQM) endorses and confirms to Environmental Conservation Department:

- The accuracy and completeness of the EMP;
- The EMP has been prepared in compliance with applicable Environmental Conservation Law, Rules and Procedures;
- That all the information contained in the report is accurate and a truthful representation of all findings as relating to the Project.

The project proponent and its contractor and subcontractor will comply with EMP commitment, Environmental Management Plan that described in the EMP and all applicable Myanmar Laws & regulation requirements and all necessary International laws and Standards.
The project proponent commitments are detailed in **Table 3.3**.

Table 3.3: Project Relevant Commitment List

Laws and Regulations	Description
The Environment Conservation Law, 2012	
The project proponent has to comply Section 7, Subsection {o) of the law and will pay compensation if the project proponent causes environmental impacts. **The project proponent has to comply with Section 14.** The project proponent when 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. **The project proponent has to comply with Section 15.** If the project proponent causes a point source of pollution they have to 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 has to be arranged to dispose the wastes in accord with environmentally sound methods. **The project proponent has to comply with Section 16 as follows:** (a) shall be responsible to carry out by contributing the stipulated cash or kind in the relevant combined scheme for the environmental conservation including the management and treatment of waste; (b) shall contribute the stipulated users' charges or management fees for the environmental conservation according to the relevant industrial estate, special economic zone and business organization;	

(c) shall comply with the directives issued for environmental conservation according to the relevant industrial estate, special economic zone or business.

The project proponent will comply Section 24. The project proponent has to allow The Ministry to 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.

The project proponent will comply Section 29. Project proponent has to not violate any prohibition contained in the rules, notifications, orders, directives and procedures issued under this Law.

The project proponent will comply Section 30. The project proponent shall not, without permission of the Ministry, import, export, produce, store, carry or trade any material which causes impact on the environment prohibited by the Ministry.

Environmental Conservation Rules, 2014

The project proponent has to comply with Rule 69. If the project proponent does not comply according to section 69, the project proponent will be prosecuted according to Environmental Conservation Law, Section 31.

Myanmar Investment Law, 2016

The project proponent has to comply with Chapter (13), Section 51 as follows:

(a) shall appoint of any citizen who is a qualified person as senior manager, technical and operational expert, or 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 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 project proponent and employee in accordance with the labour laws and rules;

(e) shall ensure to obtain the entitlements and rights in the labour laws and rules, including minimum wages and salaries, leave, holidays, overtime fees, damages, compensation of the workman, social welfare, and other insurance related to workers in stipulating the rights and duties of employers and employees and occupational terms and conditions in the employment contract;

(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.

The project proponent has to comply with Chapter (16) Responsibilities of Investors, Section 65 as follows:

(e) shall immediately inform the Commission if it is found that natural mineral resources or antique objects and treasure trove 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 project proponent has to continue to carry out the investment in such land, and if not allowed, the project proponent has to transfer and carry out, by obtaining the permission, at the substituted place which is selected and submitted by him;

(f) 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, discontinuation of investment, or reduction of workforce;

(g) shall abide by the 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;

(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, 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 its 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 labour laws;

(n) shall have the right to sue and to be sued in accordance with the laws;

(o) shall pay effective compensation for loss incurred to the victim, if there is 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 a Permit or an 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. Such

investments have to be submitted the situation of environmental and social impact assessment to the Commission during the permitted investment period.

The project proponent has to comply with Chapter 17 Insurance, Section 73 as follows:

The project proponent has to ensure the types of insurance stipulated in the provision of the rules at any insurance enterprise that is entitled to carry out insurance businesses within the Union.

The project proponent has to complySection 83 as follows:
Before any investment dispute between the investor and the Union or between the investors is brought to any court or arbitral tribunal, all disputing parties shall use due attempts to settle the disputes amicably.

The project proponent has to comply Section 84 as follows if investment disputes are not able to be settled amicably:

(a) if the dispute settlement mechanism is not stipulated in the relevant agreement, it shall be settled in the competent court or the arbitral tribunal in accord with the applicable laws;

(b) if the dispute settlement mechanism is stipulated in the relevant agreement, it shall be complied with and carried out in accord with the mechanism.

Electricity Law, 2014

The project proponent has to comply with the following sections:
Section 35. The project proponent shall not engage in electricity-related work without having obtained a license from the relevant government department or organization.
Section 36. No license holder shall engage in any work except the work contained in the license.
Section 37 The project proponent shall not perform electrical installations and repairs without having an electrical aptitude certificate.
Section 38. The project proponent shall not engage in electrical power generation, transmission, connection or use without having an electrical safety certificate.
Section 39. The project proponent shall not engage in the import, domestic production, export, distribution or sale of electrical appliances which do not conform to the norms stipulated by the relevant ministry.
Section 40. No holder of a license to engage in electricity-related work shall perform the work jointly with, or transfer it to, someone else without the permission of the relevant department or organization.

Section 41. No holder of a license to engage in electricity-related work shall sell, mortgage, lease, exchange, or use any other method to transfer the license or the whole work for which the license was granted or any part thereof without the permission of the relevant government department or organization which issued the license.
Section 42. The project proponent shall not construct anything, grow trees, or engage in other inopportune activities within the electrical power line area.
Section 43. The project proponent shall not, without the permission of the holder of the license to engage in electricity related work, obtain electric power through a connection to the line, or waste or use electric power.
Section 44. No one shall divert electric power, cut off a power line or destroy any electrical apparatus used an electricity-related work.

Private Industrial Enterprise Law, 1990

The project proponent has to comply with the following basic principles:
Section 3. (a) to enhance the higher proportion of the manufacturing value added in the gross national product and value of services, and to increase the production of the respective economic enterprises which are related to the industrial enterprise;
(b) to acquire modern technical know-how for raising the efficiency of industrial enterprises and to establish the sale of finished goods produced by the industrial enterprise not only in the local market, but also in the foreign market;
(c) to cause utilization by relying mainly as local natural resources;
(d) to cause narrowing down of the gap between rural development and urban development by causing the development and improvement of industrial enterprises;
(e) to cause opening up of more employment opportunities;
(f) to cause avoidance of or reduction of the use of technical know-how which cause environmental pollution;
(g) to cause the use of energy in the most-economical manner.

The Factories Act, 1951

The Factories Act, 1951 and Law Amending the 1951 Factories Act -Pyidaungsu Hluttaw Law No. 12/2016 contains provisions for the proper disposal of waste and effluents in factories; treatment of waste water; regulations for health and cleanliness in factories, and the prevention of hazards.

The project proponent has to comply with the following sections.

Section 23	Fencing of Machinery

	(1) In the project, the following shall be securely fenced by safe-guards of substantial construction which shall be constantly maintained and kept in position while the machinery is in operation.
Section 30	Hoists and Lifts (1) Every hoist or lift shall be of good mechanical construction, sound material and strength and shall be properly maintained. (2) Every hoist or lift shall be thoroughly examined by an authorized examiner at least once in every period of six months and a register shall be kept containing the prescribed particulars for every such examination. (3) Every hoist-way or lift-way shall be sufficiently protected by an enclosure fitted with gates. The hoist or lift and every such enclosure shall be so constructed as to prevent any person or thing from being trapped between any part of the hoist or lift and any fixed structure or moving part. (4) The maximum safe working load shall be clearly marked on every hoist or lift and no load greater than that shall be carried thereon. (5) The cage of every hoist and lift used for carrying persons shall be fitted with a gate on each side which provides access to a landing.
Section 32	Revolving Machinery (1) In the project in which the process of grinding and abrading is carried on there shall be permanently affixed to or placed near each machine in use a notice indicating the maximum safe working peripheral speed of every grinding of abrading wheel. The speed of the shaft or spindle upon which the wheel is mounted, and the diameter of the pulley necessary to secure such safe working peripheral speed. (2) The speeds indicated in notice under sub section (1) shall not be exceeded. (3) Effective measures shall be taken in the project to ensure that the safe working peripheral speed of every revolving vessel, cage, basket fly wheel, pulley, discs or similar appliance driven by power is not exceeded.
Section 33 (1)	Pressure Plant (1) If in any factory, any part of the machinery or plant used in a manufacturing process is operated at a pressure above atmospheric pressure, effective measures shall be taken to ensure that safe working pressure of such parts is not exceeded. (2) The President may make rules providing for the examination and testing of any plant or machinery refer to in sub section (1) and prescribing such other safety measures in relation thereto as may in his opinion be necessary in any factory or class of factories.
Section 35	Heavy Lifting

	(1) No woman adolescent or child shall be employed in the project to lid or carry or move any load so heavy as to be likely to cause injury. (2) The President may make rules prescribing the maximum weights that may be lifted, carried or moved ordinarily by persons employed in factories or in any class or description of factories or in carrying on specified process.
Section 37	Protection of Eyes In respect of any such manufacturing process carried on in any factory as may be prescribed, being a process, which involves- (a) risks of injury to the eyes from particles or fragments thrown off in the course (b) of the process; or (c) risk to the eyes of exposure to excessive light, the President may make rules that require that effective screens or suitable goggles shall provide for the protection of persons employed on, or in the immediate vicinity of the process. Protection from Fumes (1) In the project, no person shall enter or be permitted to enter any chamber, tank, vat, pit, pipe, flue or other confined space in which dangerous fumes are liable to be present to such an extent as to asphyxiate persons, unless it is provided with a man-hole of adequate size, or other effective means of egress. (2) No portable electric light of voltage exceeding 24 volts shall be permitted in the project for use inside any confined space referred to in sub-section (1), and where the dangerous fumes present are likely to be inflammable, no lamp or light other than that of flame-proof construction shall be permitted to be used in such confined space. (3) No person in the project shall enter or be permitted to enter any such confined space referred to in sub-section (1) unless all possible measures have been taken to remove any fumes which may be present and to prevent any ingress of fumes and unless either, (a) a certificate in writing has been given by an authorized examiner, based on a test carried out by himself, that the space is free from dangerous fumes and fit for persons to enter; or (b) the person entering is wearing a suitable breathing apparatus and a belt securely attached to a rope the free end of which is held by a person standing outside the confined space. (4) In the project, suitable breathing apparatus, reviving apparatus and belts and ropes shall be kept ready for immediate use in the vicinity of any such confined space which any person has entered. All such apparatus shall be examined at regular intervals and

	certified by an authorized examiner to be fit for use; and a sufficient number of the persons from amongst the employed in every factory shall be trained in the use of all such apparatus and in artificial respiration. (5) In the project, no person shall be permitted to enter any boiler, boiler furnace, boiler flue, chamber, tank, vat, pipe, or other confined space for the purpose of working or making any of examination therein until it has been sufficiently cooled by ventilation or otherwise so as to be safe for persons to enter. (6) The President may make rules prescribing the minimum dimensions of the manholes referred to in sub-section (1), and may by order in writing exempt or subject to such conditions as he may think fit, any factory or class or description of factories from compliance with any of the provisions of this section.
Section 39	Explosive or Inflammable Dust, Fume, Etc. (1) In the project, any manufacturing process produces dust, fume or vapor of such nature and to such an extent as to be liable to explode on ignition. All possible measures shall be taken to prevent any such explosion by – (a) effective enclosure of the plant or machinery used in the manufacturing process; (b) removal or prevention of accumulation of dust, fume or vapor; (c) isolation or effective enclosure of all possible sources of ignition (2) In the project, the plant or machinery used in a process referred to in sub-section (1) is not so constructed as to withstand the force of such an explosion, all possible measures shall be taken to prevent the spread of the explosion and to minimize the damage caused thereby, by providing chokes, baffles, vents or other effective appliances in the plant or machine. (3) In the project, any part of a plant or machinery that contains any explosive or inflammable fumes and vapor under pressure greater than atmospheric pressure, such part shall not be opened except in accordance with the following provisions, namely: - a) before the fastening of any joint of any pipe connected with such part is loosened, any flow of gas or vapor into the part or into any such pipe shall be effectively stopped by a stop-valve or other means; b) before any such fastening of any joint or any pipe or the firmly fastened cover is removed, all measures shall be taken to reduce the pressure of the fume or vapor in the part or pipe to atmospheric pressure; c) In the project, any such fastening has been loosened or removed effective measures shall be taken to prevent any explosive or inflammable fume or vapor from escaping from the pipe plant or parts of machinery until such cover or joint has been firmly re-fastened or firmly refaxed. (4) No plant, tank or vessel which contains, or has contained any explosive or inflammable substance, shall be subjected in any factory to any welding, brazing, soldering or cutting operation involving the application of heat, unless adequate measures have

	been taken to remove such substance and fumes arising therefrom, or to render such substance and fumes non- explosive or non-flammable, and unless a certificate in writing has been given by a competent examiner after a test carried out by himself that the plant, tank, or vessel is free from explosive or flammable vapor. No such substance shall be allowed to enter such plant, tank or vessel after any such operation, until the metal has cooled sufficiently to prevent any risk of igniting the substance.
Section 40	Arrangements to be made in Case of Fire (1) The project shall be provided with such means of escape in case of fire as may be prescribed, and if it appears to the Inspector that any factory is not so provided, he may serve on the manager of the factory an order in writing specifying the arrangements which, in his opinion, should be carried out to bring the factory into conformity with the provisions of this section and any rules made thereunder, and requiring them to be carried out before a date specified in the order. (2) In the project the doors affording egress from any room shall not be locked or fastened so that they cannot be easily and immediately opened from the inside while any person is within the room, and all such doors, unless they are of the sliding type, shall be constructed to open outwards. (3) In the project, every window, door or other exit affording a means of escape in case of fire, other than the means of exit in ordinary use, shall be distinctively marked in a language understood by the majority of workers and in red letters or by some other effective and clearly understood sign. (4) In the project there shall be installed apparatus to give warning in case of fire clearly audible to every person employed in the factory. (5) A passage - way giving access to such means of escape in case of fire shall be kept clear for the use of all workers in every room of the factory. (6) Effective measures shall be taken to ensure that in the project - (a) where more than twenty workers are ordinarily employed in any place on the lowest floor, or (b) where explosive or highly flammable materials are stored or used, all the workers are familiar with the means of escape in case of fire and have been adequately trained in the procedure to be followed in such case.
State-Owned Economic Enterprises Law, 1989	
This law sets out economic enterprises to be carried out solely by the government, as well as the rights of carrying out other economic enterprises, and the right to form organizations. **Chapter III - Right of carrying out other Economic Enterprises**	

Section 1 – The project proponent has the right to carry out any economic enterprise other than those prescribed under Section 3 to be carried out solely by the Government.

Chapter V Offences and Penalties

1. If the project proponent is convicted of an offence of carrying out, without the permission of the Government, any economic enterprise prescribed under Section 3 to be carried out solely by the Government they will be punished with imprisonment for a term which may extend to a period of 5 years and may also be liable to a fine. Furthermore, property both moveable and immoveable relating to the economic enterprise may be confiscated.

2. If the project proponent is convicted of an offence of violating an order or any condition notified under section 4 or section 5 they shall be punished with imprisonment for a term which may extend to a period of 3 years and may also be liable to a fine.

The Petroleum and Petroleum Product Law, 2017

Section 10 (a, d), 11, 13, 15, 16,17,18 and 31 (a, d)

The Petroleum and Petroleum Products Law (the "PPPL") 2017 was enacted by Pyaydaungsu Htuttaw as Pyaydaungsu Htuttaw Law No. 20/2017 on 1st August 2017 to repeal the Petroleum Act 1934. The PPPL contains the provisions on import and export, transportation, storage, refinery, distribution, inspection and testing of petroleum and petroleum products and issuance of relevant licenses.

Licenses for exportation, importation, transportation, transit, storage, refinery, distribution, testing of petroleum and any petroleum products must be obtained from the MOEE, other relevant Ministries and any business related with the petroleum products cannot be operated without a relevant license.

The Relevant Sections are 10 (a, d), 15 ,16, and 31 (a, d)

Section 10. The project proponent has to receive permission and licenses from The Ministry of Natural Resources and Environmental Conservation to carry out the following functions relating to any petroleum and petroleum product;

(a) issuing licence for the right to store for the storage tanks and warehouses;

(d) if it occurs environmental impacts in carrying out petroleum and petroleum product business activities, taking action, as necessary, in accordance with the existing laws of on-site inspection;

Section 11. On all receptacles containing any dangerous petroleum and petroleum product, the warning sign of danger by stamping, embossing, painting, printing or any other means shall be expressed. If it is impossible to express as such, similar warning signs of the nature of danger of gasoline, spirit or petroleum shall be expressed in writing at the ostensible place in salient words or signs near the receptacle.

Section 13. Through the pipeline that transports any petroleum and petroleum product, warning sign of danger shall be mentioned in writing in salient word or sign.

Section 15. The project proponent desirous to transport or store non-dangerous petroleum and petroleum products locally, has to obtain licence if it is more than 500 gallons. However, in storing 500 gallons and less, receptacle not exceeding 200 gallons has to be used.

Section 16. The project proponent may without obtaining licence, store, import or transport any dangerous petroleum and petroleum product not exceeding six gallons not intended for sale.

Section 17. If it is desirous to store any dangerous petroleum and petroleum product according to section 16, the product shall be put and stored in the glass, stone or metal receptacle with secure cap. If it is desirous to store in the glass or stone receptacle, the volume shall not exceed 0.25 gallon. If it is desirous to store in metal receptacle, the volume shall not exceed 5 gallons.

Section 18. The driver, master of ship and owner of a machine-powered vehicle or machinery shall not require to obtain license or permit for the import, transport and storage of the volume of dangerous petroleum and petroleum products not exceeding 20 gallons stored to use for such machine-powered, vehicle or machinery, in addition to petroleum and petroleum product contained in the original tank of the machine-powered vehicle or machinery that uses any petroleum and petroleum product.

Section 31: The Project proponent

(a) has to not violate any prohibition contained in the rules, regulations, bye-laws, notifications, orders, directives, procedures and conditions or fail the duty to implement;

(d) has to not have the right to carry out without undertaking the environmental impacts, in operating petroleum and petroleum product business activities;

The Underground Water Act, 1930

The Underground Water Act, 1930 provides measures for systematic and sustainable use of underground water and prohibitions on accessing and using underground water without a license.

The project proponent has to comply with as follows:
Section 1. This Act extends to such areas as the President of the Union may, by notification,1 direct and shall apply only to tubes exceeding a depth to be prescribed by the President of the Union: Provided that the President of the Union may prescribe different depths for different local areas. **Section 3.** The project proponent shall not sink a tube for the purpose of obtaining underground water except under and in accordance with the terms of a license granted by the water officer. Every person owning a tube which was in existence before the extension of this Act to the local area concerned shall apply to the water officer for a license for the said tube, and such license shall be granted free of charge. **Section 4.** (1) Any Magistrate taking cognizance of an offence under section 3 may at any time order the tube in respect of which the offence has been or is alleged to have been committed to be forthwith closed until such time as a license for the same has been taken out in accordance with the provisions of the said section. (2) If the order for the closure of a tube under sub-section (1) is not complied with, the Deputy Commissioner, Sub divisional Officer or Township Officer exercising jurisdiction over the local area concerned may cause the said tube to be closed, and the expense of such closure shall be recoverable from the owner of the tube as if it were an arrear of land-revenue. **Section 5.** Every person obtaining or attempting to obtain underground water shall supply the water officer with such information as the President of the Union may by rule prescribe.
The Freshwater Fisheries Law , 1991
The project proponent has to comply with as follows: **Section 3.** Freshwater fishery shall be carried out in accordance with the following objectives: a. to further develop the fisheries. b. to prevent the extinction of fish. c. to safeguard and prevent the destruction of freshwater fisheries waters. d. to obtain duties and fees payable to the State. e. to manage the fisheries and to take action in accordance with the Law. **Section 40**. No one shall cause harassment of fish and other aquatic organisms or pollution of the water in a freshwater fisheries water.
Farm Land Law, 2012
The project proponent has to comply with as follows: **Section 9.** The following rights shall be enjoyed in connection with the right for farming:

(a) right to have such land in hand, right for farming and gain benefit of such farm;
(b) right to sell, pawn, lease, exchange, or donate, in whole or in part of the right for farming in accord with prescribed disciplines;
(c) disputes arising out of inheritance of farmland shall be decided upon by the law respective court in accord with existing law;
(d) the duration of the right for farming shall continue so long as the stipulated conditions are not breached;
(e) land development operation are to be carried out by doing joint-venture with the investment of rural cooperative association or private investors;
(f) in accordance with Myanmar Investment Law, foreigner or organization containing foreigner are to be carried out by doing joint-venture.

Section 14. A person who has the permission of right for farming should not be sold, pawned, leased, exchanged or donated to any foreigner or organization containing foreigner without the permission of State Government.

Section 30. In respect of the application to utilize the farmland for other purposes in the interest of the public:
(a) The Central Farmland Management Body shall give permission to utilize the paddy land for other purposes, with the recommendation of the Region or State Farmland Management Body;
(b) The respective Region or State Government shall give permission to utilize the farmland for other purposes except paddy land, with the recommendation of the Region or State Farmland Management Body.

Section 113. With the expectation of upgrading the social economic life of farmer to formation of the farmer organization may be formed as per existing law.

Section 114. Anyone who get the right to use farm land if he has not applied to get the permit certificate to work farm land as he is not designated as someone who get the right to work farm land, he shall not enjoy the benefits acquired by the person who get the right to work farm land.

Section 115. The central farm land management committee shall designate the method to be performed regarding the spoilage and loss of permit certificate of the right to work farm land.

Section 116. The central farm land management committee shall encourage effectively for the vanishing of slash and burn cultivation and to introduce terrace cultivation on high land for the environment conservation, not to spoil the watershed area the forest, not to spoil top soil, and to regulate the climate.

Forest Law, 1992

The Burma Forest Act 1902, with amendment made from time to time, had been in use up till the new forest legislation, Forest law 1992, was promulgated by the State Law and Order Restoration Council in November 1992. The new forest law, in line with the Myanmar Forest Policy, focuses on the balanced approach towards conservation and development issues implicit in the concept of sustainable forestry. It decentralizes

the management and opens up opportunities for increased private sector involvement in timber trade. Highlighting environmental and biodiversity conservation, the law encourages community forestry and people's participation in forest management to meet the basic needs of the rural people, but prescribes severe punishments for forest offences. In addition, the MOF has promulgated the Forest Rules in 1995. Provisions to conserve water, soil, biological diversity and the environment; sustain forest produce yields; protect forest cover; establish forest and village firewood plantations; sustainably extract and transport forest products.
Biodiversity & Protected Area Law, 2018
Section 39. If the propjet proponent commits any of the following acts, on conviction be punished with imprisonment for a term which may extend to maximum 3 years or with fine which may extend to minimum Kyats 200,000 or maximum Kyats 500,000 or with both- (d) Causing water and air pollution, causing damage to a water-course or putting poison in the water in a natural area, passing through the electric current, and using chemicals and explosive substances. (e) Possessing or disposing of pollutants or mineral pollutants in a natural area. **Section 41**. If the project proponent commits any of the following acts shall, on conviction be punished with imprisonment for a term which may extend to minimum 3 years to maximum 10 years or with fine- (a) Killing, hunting or wounding, collecting, selling a completely protected wild animal or animals controlled in national trade without permission, possessing or transporting or transferring such wild animal or any part thereof or blood of such animals or product deriving from the parts of such animals without permission; (b) Extracting, collecting a completely protected natural plants or plants controlled in national trade or destroying, collecting, possessing, selling, transferring and transporting such plant or any parts thereof or product deriving from the parts of such plant without permission.
The Protection of Wildlife and Wild plant and Conservation of Natural Area Rule , 2002
Project proponent must comply with Sections 4 as follows: From the day after the minister announce the natural area intended for classification or zoological and botanical garden, some prohibition can be inscribed, except the existing opportunity in that day, relating with the following in which the project proponent shall follow: (a) building new infrastructure (b) Killing, hunting, wounding or collecting, wild animals, possessing, selling or transporting or transferring such wild animal or any part thereof, and damaging, cutting, extracting and collecting natural plants or forest product. (c) digging, clearing the land (d) crop growing

	(e) using as pasture land (f) burning (g) fishing (h) hunting (i) polluting water and air, damaging the drainage or poisoning the water, possessing or disposal of any poisonous material and waste metal, without permission.
Land Acquisition Act, 1894	
	Land acquisition for a company may be carried out where it is "likely to prove useful to the public." In these cases, the Government has the responsibility for carrying out the acquisition and distributing the compensation; however, the company acquiring the land has to provide the compensation. Compensation is based on the market value of the land and also possible damage incurred by the private landowner, such as loss of crops and firewood or the cost of changing residence and place of business. Land in-kind can also be provided in place of monetary compensation (Section 6). These losses should take place "in consideration of the compulsory nature of the acquisition" (Section 23). The Law sets out basic procedures governing land acquisition, including a preliminary investigation, and a procedure for notification of persons interested in the land. The Law also includes provision for objections to the land acquisition, in which the objector is granted the 'opportunity of being heard', where the objections raised may be further explained. However, the President's decision on the objection is final, in practice giving him/her wide discretionary powers (Section 5).
The Vacant, Fallow and Virgin Lands Management Law, 2012	
Section 16	The project proponent who has the right to cultivate or utilize vacant, fallow and virgin lands shall; (a) carry out only the type of business permitted and affiliated economic enterprises. (b) reclaim and carry out the permitted land until the completion of business according to the stipulation within 4 years starting from the day of permission. For the lapse of the prescribed period due to natural disasters or unstable situation, central committee may revise the stipulated term. (c) not mortgage, gift, sell, lease or transfer by other means or divide the permitted Vacant, Fallow and Virgin Lands without the permission of the Union Government. (d) pay up the land revenue for vacant, fallow and virgin lands, which he has the right to cultivate or utilize .

	(e) comply with the conditions relating to the right to cultivate or utilize the vacant, fallow and virgin lands prescribed by the Central Committee. (f) not extract other natural resources above or below the ground except the permitted business. (g) when acquiring the required land area from the land permitted in the event of finding the natural resources within the permitted land and the Government is desirous to extract commercially, shall return as directed by the Union Government.
Section 19	The project proponent has to comply with the Central Committee right to acquire the required minimum land area from the permitted vacant, fallow and virgin lands if one of the following conditions arises: (a) if the ancient cultural heritages are found in the permitted vacant, fallow and virgin lands; (b) if infrastructure project or special project is required to be implemented for the interest of the State; (c) if different resources other than the permitted type of metal is found in the permitted vacant, fallow and virgin lands for the mineral production business; (d) if the mineral resources are found in the vacant, fallow and virgin lands permitted to carry out the business contained in Section 4, Sub- section(a), (b) and (c).
Conservation of Rivers, Creeks and Water Resources Law, 2006	
The Conservation of Water Resources and Rivers Law (2006) was promulgated on 2nd October 2006. The aims of this Law are as follows: • To conserve and protect the water resources and rivers system for beneficial utilization by the public; • To ensure smooth and safe waterways navigation along rivers and creeks; • To contribute to State economic development through improving water resources and river systems; and • To protect environmental impact. The key sections are 11 (a, b), 19, 21 and 24.	
Section 11	The project proponent shall not: (a) 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. (b) catch aquatic creatures within river-creek boundary, bank boundary or waterfront boundary with poisonous materials or explosives. Section
	The project proponent shall not 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.
	The project proponent shall not: (a) build lavatories unsuitable to the urban and rural community lifestyle in the bank area and watercourse area. (b) drill well or pond or dig earth without the permission of the Directorate.

	The project proponent shall not: (a) violate the conditions relating to navigation of vessels in rivers and creeks prescribed by the Directorate for conservation of water resources, rivers and creeks. (b) violate the conditions prescribed by the Directorate so as not to cause water pollution and change of watercourse in rivers and creeks.
The Protection and Prevention of Cultural Heritage Area, 2015	
The Protection and Preservation of Cultural Heritage Region Law, 1998 Amended by Law. No.1/2009 Provisions to protect ancient sites and regions and cultural heritage areas from any adverse impacts due to industrialization, tourism and urbanization.	
Section 20	The project proponent shall not carry out any of the following in the cultural heritage region: (a) destroying an ancient monument; (b) willfully altering the original ancient form and structure or original ancient workmanship of an ancient monument; (c) excavating to search for antiquities; (d) Exploring for petroleum, natural gas, precious stones or minerals.
Section 23	The project proponent shall not plough and cultivate or carry out any activity which may cause damage to the cultural heritage within the boundary notified by the Department in the cultural heritage region.
The Protection and Prevention of Antique Objective Law, 2015	
The Protection and Preservation of Antique Objects Law (No. 43/2015) covers requirements for the finding of antique objects.	
Section 12	If the project proponent finds any object which has no owner or custodian, has to promptly inform the relevant Ward or Village-Tract Administrator if they know or if it seems reasonable to assume that the said object is an antique object.
Section 13(a)	If the information is received under section 12, the Ward or Village- Tract Administrator shall keep the said object as may be necessary and shall forward the information to the relevant Township Administrative Office within 14 days. The Township Administrator shall promptly carry out the necessities and inform the Department within 7 days from the date on which the information is received.
The Protection and Prevention of Ancient Monument Law, 2015	
The Protection and Preservation of Ancient Monuments Law (No. 51/2015). The project areas are not near any protected or Ancient Monuments including the Zarli Mountain.	

Section 12	If the project proponent who finds who 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, they shall promptly inform the relevant Ward or Village-Tract Administrative Office.
Chapter VII. Applying for prior Permission, Scrutiny and Issue	
Section 15	If the project proponent aiming at realizing any of the following within the specified area of an ancient monument shall apply to get prior permission to the Department: (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; (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;
Chapter VIII Prohibitions	
Section 20	The project proponent shall not carry out any of the following acts which are assumed to cause damage to an ancient monument within the specified area of an ancient monument or of a listed ancient monument without obtaining written prior permission: (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 , 2019	
Section 46	Concerning the drilling of petroleum or natural gas and mining of precious stones or minerals for the benefit of the State in the cultural heritage region-

	(a) The project proponent shall prohibit the drilling and mining in the cultural heritage region stipulated as the global and national heritage regions. (b) The project proponent shall carry out the drilling and mining with the permission of the government in other cultural heritage regions except Sub-section (a).
The Protection of Rights of National Race Law, 2015	
This law has provisions for equal treatment and considerations for various ethnicities and races within Myanmar. If the project impacts Indigenous Peoples the proponent must provide complete, accurate and precise information about the Project proposed for their areas as per Section 5 of The Protection of Rights of National Race Law, 2015.	
Section 3	The project proponent shall (a) promote the sector of public co-operation in implementing the forestry policy and the environmental conservation policy of the Government; (d) develop the economy of the State, to contribute towards the food, clothing and shelter needs of the public and for perpetual enjoyment of benefits by conservation and protection of forests; (e) to carry out in accordance with international agreements relating to conservation of forests and conservation of environment; (f) to prevent the dangers of destruction of forest and bio-diversity, outbreak of fires, infestation of insects and occurrence of plant disease; (g) to carry out simultaneously conservation of natural forests and establishment of forest plantations;
Import and Export Law, 2012	
Chapter IV Prohibitions	
Section 7	Project Proponent who obtained any license shall not violate the conditions contained in the license.
Ward and Village Tract Administration Law, 2012	
Project proponent shall comply with the Ward and Village Tract Administration Law and inform the lists of people that live in the project area and campsite to the relevant ward/village offices.	
Public Health Law, 1972	
Section 3	The project proponent shall comply with Clause 9, Subsection 1 of Section 3. The project proponent has to provide required infrastructure relating to environmental health, such as garbage disposal, use of water for drinking and other purposes, radioactivity, protection of air from pollution, sanitation works and food and drug safety for all works.

Section 5	The project proponent has to accept any inspection, anytime, anywhere if it is needed.
The Prevention and Control of Communicable Disease Law, 1995 and Amendment of Prevention and Control of Communicable Diseases Law, 2011	
Section 3	In order to prevent the outbreak of Communicable Diseases, the project proponent has to work with the Department of Health shall to implement required activities under this section.
Section 4	The project proponent has to comply with the measures undertaken by the Ministry of Health and the Department of Health under section 3 in respect of prevention of the occurrence and spread of communicable disease and control thereof."
Section 9	If the project proponent notices occurrence of any of the following matters, the project proponent has to report immediately to the nearest health department or hospital: (a) En-masse death of animals including chicken and birds (b) (b) rat fall; (c) suspicion or occurrence of epidemic disease; occurrence of notifiable disease."
Section 11	The project proponent in order to prevent and control the spread of a Principal Epidemic Disease has to allow the Health Officer to undertake the measures detailed in Section 11.
The Control of Smoking and Consumption of Tobacco Product Law, 2006	
The Control of Smoking and Consumption of Tobacco Product Law (No. 05/2006)	
Chapter VI - Functions and Duties of Person-in-charge	
Section 9	The project proponent shall establish a smoking area and establish notice board for non-smoking area, and to accept the inspection of Ministry of Health as follows: (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. (c) supervise and carry out measures so that no one can smoke at the non-smoking area. (d) accept the inspection when the supervisory body comes to the place for which they are responsible.
The Myanmar Fire Force Law, 2015	

The Myanmar fire force law, 2015 covers requirements for firefighting and fire protection.	
The project proponent shall comply with Chapter 11, Section 25 as follows:	
Section 25	The project proponent shall implement the management of fire sub-station and required equipment to ensure (a) No absence for organizing separate fire force (b) No absence to set ready for fire safety equipment
Shops and Establishments Law, 2016	
Section 13, Project proponent has to ensure that on their project site: (a) Nobody under the age of 14 shall be allowed or required to work at a shop or at an establishment. (b) Nobody under the age of 16 shall be allowed to work more than the designated work time at a shop or at an establishment. **Section 14, Project proponent has to ensure that on their project site:** (a) Anyone who is over 14 and under 16 may work with the permission of a doctor stating in a recommendation letter that the person is fit to work. However, this person shall not be allowed to work more than 4 hours per day. (b) Nobody over 14 and under 16 shall be allowed or required to work from 6:00 pm to 6:00 am. (c) Nobody over 14 and under 16 shall be allowed or required to work at another shop or establishment on the same day after working at a shop or establishment. (d) No worker under 18 shall be allowed or required to perform work of a dangerous type or work at a dangerous workplace. (e) Anyone between 16 and 18 shall, with the recommendation of a doctor, be allowed to work at workplaces where it is safe and there is no impact on the mental and physical development, provided that this person has finished proficiency training for the relevant job, is able to understand and follow the directives for health and safety at the workplace, and is fit and healthy. **Section 15, The project proponent-** (a) shall designate at least one day per week as off-day for the worker at the respective shop or establishment. (b) shall not deduct the rightful salary of the worker for the off-day under sub-section (a). **Section 16, The project proponent has to pay the salary not later than 7 consecutive days after the salary payment period of the worker at the shop or establishment.** **Section 17, The project proponent** (a) shall calculate and pay the overtime fees in compliance with the agreed overtime payments based on the worked overtime hours. (b) shall to not request overtime work without paying overtime fees according to sub-section (a). **Section 21, In the cases of this law, the project proponent**	

(a) shall arrange the respective documents, lists, contracts, evidence, forms and samples to be inspected by the inspector. (b) shall, upon request, submit the registration book kept under this law and the rules, evidence of being the owner or documents regarding the business of any shop or establishment to the inspector. **Section 24, The project proponent has to comply with the following at every shop and establishment.** (a) shall arrange for cleaning, good ventilation, and health. (b) shall arrange for fresh air and sufficient light. (c) shall arrange for it not being louder than the specified noise level. (d) shall arrange for the prevention of overheating [literal translation] and the prevention of fire hazards. (e) shall arrange for sufficient first aid boxes and medicine for the employees according to the provisions.	
The Employment and Skill Development Law, 2013	
Employment and Skill Development Law (No 29/2013). The key sections are 5, 14, and 30 (a and b).	
Section 5	The project proponent shall employ according to Section 5 of the Employment and Skill Development Law (No 29/2013).
Section 14	The project proponent shall carry out the training program in accord with 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 project proponent 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%; (b)The project proponent shall ensure that put in money paid under subsection (a) has to not be deducted from the wage and salary of the employees.
The Workmen Compensation Act, 1923 (amended 2005)	
Workman's Compensation Act (1923) Amended by Law No 4/2005	
Section 10 (a, b) and 11	The project proponent shall compensate for death and injury during the working hours according to Workman's Compensation Act (1923) Amended by Law No 4/2005.
Labour Organization Law, 2012	
The Labour Organization Law, (No. 07/2011) and The Labour Organization Rules, 2012 were enacted to protect the rights of the workers, to have good relations among the workers or between the project proponent and the worker, and to enable to form and carry out the labour organizations systematically and independently.	

Section 17 to 22	The project proponent shall: • Recognize the labour organizations • Allow the member of executive committee assigned by the labour organization to perform their duty not exceeding two days per month • Assist as much as possible if the labour organizations' requests help which is in the interest of the factory's workers.
The Settlement of Labour Dispute Law, 2012	
Settlement of Labour Dispute Law (No. 05/2012) Amended by Law No. 40/2014 was enacted for the settlement of labour disputes:	
Section 23	A party, employer or worker, may complain individual dispute relating to his grievance to the Conciliation Body and if he is not satisfied with the conciliation of such body in accord with stipulated manners, may apply to the competent court in person or by the legal representative.
Section 38	No project proponent shall fail to negotiate and coordinate in respect of the complaint within the prescribed period without sufficient cause.
Section 39	No project proponent 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 project proponent 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.
Section 41	No project proponent shall carry out lock-out or strike to amend such decision or agreement within the effective period of the decision of the Arbitration Body or the Arbitration Council or any collective agreement.
Section 42	No project proponent shall prohibit the right to work independently of the workers who are not desirous to participate in the strike nor impede the right of a worker to strike.
Section 43	No project proponent shall fail to abide by or carry out any condition contained in agreement concluded before the Conciliation Body in respect of individual dispute or collective dispute.
Section 44	No person, after having informed in advance by the Arbitration Body or Tribunal for settling the dispute, shall fail to arrange to enable to examine the trade under dispute or to produce the documents which is considered by the Arbitration Body or Tribunal that it concerns with the dispute or to appear as a witness when he is so summoned.
Section 45	No project proponent, if he is sent notice for examination before the Arbitration Body or Tribunal, shall fail without sufficient cause to appear in person or to send legal representative within the stipulated period.

Section 51	If the project proponent, 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 has to be liable to pay full compensation in the amount determined by the Arbitration Body or Tribunal. Such money has to be recovered as the arrear of land revenue.
Minimums Wages Law, 2013	
The Minimum Wages Law, No. 07/2013 was enacted on 22nd March 2013 (The Minimum Wages Rules, 2013). Section 12 (d) of the law provides that the project proponent has to pay the minimum wage to the workers working in the commercial, production business and service in cash.	
Section 12	The project proponent: (a) shall pay wage to the worker less than the minimum wage stipulated under this Law; (b) shall 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;
Section 13	The project proponent: (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 sub- section(b) to the relevant department in accord with the stipulations; (d) shall accept the inspection when summoned by the inspection officer. Moreover, he has to produce the said lists and documents upon asking to submit;
The Minimum Wages Rules, 2013 include: Chapter 9 - The power and obligations of the project proponent	
Section 43	The project proponent: (e) before fixing of the minimum wage by the National Committee under this rule, if his remuneration is less than the prescribed amount, he should be paid up to the full amount; (f) part time, hourly job employees shall be paid the prescribed minimum wage for the working hours; (g) for the salary employees one day day-off has to be allowed in a week. If he has to work on the off day, overtime wage

	shall be paid in accord with the existing law;
Payment of Wages Law, 2016	
Payment of Wages Law (No 17/2016) covers the following requirements:	
Chapter 2	
Section 3 **Section 4** **Section 5**	The project proponent shall pay for salary either Myanmar Kyats or Foreign Cash permitted by National Bank of Myanmar. When delivery the salary (b) If the project proponent needs to pay the other opportunities or advantages, they can pay cash together with other materials according employee's attitude. When the contract finish, the project proponent shall pay the salary (not more than one month) to employees. For the permanent worker, has to pay per monthly. If more than 100 employees, has to pay within the 5 days from the end of month. If fire the employees, has to pay salary within two days after fire. When employee dies due to the accident, has to pay money as insurance to employee's family within two days. If the project proponent encounters difficulty to pay the wages according to Section 4 sub-section (c) because of significant happenings, including natural disaster, the project proponent shall report to the Department with solid evidence that wages will be paid at the mentioned day upon the workers' agreement.
Chapter 3	
Section 7 **Section 11**	Project proponent shall comply with all sections covering all the issue of deducted salary based on different categories. According to Chapter 3, Section 7, the project proponent shall deduct: (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. According to Chapter 3, Section 11, the project proponent shall also deduct for:

Section 14	(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. (b) A breach of the employment contract or breech of any rules for which a fine had been previously set. No other deductions are allowed, except those covered above by Sections 7 and 11 of Chapter 3. Furthermore, according to Chapter 3, Section 10, no deductions shall ever be allowed for any workers under the age of 16. Section 14. If an Employee carries out overtime work, the project proponent shall ensure he/she is allowed the presiding overtime rate as set by the Law.
Social Security Law, 2012	
The objectives of the Social Welfare Law (2012) and accompanying Social Welfare Rules (2014) include providing workers with the right to draw back some of the contributions paid by employers and workers as savings in accordance with the stipulations, and to obtain the right to continue medical treatment, family assistance benefit, superannuation benefit, survivors' benefit, unemployment benefit, the right to residency and ownership of housing after retirement in addition to health care and pecuniary benefit for sickness, maternity, death, employment injury of the workers. Project proponent shall comply with all social security requirements for drilling worker including foreign experts.	
Section 11	The Social Welfare Law (2012) requires the project proponent establishments to comply with the provisions for compulsory registration with the social security system and benefits (indicated in the Social Welfare Law) if they employ a minimum number of workers as determined by the Ministry of Labour in co-ordination with the Social Security Board: 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.
Section 15	The project proponent shall ensure it meets the requirements of the social security funds
Section 18	(b) The project proponent shall deduct contributions to be paid by worker from his remuneration and pay to the social security fund together with contribution to be paid by him. The employer shall also bear the expenses for such contribution.
Section 48 (b)	(b) The employers may affect insurance by registering voluntarily for insurance of the workers who are not applied to provisions of compulsory registration for employment injury benefit insurance system, by paying stipulated contribution to employment

	injury benefit insurance fund.
Section 49	(a) The project proponent and insured persons of establishments where the project proponent had registered compulsorily in accordance with sub-section (a) of section 48 or where the project proponent had registered voluntarily in accord with sub-section (b) of section 48 who have paid contribution to employment injury benefit fund has to not apply to the provisions contained in the Workmen's Compensation Act as regards the employment injury benefit; (b) The insured persons who has affected insurance for employment injury benefit in accord with sub-sections (a) and (b) of section 48 has to be entitled only to the employment injury insurance benefits contained in this Law.
Section 75	The project proponent: (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.
Leaves and Holidays Act, 1951	
The Leave and Public Holiday Act, 1951 Amended by Law No. 06/2006 and No. 30/2014. The project proponent shall allow the leaves and holidays defined by the national government. "National" means 'the Republic of the Union of Burma".	
The Motor Vehicles Law, 2015 and Rule, 1987 and Rule 1987	
The project proponent shall comply with the noise, traffic and exhaust sections of the Motor Vehicle Law No. 55/15	
Myanmar Insurance Law, 1993	

Requires any business which may pollute the environment to effect compulsory general liability insurance.	
Section 15	The project proponent shall ensure all motor vehicles effect compulsory Third-Party Liability Insurance with the Myanmar Insurance.
Section 16	The project proponent 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 affect compulsory General Liability Insurance with the Myanmar Insurance.
The Prevention of Danger of Hazardous Chemical and related Substances Law, 2013 (Section 16,17,23,27)	
The Prevention of Hazard from Chemicals and Related Substances Law was enacted on 26th August 2013. The objectives of this Law include: protecting natural resources from decrease and loss, and safeguarding living things from endangerment caused by chemical and chemical related substances; and systematically controlling safety in carrying out approved chemical and associated materials businesses. The Law requires continuous development of worksite safety, health and environmental conservation. The Prevention of Hazard from Chemicals and Related Substances Law (2013) defines Chemical as: imposing danger to the health or life of man or animal or chemical element, chemical compound and chemical mixture which cause bad consequences to the environment naturally or appearing after created by man. This definition includes the vapor, liquid, waste materials of oily and solid which act chemically and technically.	
Section 16	The project proponent who has obtained a license: - (a) shall abide the license regulations; (b) shall perform to abide strictly the instructions for being safety in using the chemical and related substances by himself and also the persons who serve the work; (c) shall keep the required safety equipment enough in the chemical and related substances businesses, furthermore has to grant the personal protection equipment and dresses free of charge to the working persons; (d) shall make the course of training and study and instruction if necessary, to the working persons for using the occupational safety equipment, the personal protection equipment and the dresses systematically in the chemical and related substances business; (e) shall be inspected by the respective Supervisory Board and Boards of Inspection in respect of whether or not the hazard may impact on the Human Being and Animals' health and the environment; (f) shall make medical checkup the working persons who will work in the chemical and related substances business and has to permit to serve in that work after obtaining the recommendation that his health is suitable for that work. This medical checkup records have to be kept systematically;

	(g)shall send the copy of informative letter of the permission to the respective Department of Township Administration, if the hazardous chemical or related substances are permitted to store; (h)shall acquire in advance the guidance and agreement of the respective Department of Fire Brigade, if the business that is worried to fire hazard is operated by using the fire hazard substances or the explosive substances; (i) shall transport only the permitted amount of the chemical and related substances in accordance with the prescriptive stipulations, if they are transported in local; (j) shall take the permission from the Central Supervisory Board if the chemical and related substance is altered and transferred from one place to any other place which contained in the license; (k)shall abide and perform in accordance with the related environmental laws not to impact and damage to the environment in operating the chemical and related substances business.
Section 17	The project proponent who has obtained a license, shall put the insurance in accordance with the prescriptive stipulations to be able to pay the compensation, if the impact and damage is occurred on the Human Being and Animals or the environment in respect of the chemical and related substances businesses.
Section 23	The project proponent who has obtained the registration certificate: - (a) shall apply to register again, to the Central Supervisory Board if the chemical and related substances, which are not contained in the registered list, are used; (b) shall inform and submit the unused chemical and related substances list to the Central Supervisory Board, although which are contained in the registered list.
Section 27	The project proponent who has obtained the license shall comply with the following matters to control and decrease the hazard of the chemical and related substances: - (a) classifying the hazard level to protect in advance the hazard according to the properties of the chemical and related substances; (b) expressing the Material Safety Data Sheet and Pictogram; (c) providing the safety equipment, the personal protection equipment to protect and decrease the accident and attending to the training to be used systematically; (d) performing in accordance with the stipulations in respect of transporting, possessing, storing, using, discharging the chemical and related substances;

	(e) not being imported or exported the chemical and related substances banned by the Central Supervisory Board and the machinery and equipment which are used them.
Healthcare Waste Management Guideline	
Project Proponent shall manage all medical wastes / clinical wastes management in compliance with the Health the Care Waste Management Guideline once stipulated by Ministry of Health and Sports	

3.2.1 Overall Commitments

The Project will comply with the Myanmar Environmental Conservation Law (2012), Environmental Conservation Rules (2014), Environmental Quality (Emission) Guidelines (2015) and all necessary international standards. The project proponent makes the following commitments:

- The project will comply with commitments, mitigation measures and management plans stated in the EMP report.
- The company is responsible for its actions and omissions and those of its contractors, subcontractors, officers, employees, agents, representatives, and consultants employed, hired, or authorized by the company acting for or on behalf of the Project.
- Support programs for livelihood restoration and resettlement in consultation with the Project Affected Persons (PAPs), related government agencies, and organizations and other concerned persons for all adverse impacts.
- 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 requirements set forth in the ECC, all applicable Laws, the Rules, this Procedure and standards, Project commitments and conditions when providing services to the Project.
- Timely notify and identify in writing to the respective departments including (Pollution Control Department (MCDC) and ECD (Mandalay) etc., providing detailed information as to the proposed Project's potential adverse impacts.
- Immediately inform and identify in writing to the respective ministries/departments and /township administrative department providing detailed information as to the proposed potential Adverse Impacts if any natural mineral resources, antique objects, treasure trove or historical things are found.
- Abide by the terms and conditions, stipulations of special licenses, permits, and business operation certificates issued to them, including the rules, notifications, orders, and directives and procedures issued by the MIC and the applicable laws, terms and conditions of contract and tax obligations.
- Abide by the terms and conditions, stipulations of special licenses, permits, and business operation certificates issued investment permitted above and under the land on which the investor is entitled to lease or use and not included in the original contracts.
- Carry out in accordance with the stipulations of the relevant department if it is, by the nature of business or by other need, required to obtain any license or permit from the relevant Union Ministries government departments and governmental organizations, or to carry out registration.
- Abide by the applicable laws, rules, procedures and best standards practiced internationally for this investment not to cause damage, pollution, and loss to the natural and social environment and not to cause damage to cultural heritage.
- Respect and comply with the customs, traditions and traditional culture of the ethnic groups in the Union.
- Pay effective compensation for loss incurred to the victim, if there is 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.
- Respect and comply with the labor laws.
- Have the right to sue and to be sued in accordance with the laws.
- Ensure equal rights for local workers and avoid salary bias, i.e. ensure that local and foreign workers have the same salary at the same level.
- Ensure that all foreign employees apply for the proper work permit and visa through the Myanmar Investment Commission (MIC) or the Ministries concerned..
- Provide rights and benefits including but not limited to, leave, holidays, overtime pay, compensation and social security. Most of the relevant particulars are in the Myanmar Companies Act.
- 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.
- 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.
- Settle disputes, within the law, between workers, employers, consulting experts or any other personnel involved in the business operation.
- 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, discontinuation of investment, or reduction of workforce.

3.3 Institutional Framework

The aim of this Chapter is to describe the Administrative and political divisions of Myanmar including environmental organizations.

1) Administrative Divisions

Myanmar is a multi-ethnic country composed of over 135 ethnic groups, and viewing macroscopically, in the central part of the country from north to south along Irrawaddy River resides the largest group covering 70% of the total population, Bama, and in mountainous area in east and west reside most of the minorities.

Myanmar has a three levels administrative structure, as described below.

The first level subdivision includes:

- Seven states
- Seven regions (regions were previously referred to as “divisions”, prior to August 2010)
- Five self-administered zones

- One self-administered division
- One union territory

States and regions are divided into districts. Districts consist of townships, which are composed of towns, wards and village-tracts that are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is defined in the Constitution.

Each region and state have a Regional/State Government, consisting of a Chief Minister, Ministers and an Advocate General. Legislative authority resides with the State/Regional "Hluttaw" (a parliament or legislative body), which are made up of elected civilian members and representatives of the military.

The Constitution states that Naypyidaw is a Union Territory under the direct administration of the President. The Naypyidaw Council, led by a Chairperson, carries out general functions on behalf of the President. The Chairpersons of the Naypyidaw Council are appointed by the President, and include civilians and representatives of the military.

Self-Administered Zones and Self-Administered Divisions are administered by a Leading Body, which is headed by a Chairperson, and has executive and legislative powers. The Leading Body consists of elected State/Regional Hlutttaw members and military personnel.

Mandalay KyarNiKan Landfill Gas Recovery and Generation Project is located in Patheingyi Township in the Mandalay Region of Myanmar.

2) Ministry of Natural Resources and Environmental Conservation (MONREC) is mandated to draft the regulations to enact the law, including regulations and standards on environmental safeguards on environmental pollution abatement (i.e., for industrial or urban pollution discharge standards and procedures) and on environmental quality standards for air, water, heavy metals, and toxic substances.
It established a system of environmental impact assessment which shall require any proposed project or business or activity or undertaking in Myanmar by any ministry, government department, corporation, board, development committee, local authority, company, cooperative, institution, enterprise, firm or individual likely to have a significant impact on the environment to obtain approval for its implementation in accordance with the Environmental Impact Assessment Procedure (2015).

3) Mandalay City Development Committee (MCDC)
Mandalay City Development Committee (MCDC) is the city government responsible for financing, planning and delivering urban services including waste management in all six townships of Mandalay city. The Mayor who is also the Minister for Development Affairs in Mandalay Regional Government heads the governing body of the MCDC. The Deputy Mayor, Secretary, Joint-Secretary and nine Committee members for the daily operation, assist the Mayor. Currently, MCDC is divided into 14 departments made up of over 6,000 staff. Among all these departments, the Cleansing Department (overall waste management), Water and Sanitation Department (water supply, waste water and sanitation management), Motor Transport and Workshop Department (waste collection), and Playgrounds, Parkes and Gardens Department (city greening and landscaping), Administration Department/ Finance Department (administration and city finance), Revenues Department (collection of waste collection fees), Agriculture and Livestock Breeding Department (agricultural waste), Public Relation and Information Department (information gathering and sharing), and Inspection Department

(inspection and monitoring) are focused on waste management activities in their respective areas.

Law, Bylaw, Operation Guidelines of Mandalay City Development Committee

- The City of Mandalay Development Law (2002)
- Revised Mandalay City Development Law – 12 Jan 2015
- Mandalay City Development Bylaw – 14 May 2015
- Operation Guidelines – for each set of sectoral activities
- Conservation of Environment and Cleansing is enacted included with package of tasks in Amending Law on Mandalay City Development Law, 2014.
- In bylaw, waste management and environmental conservation are taken account as essential requirements for Business Administration and Licensing Regulations.

3.4 Project's Environmental and Social Standards

3.4.1 Air emissions

The National Environmental Quality (Emission) Guidelines do not cover air emission guidelines of LFG flare and combustion.
If so, the standard values established by ***Protection of the Environment Operations (Clean Air) Regulation, Australia, 2010*** will be referred. Emissions from any internal reciprocating combustion engine fueled on landfill gas must not exceed the concentration limits in this regulation in **Table 3.4.**

Table 3.4: Gas Emission Standards for LFG Combustion Engine

Pollutant	Standard of Concentration (mg/m^3)
Hydrogen sulfide (H2S)	5
Nitrogen dioxide (NO2) or nitric oxide (NO) or both, as NO2 equivalent	450 (internal reciprocating combustion engine) 350 (flare)
Sulfuric acid mist (H2SO4) or sulfur trioxide (SO3) or both, as SO3 equivalent	100
Volatile organic compounds as n-propane equivalent	40

Emissions from landfill gas flares are regulated through the Environmental Permit for the landfill. The emission limit values in the following table were derived from comparable European standards and from various research projects, and published in the previous version of this guidance (Environment Agency LFTGN05 2004). International standards based on the ***UK Emission Standards for Enclosed Landfill Gas Flares*** are also described in **Table 3.5.**

Table 3.5: Emission standards for enclosed landfill gas flares

Determinant	Emission standard mg/m3 *
Oxides of nitrogen as NO2	150
Carbon monoxide CO	50-100
Total VOCs as carbon	10

Remark: * At STP (273K (0o C), 101.3 kPa), dry gas, 3 percent oxygen.

3.4.2 Wastewater

With the provisions of the National Environmental Quality (Emission) Guidelines, project types where industry-specific guidelines are not set out in these Guidelines, have to apply the following general guideline values during project operations in order to incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety or the environment.

Table 3.6: Wastewater, storm water runoff, effluent and sanitary discharges levels

Parameter	Unit	Guideline Value
5-day BOD	mg/L	50
COD	mg/L	250
Ammonia	mg/L	10
Arsenic	mg/L	0.1
Cadmium	mg/L	0.1
Chlorine (total residual)	mg/L	0.2
Chromium (hexavalent)	mg/L	0.1
Copper	mg/L	0.5
Cyanide (Free)	mg/L	0.1
Cyanide (Total)	mg/L	1
Fluoride	mg/L	20
Iron	mg/L	3.5
Lead	mg/L	0.1
Mercury	mg/L	0.01
Nickle	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
Sulfide	mg/L	1
Temperature	°C	<3b
Total Coliform	100ml	400
Total Phosphorus	mg/L	2
TSS	mg/L	50
Zinc	mg/L	2

3.4.3 Noise

Conformance with the provisions of the National Environmental Quality (Emission) Guidelines provide the basis for regulation and control of noise and vibration, air emissions, and effluent discharges of the Environmental Conservation Law —from various sources in order to prevent pollution for purposes of protection of human and ecosystem health.

Table 3.7: Noise standard value of Environmental Quality Guideline (EQG)

Receptor	One Hour LAeq (dBA)	
	Daytime 7:00 – 22:00	Nighttime 22:00 – 07:00
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Chapter 4

Description of the Project and Alternatives Selection

4. Description of the project

4.1 Project site location and description

The proposed Kyar Ni Kan landfill gas recovery project site is located in approximately 10 km north of the central Mandalay city. The exact GPS information of landfill site is (Latitude: 22.086969, Longitude: 96.162812).

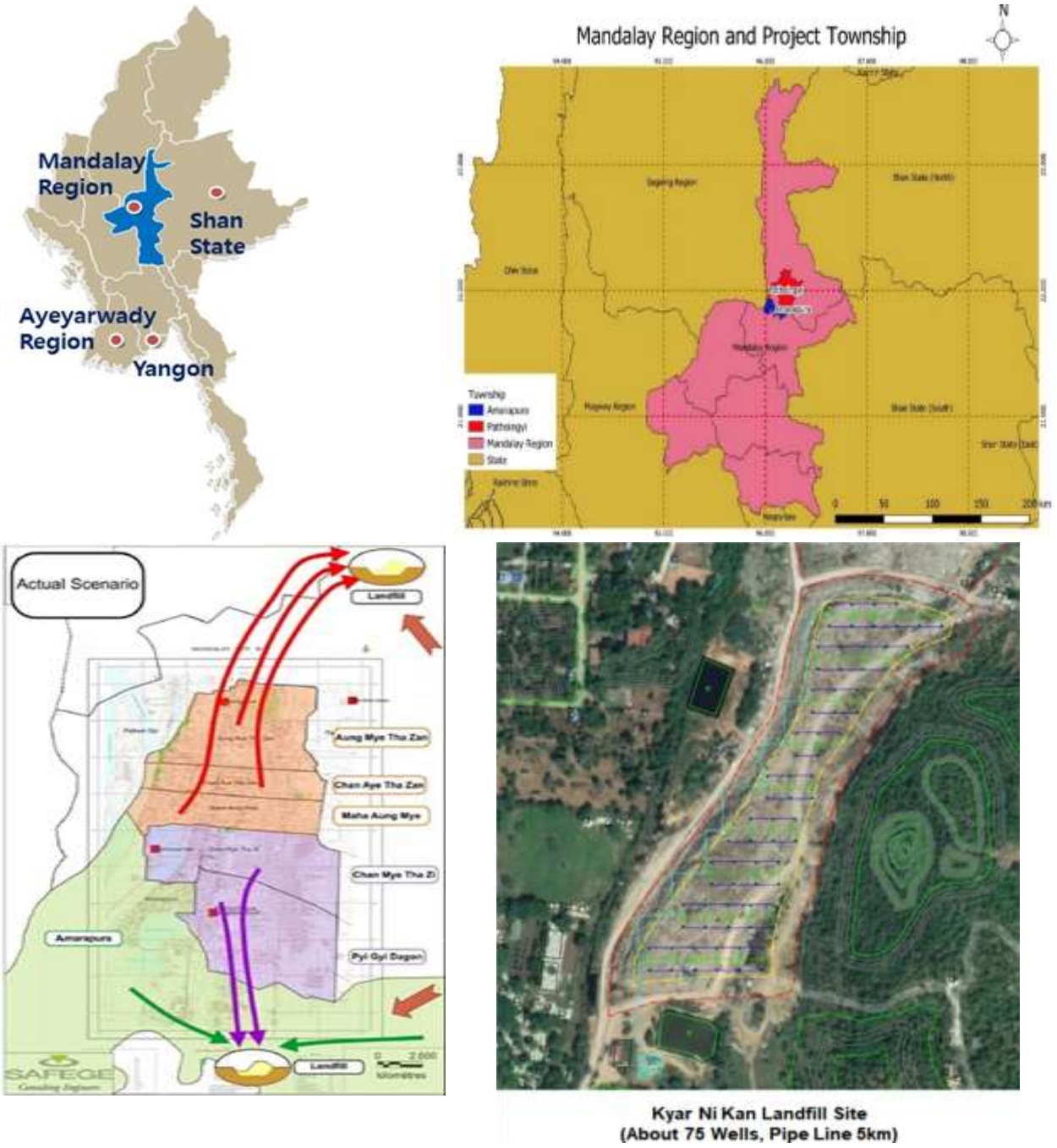


Figure 4.1: The Kyar Ni Kan landfill gas recovery project site located in the Patheingyi Township, Mandalay region

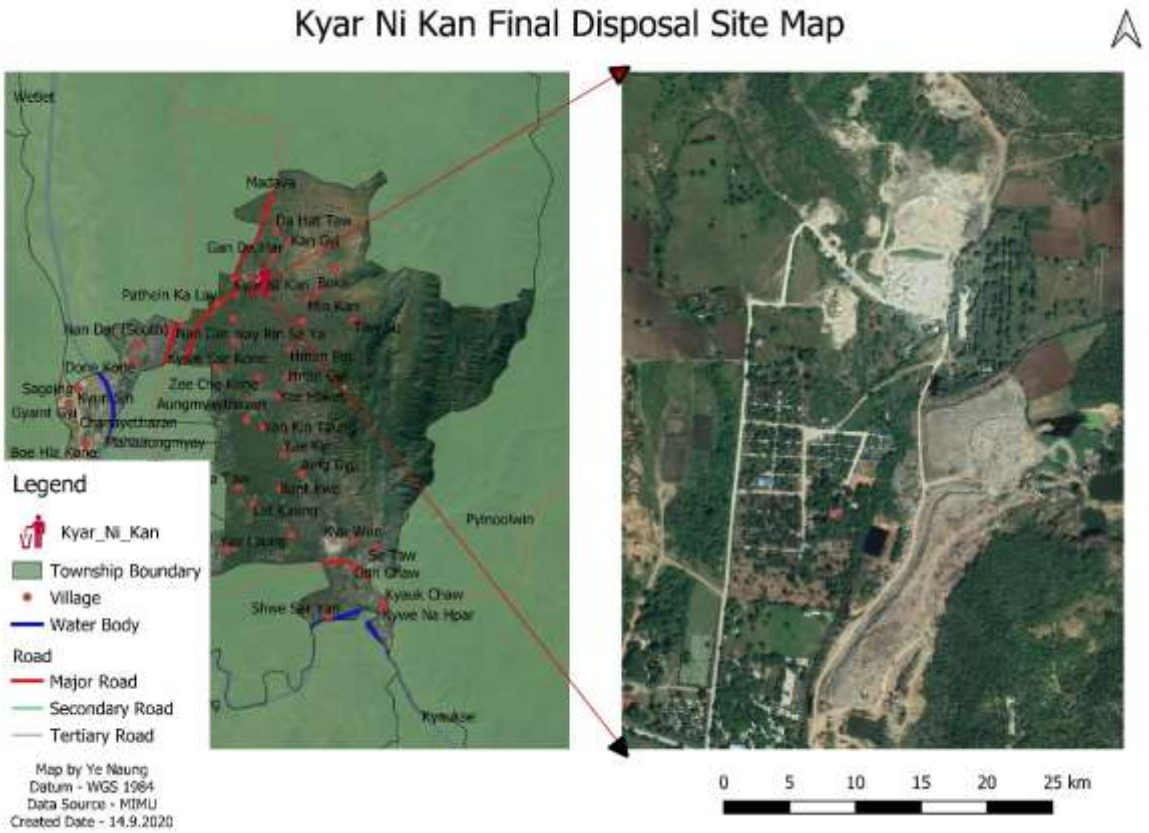


Figure 4.2: The map of the proposed Kyar Ni Kan landfill gas recovery project site

4.2 Objectives of the proposed project

The objectives of the Landfill Gas Recovery and Generation Project are as follows:

(1) To create a cleaning and developing land use mechanism

(2) To capture and flare the landfill gas (LFG) generated from the landfill site reducing atmospheric emissions of methane, a greenhouse gas (GHG) which contributes to global warming and climate change applying the Clean Development Mechanism (CDM)

(3) To ensure environmental conservation through innovation and improvement of final waste disposal site in Mandalay city according to Mandalay City Waste Management Strategy and Action Plan (2017-2030)

4.3 Project proponent information

The project proponents for the Landfill Gas Recovery and Generation are both Myanmar Government (Ministry of Natural Resources and Environmental Conservation (MONREC) and Mandalay City Development Committee (MCDC)) and Korea side (KOREA EAST-WEST POWER CO., LTD. and the HANATEC CO., LTD). This project is aimed at reducing atmospheric emissions of methane, a greenhouse gas (GHG) which contributes to global warming and climate change.

The following chart describes the detail information of the name of the project participant of Landfill Gas Recovery and Flaring Plant construction phase.

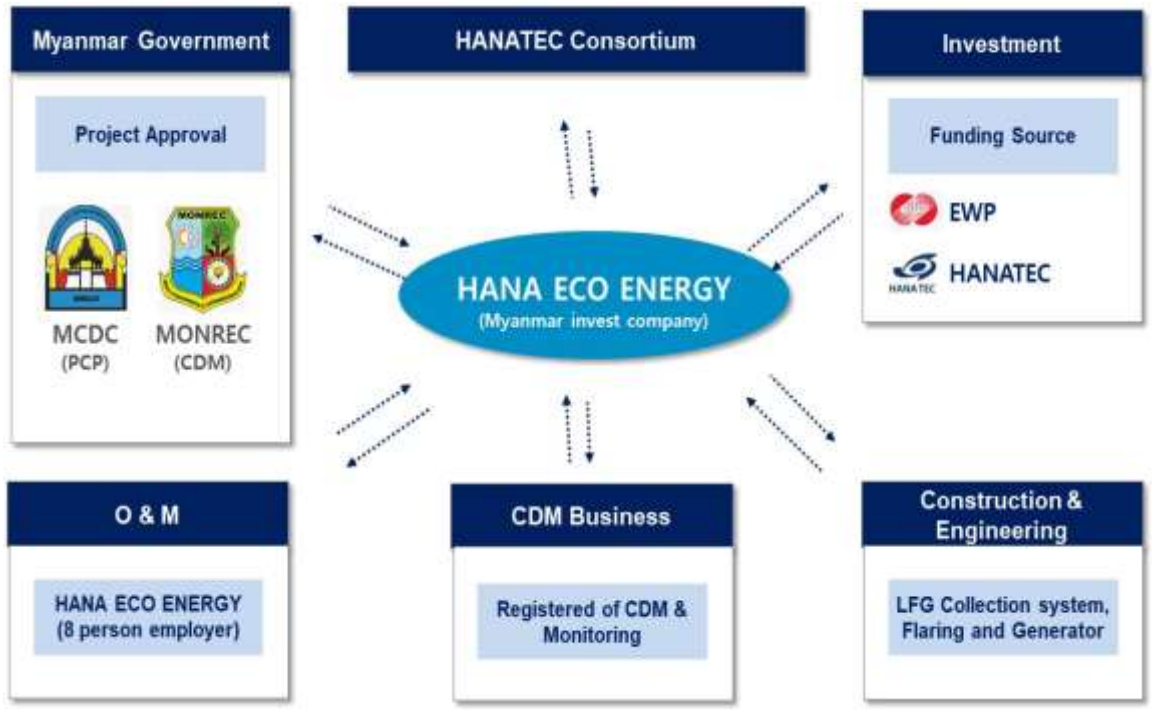


Figure 4.3: The project proponents

4.4 Project Schedule and financial plan

Earliest project start date	Construction start date (expected): 2020.12 (7 Months)
End date of project	Construction end date (expected): 2021.06 (7 Months)
Project lifetime	10 years (2021.8.1 ~ 2031.7.31)
For CDM projects: Expected Crediting Period	10 years

	PERIOD	UNIT	SUM	-1	0	1	2	3	4	5	6	7	8	9	10
	YEAR			2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	Expected Emission Reductions	Ton	265,404			31,149	30,001	28,904	27,850	26,851	25,891	24,972	24,092	23,249	22,441
	Myanmar NDC Share	Ton	26,540			3,115	3,000	2,890	2,785	2,685	2,589	2,497	2,409	2,325	2,244
Cash Inflow	Revenue	USD	4,777,266			560,478	540,914	520,266	501,383	483,322	466,040	449,497	433,654	418,478	403,933
	Total operating income	USD	4,777,266	-	-	560,478	540,914	520,266	501,383	483,322	466,040	449,497	433,654	418,478	403,933
Cash Outflow	CAPEX	USD	2,577,338	328,198	2,051,433	197,707	-	-	-	-	-	-	-	-	-
	1. Construction	USD	2,057,961	166,492	1,693,762	197,707	-	-	-	-	-	-	-	-	-
	(1) Civil Works	USD	19,627	19,627	-	-	-	-	-	-	-	-	-	-	-
	(2) Construction	USD	146,865	146,865	-	-	-	-	-	-	-	-	-	-	-
	(3) Piping & Installation	USD	6,922	-	6,922	-	-	-	-	-	-	-	-	-	-
	(4) Machinery	USD	1,292,692	-	1,094,985	197,707	-	-	-	-	-	-	-	-	-
	(5) Electricity and measurement contr	USD	591,855	-	591,855	-	-	-	-	-	-	-	-	-	-
	2. Shipping & Customs	USD	159,705	159,705	-	-	-	-	-	-	-	-	-	-	-
	(1) Shipping Cost	USD	71,771	71,771											
	(2) Customs	USD	87,934	87,934											
	3. Others	USD	367,671	-	367,671	-	-	-	-	-	-	-	-	-	-
	(1) Electricity Cost	USD	2,415	-	2,415	-	-	-	-	-	-	-	-	-	-
	(2) Labor Cost	USD	9,660	-	9,660	-	-	-	-	-	-	-	-	-	-
	(3) Office Rent fee	USD	2,415	-	2,415	-	-	-	-	-	-	-	-	-	-
	(4) Design & Supervision	USD	125,000	-	125,000	-	-	-	-	-	-	-	-	-	-
	(5) Others	USD	103,020	-	103,020	-	-	-	-	-	-	-	-	-	-
	(6) Reserve	USD	125,162	-	125,162	-	-	-	-	-	-	-	-	-	-
	OPEX	USD	2,974,338	-	144,859	196,478	198,502	196,838	206,035	205,888	201,377	212,968	207,013	217,839	94,097
	(1) Facility Operation Cost	USD	817,516	-	47,574	69,052	46,502	48,160	55,953	53,306	46,652	105,752	46,552	103,346	13,636
	(2) CDM Verification & Validation	USD	433,333	-	25,000	50,000	58,333	50,000	50,000	50,000	50,000	-	50,000	-	50,000
	(3) Labor Cost(Myanmar)	USD	306,807	-	19,929	27,361	28,181	29,027	29,898	30,795	31,718	32,670	33,650	34,660	8,925
	(4) Hana Eco Energy O&M Cost	USD	699,497	-	41,657	58,431	60,242	62,111	64,043	66,037	68,097	70,225	72,424	74,695	21,536
	(5) Others	USD	8,104	-	5,362	546	487	427	366	305	244	183	122	61	-
	(6) Reserve	USD	49,281	-	4,544	5,078	4,766	5,091	4,766	5,346	4,766	5,078	4,766	5,078	-
	Total Cash Outflow	USD	4,651,676	328,198.1	2,206,482.5	378,177.4	198,681.8	196,838.8	206,025.0	205,888.2	201,377.3	212,968.4	207,513.4	217,839.0	94,097.0

Figure 4.4: Financial Plan (Capex & Opex)

4.5 Project site description

4.5.1 Proposed activities

The project activities involve the capture of methane to produce electricity for the on-site needs. In the process, heat will also be used to evaporate leachates. A back-up enclosed flaring unit will also be part of the project. GHG emission reductions will result from the efficient combustion of otherwise flared LFG, in the power generation, leachate evaporation, and flaring equipment.

The project involves methane destruction through burning and combustion in internal-combustion engines, while generating energy that will be used internally in the landfill. Other activities also include a gas extraction system, equipment for gas burning, a gas pre-treatment plant and gas reception engines, as well as the engines for burning the Landfill Gas (LFG) generated in dumping zones.

The Power Plants will be installed comprehensively over the closed areas of the landfill. Installations will include initially approximately 112 (Kyar Ni Kan Landfill Site) vertical extraction wells of high-density polyethylene pipes (HDPE). The plants also include an automatic flare & generator plant composed by blowers, moisture separator and enclosed flaring & generator plant, and the LFG measuring and recording equipment.

The flaring plant will a maximum capacity of 500 Nm3/hr and generator plant will have a maximum capacity 500 kW (500kW X 1 set) and destruction efficiency between 98% and 100%.

4.5.2 Technology to be employed

The LFG collection typically begins after a portion of the landfill (known as a "cell") is closed to additional waste placement. Collection systems can be configured as either vertical wells or horizontal trenches. Most landfills with energy recovery systems include a flare for the combustion of excess gas and for use during equipment downtimes.

The Kyar Ni Kan proposed project will configure the most common method of LFG collection involving drilling vertical wells in the waste and connecting those wellheads to lateral piping that transports the gas to a collection header using a blower or vacuum induction system.

4.5.3 Greenhouse gases targeted ($CO_2/CH_4/N_2O/HFCs/PFCs/SF_6$)

The implementation of project activities in the target areas will contribute positively to climate change, as the emission of greenhouse gases emission will be reduced. Methane (CH_4) is the main GHG generated at the landfill, and combustion of such gas yields carbon dioxide (CO_2) which is less harmful (being methane 25 times as dangerous as carbon dioxide in terms of climate change); other compounds destroyed by flaring include ammonia. Also, electricity generated from project activity will replace fossil fuel power generation supplied to the grid. In the absence of the project this energy would have been generated with fossil fuel sources.

4.5.4 Type of activities for CDM

AMS-III.G."Landfill Methane Recovery" version 10.0
AMS-I.D."Grid connected renewable electricity generation" version 18.0

4.5.5 The collection system

It will be installed comprehensively over the closed areas of the landfill. Installations will include initially approximately 112 vertical extraction wells of high-density polyethylene pipes (HDPE).

4.5.6 Flare & Generator plant

The project also includes an automatic flare & generator plant composed by blowers, moisture separator and enclosed flaring & generator plant, and the LFG measuring and recording equipment. The flaring plant will have a maximum capacity of 500 Nm^3/hr and generator plant will have a maximum capacity 500 kW.

4.5.7 The equipment system

The various equipment system will be installed in the proposed project: as collection wells and piping

- **Extraction system**: Blowers, Valve and Flow control systems
- **Condensate systems**: Traps and knock out vessels, pipes to remove gas condensates
- **Blower**: Blower is necessary to pull the gas from the collection wells into the collection header and convey the gas to downstream treatment and energy recovery systems. The size, type and number of blowers needed depend on the gas flow rate and distance to downstream processes
- **High temperature Flaring Station**: A flare is a device for igniting and burning the LFG. Flares are a component of each energy recovery option because they may be needed to control LFG emissions during start up and downtime of the energy recovery system and to control gas that exceeds the capacity of the energy conversion equipment. In addition, a flare is a cost-effective way to gradually increase the size of the energy generation system at an active landfill. As more waste is placed in the landfill and the gas collection system is expanded, the flare is used to control excess gas between energy conversion system upgrades to prevent methane from being released into the atmosphere.

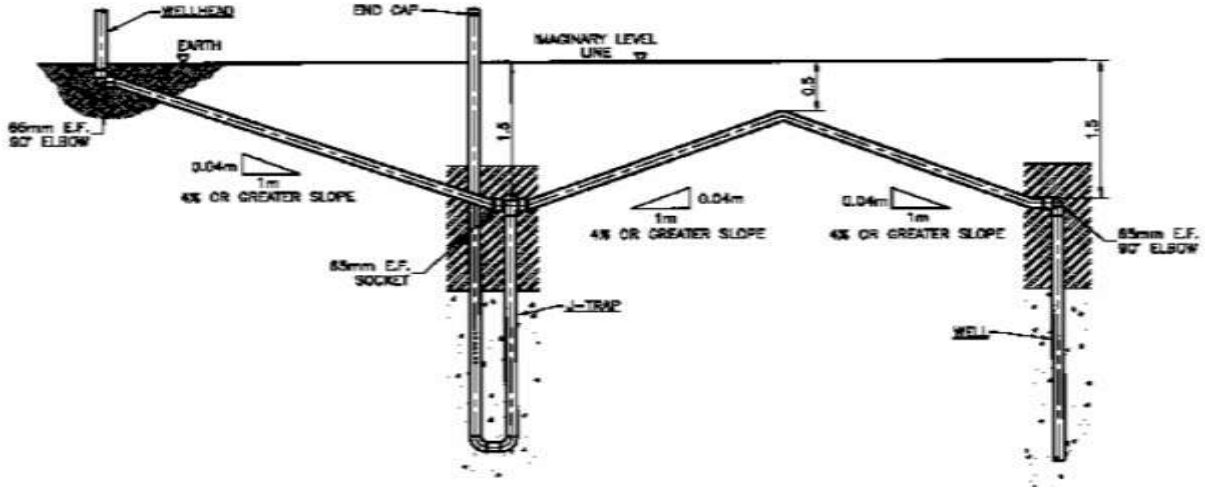


Figure 4.5: Landfill gas capture system

4.5.8 Investment plan

The project is expected to invest approximately USD 4.6 million in construction and operation over 10 years; consisting of CAPEX USD 2.6 million and OPEX USD 2.0 million (10 years). Of the total investment cost, the Korea East-West Power Co., LTD will invest USD 3.9 million in cash, and the HANATEC Co., LTD will invest USD 0.7 million in cash and kind. The Mandalay City Development Committee (MCDC) will give the above two investors the right to use two landfill sites and landfill gas over a decade.

Table 4.1: Summary of the financials

Source	Amount ($ Million)
Korea East-West Power Co., Ltd.	3.9
Hanatec Co., Ltd	0.7
The Mandalay City Development Committee (MCDC) will give the above two investors the right to use two landfill sites and landfill gas over a decade.	

4.5.9 Requirement of electricity and fuel

The total power required for the proposed unit will have a maximum capacity of 500 Nm^3/hr for the flaring plant. Since the project is recognized for GHG reduction through annual monitoring, data management is critical, and the amount of LFG flow consumed must be recorded in real time. In addition, the concentration of LFG shall be checked and recorded. All facilities operate 24 hours a day, and emergency generator facilities are available in case of power failure. Two warehouse facilities will be constructed for storing power generation facilities and parts as well. There is one generator in the construction site (generator plant will have a maximum capacity 500 kW (500 kW X 1 set) which are for lighting and construction process, etc.

4.5.10 Firefighting system

Being no data available for the construction project, the following estimations were calculated as the maximum estimation.

The carbon dioxide fire extinguishers are placed near the fuel (e.g. diesel) tanks for the potential of fire emergency cases. The fire extinguishers are placed next to the special purpose areas for emergency situations. In case of a fire emergency, approximately the volume of 32,000 gallons water is stored in the water storage tank within the project area. With the installation of compressor, air valve and fire hoses for fire protection in suitable places of the projected site and , water for firefighting will be used from the water storage tank. The fire safety training module is also designed to all staff for preventive measures to eliminate causes of fire or fire hazards in the workplace.

4.5.11 Water requirement

The main sources of water are assumed that ***tube wells*** and ***public supply*** will be utilized for the ***construction phase, operation phase*** and **decommissioning phase**.

There may be one tube well having approximately 200-300 feet depth based on Mandalay hydrogeology information and capacity of producing average 800-1,000 gallons per hour from the tube well will be settled. The total water usage of the project site is approximately 30 m3/day (7,925 gallons/day). The total water requirement for construction period (6 months) ***is 5,400 m^3 /6 months*** (1,426,500 gallons/6 months). The required water for construction of proposed project is

being supplied from the public supply through water pipelines and stored water storage tanks (6,400 gallons and 32,000 gallons) in the project site.

The ***total water usage*** of the project site during the operation phase would be only for shower and toilet which can be assumed as 100 gallons per day per person. For drinking water, purified drinking water bottles are being used.

4.5.12 Auxiliary facilities

The following assumed auxiliary facilities and other infrastructures shall be established in support to the functional requirements of the facility;

- Perimeter Fence
- Entrance Gates / Guard House / Wash Bays
- Weigh Bridge
- Power Station
- Administration Building
- Motor Shop / Work shop
- Parking Areas
- Leachate treatment reservoir
- Social and Changing Room for Workers
- Monitoring wells
- Drainage System

4.5.13 Requirement of human resources

During the construction phase, all the staff members of the project have to finish Occupational Safety and Health Administration (OSHA) training before going to the construction site. The required resources (human and machinery lists) of the project are shown in the following tables (4.2) and (4.3).

Table 4.2: Assumed human resource assignment for the proposed project

Sr.No	Personnel	Day	Night
1	Project Manager (PM)	1	
2	Assistant Project Manager	2	
3	Site Engineer	2	1
4	Surveyor	2	
5	QA/QC (Site Inspection)	1	
6	M&E Engineer	2	
7	Safety	2	
8	Admin	1	
9	Laboure	15	
10	Store Keeper	1	
11	Security	1	2
12	Driver	8	
Total		**38**	**3**

Table 4.3: Assumed equipment lists for the proposed project

Sr.No	Particular	Quantity
1	Dozer	1
2	Waste compactor	1
3	Wheel Loader	2
4	Wheeler Dump Truck	3
5	Material Handler	1
6	Generator	1
Total		**9**

4.6 In detail technologies/measures

The proposed Kyar Ni Kan project involves drilling vertical wells in the waste and connecting those wellheads to lateral piping that transports the gas to a collection header using a blower or vacuum induction system.

This includes:

- Levelling of the landfill surface to ensure appropriate surface drainage
- Drilling of gas wells into the landfill and installation of a gas collection system
- Installation of drainage facilities for the captured the gas
- Installation of a pumping and measuring system, which will extract the gas from the landfill Installation of a flaring system

The equipment is connected to on-site electric system to satisfy their energy needs and may use back-up such as reciprocating engines, turbines, microturbines, fuel cells or other energy sources.

The gas plant is provided with full safety and tamper proof monitoring equipment including gas analysis, flow measurement and combustion control instrumentation to provide electronically recorded data of both the flow rate of the residual gas and methane content. Optionally, the equipment may include instruments to measure methane destruction efficiency of the controlled combustion flare.

The project consists of the preparation of the landfill as well as the collection and flaring of the gas which is emitted from the landfill.

4.6.1 Covering with soil

The daily cover on an operational landfill site is the layer of compressed soil or earth which **is** laid on top of a day deposition of waste. The cover helps prevent the interaction between the waste and the air, reducing odors and enabling a firm based upon which vehicles may operate. The clay, plastic, special fiber, gravel and soil are the important layers for the landfill to be safe.

Clay barriers are generally used as liners and capping materials for landfill sites. In each case they isolate potentially polluting wastes from the surrounding environment such that the environmental impacts attributable to a landfill are minimized.

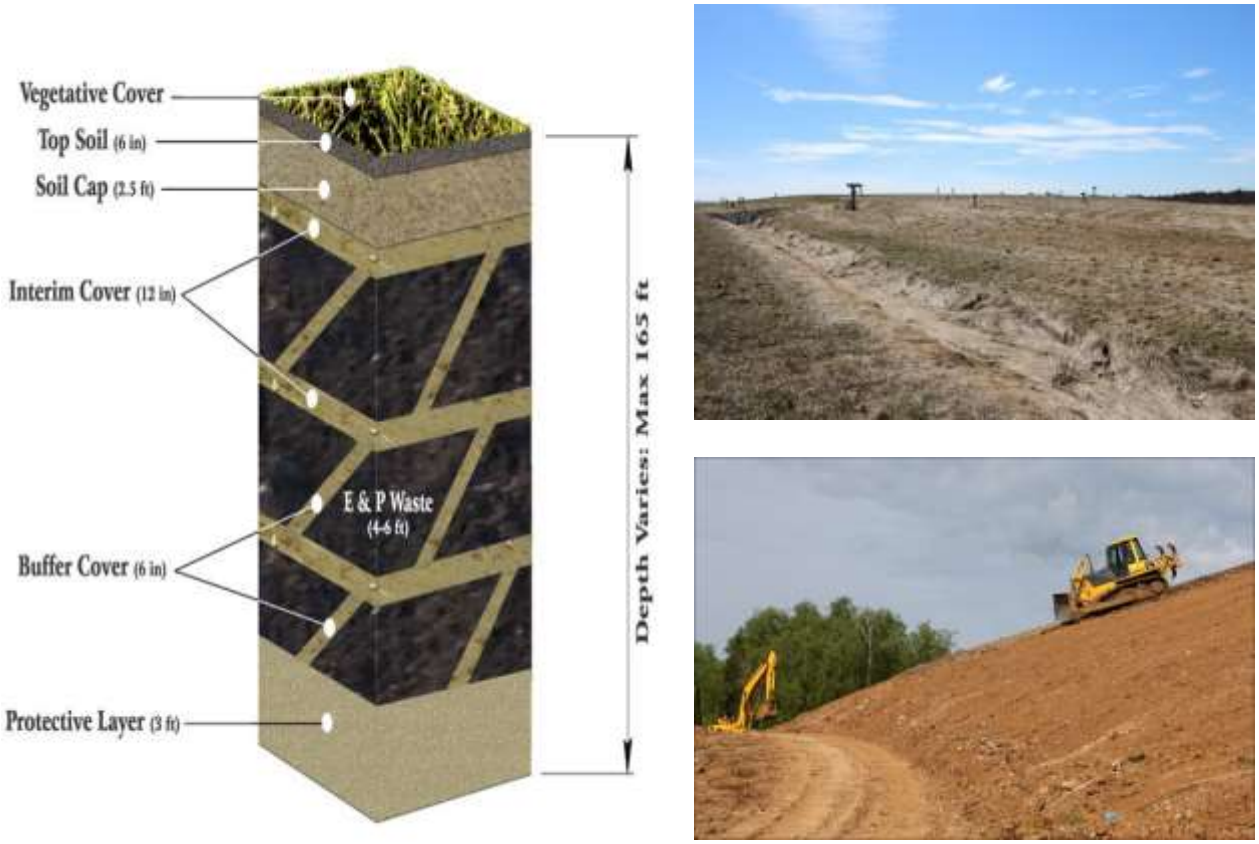


Figure 4.6: Covering soil at proposed project

4.6.2 Project boundary, sources and greenhouse gases (GHGs)

The project boundary is the physical, geographical site of the landfill where the gas is captured and destroyed/used.

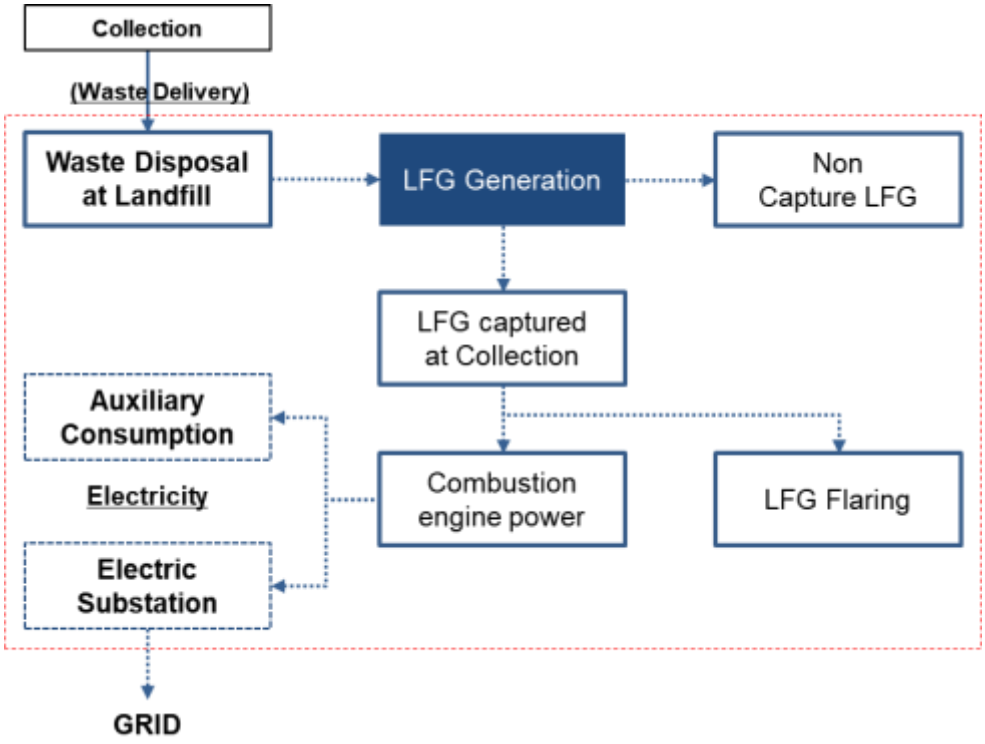


Figure 4.7: General layout plan of the proposed project

Table 4.4: Facility of the proposed project

Facility	content	Quantity
Vertical Well	Capturing the LFG (200A, HDPE 10m)	112 EA
Main Pipe	Transfer LFG to Flaring System	1EA (200m)
Flaring System	Burning Methane	500 Nm^3/hr
Generator	Generate Electricity	1EA (500kW)

4.7 Production Process

Emission reductions will be achieved through the installation of equipment above mentioned to draw landfill gas out of the landfill into a network of pipes, directing it to a series of gas conditioning equipment followed by combustion in either engine-generator sets or an enclosed flare.

By drawing landfill gas out of the landfill and combusting it, the powerful climate change effects of anthropogenic methane gas which would otherwise be emitted to the atmosphere are mitigated as the methane is converted to carbon dioxide, a biogenic result of organic decomposition.

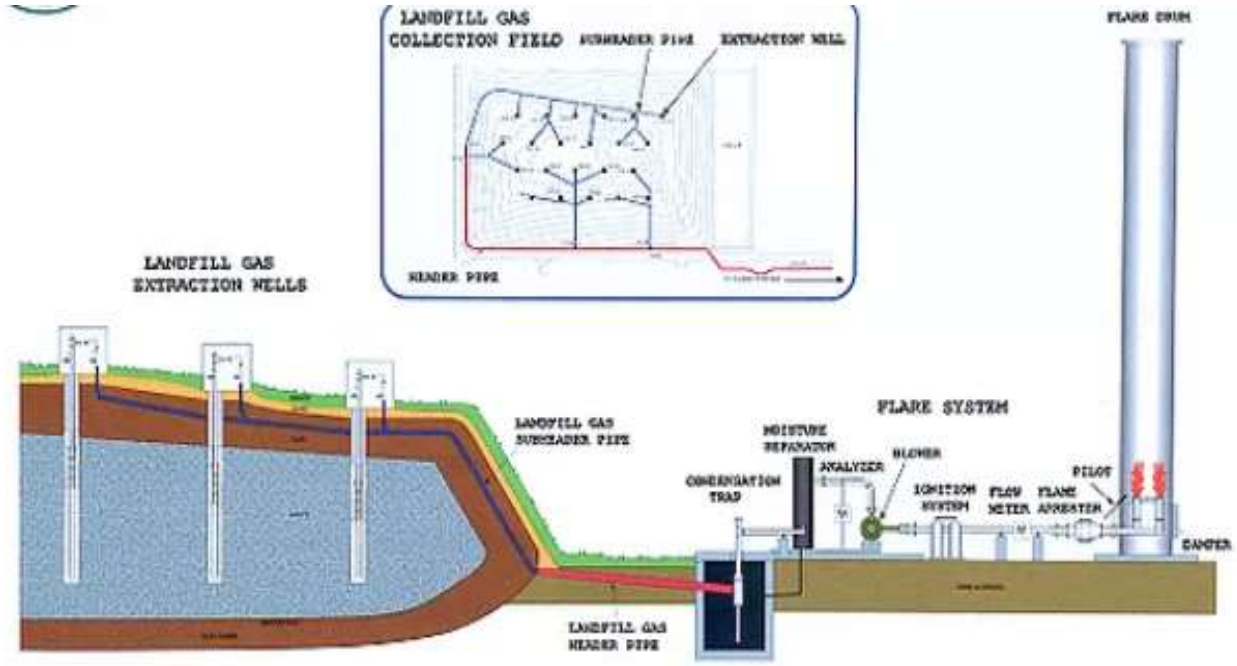


Figure 4.8: Overview of the production process

4.7.1 Processing

The Project includes the following components:

- construction of new landfill gas collection wells,
- installation of new landfill gas condensate collection/injection wells;
- installation of lateral piping within each cell to a collection header for the cell;
- installation a main header pipe which collects gas from all cell collection headers;
- installation of blowers to create a pull on the landfill gas;
- installation of two landfill gas conditioning and compression skids
- installation of the enclosed landfill gas flares;
- installation of two engine-generator sets;
- construction of a building to house Project equipment;
- creating and staffing a landfill gas operations position to monitor and maintain the gas

wells and monitoring equipment;
• conducting appropriate maintenance on all Project equipment.

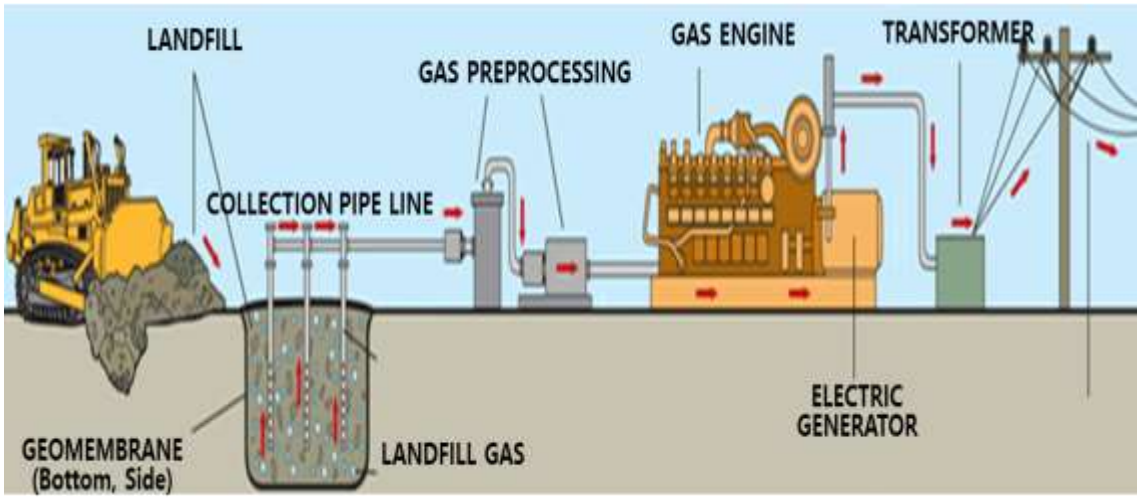


Figure 4.9: Landfill gas extraction, collection, flaring and electricity generation

Figure 4.10: Overview process of the landfill gas recovery and electricity generation project

4.8 Phase (1) LFG Collection Facility

A total of 112 gas collection wells are planned to be installed in Kyar Ni Kan Landfill. To collect LFG in Kyar Ni Kan Landfill, the construction will proceed in two stages. In the first stage, 69 collection wells will be installed in November 2020; and in the second stage, 43 will be installed in November 2022. The collection well will be installed in the landfill at a depth of 10 meters and has a diameter of 200 mm. Near the collection wells in the landfills, gravel will be installed as a

filter between garbage and the collector. The collected LFG will be transported to the LFG power plant through 100 mm and 200 mm LFG transfer pipe line.

Also these pipes will end with a perforated top and will rest over a bed of rocks of 0.6m (24 inch) wide. The pipelines will be surrounded by gravel of 1.5 to 3.0 inch that would serve as a filter between the pipelines and solid waste. 60% of the pipeline length will be covered with this gravel. These pipes will be coupled to a HDPE pipe grid to transport the LFG to the flare & generator plant and LFG control plant.

The diameters of the pipes that compose the grid will be 100mm (4 inch) and 200mm (8 inch). These pipes are joined through thermos fusion. The system is hermetically sealed to compensate all the pressure forces existent in the grid.

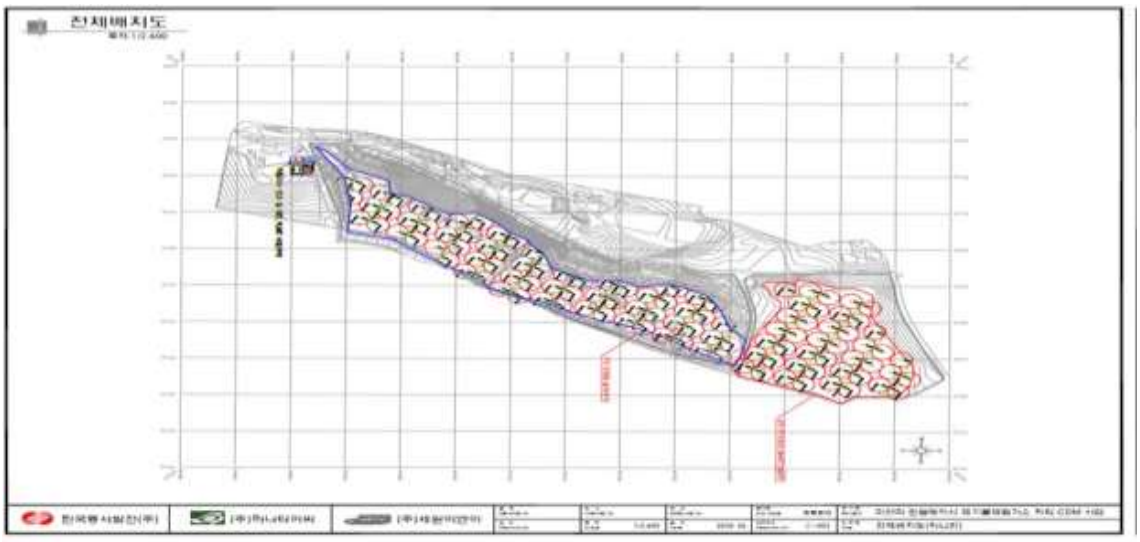
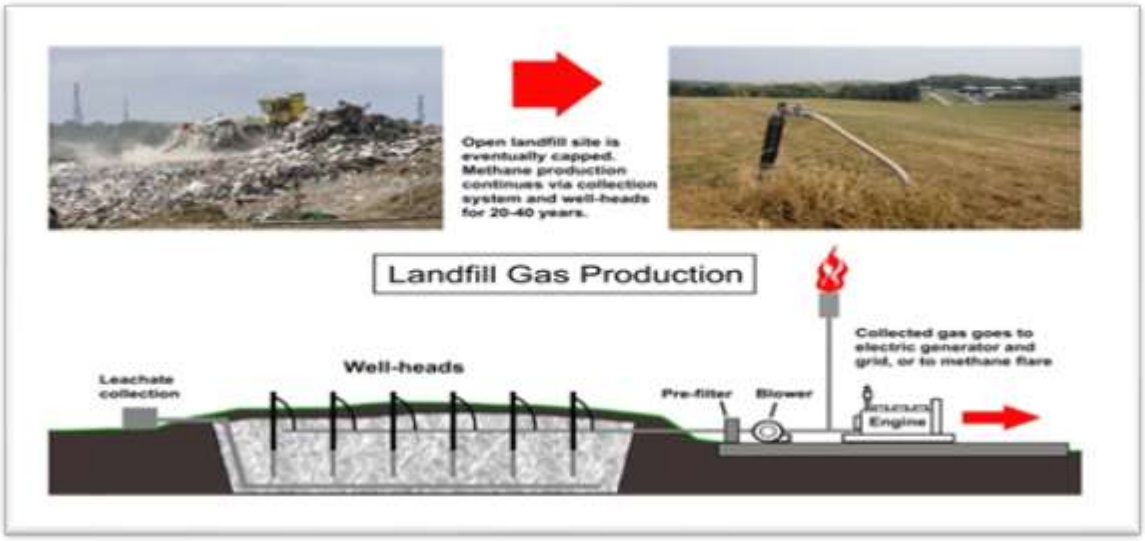
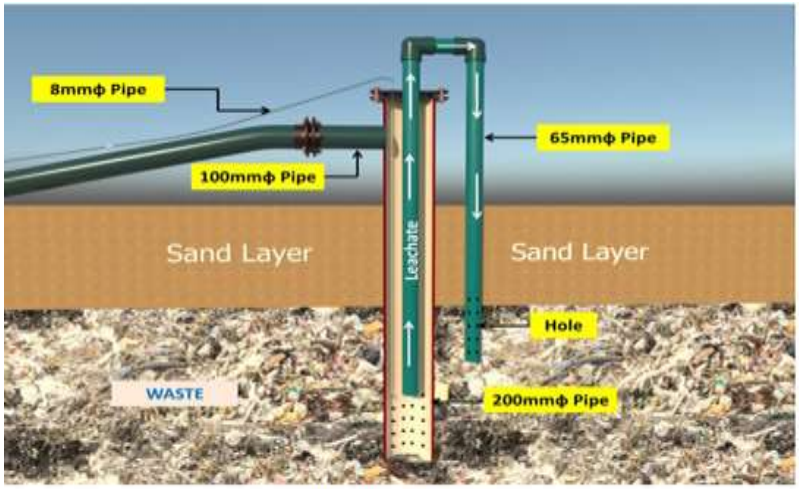


Figure 4.11: LFG Pipeline Installation Plan Layout





Conceptual Diagram
(Landfill Gas Collection Pipe Line)

LFG Collection Well (Sample)

Figure 4.12: Phase (1) Construction of landfill gas collection facility

4.9 Phase (2) Flaring System

The gas flaring facility, which incinerates LFG, is installed in each landfill at a capacity of 500 Nm^3 per hour. It operates 24 hours a day except for some maintenance periods. HANATEC has many installation experiences and performances in Korea, and those facilities are still in a normal operation.

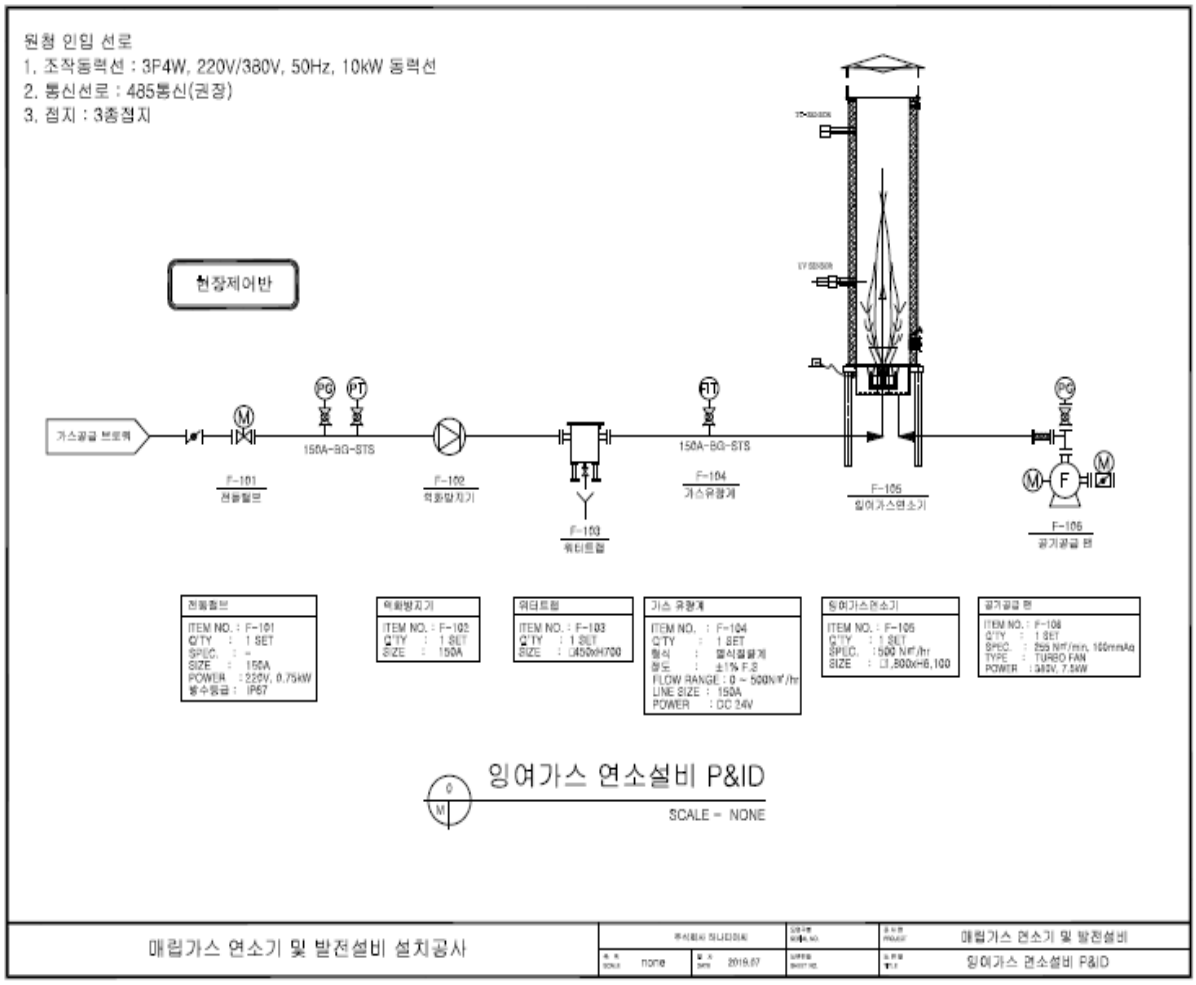


Figure 4.13: Phase (2) Landfill gas flaring system

Gas Flaring Facility (500 Nm³/hr X 24 hr)

Figure 4.14: Phase (2) Landfill gas flaring facility

4.10 Gas Monitoring

Since the project is recognized for GHG reduction through annual monitoring, data management is critical, and the amount of LFG flow consumed must be recorded in real time. In addition, the concentration of LFG shall be checked and recorded. All facilities operate 24 hours a day, and emergency generator facilities are available in case of power failure. Two warehouse facilities will be constructed for storing power generation facilities and parts as well.

Gas Analyzer **Gas Flow Meter**

Figure 4.15: Gas Monitoring Equipment

4.11 Phase (3) LFG Generation

The project also includes an automatic flare & generator plant composed by blowers, moisture separator and enclosed flaring & generator plant, and the LFG measuring and recording equipment. The flaring plant will have a maximum capacity of 500 Nm3/hr and generator plant will have a maximum capacity 500 kW electricity charge free service, and destruction efficiency between 98% and 100%.

The power plant facility, which uses LFG to generate electricity, will install set of generators at the Kyar Ni Kan Landfill to generate 500 kW of electricity per hour. The generator will operate for 4 hours a day from Monday to Friday, producing about 192MWh of electricity a year. The electricity produced will be provided free of charge to operate the Kyar Ni Kan Landfill in Mandalay City.

This system will have thermocouples that would allow to control the temperature of the flame in order to guarantee the destruction efficiency of the system standard operation and maintenance (O&M) program for LFG collection and system equipment will be implemented according to equipment manufacturer. It is projected that future well-field expansions to collect LFG from 2nd and 3rd areas will require new wells during each year of operation. Wells that are inefficient will need to be, recovered, replaced or closed.

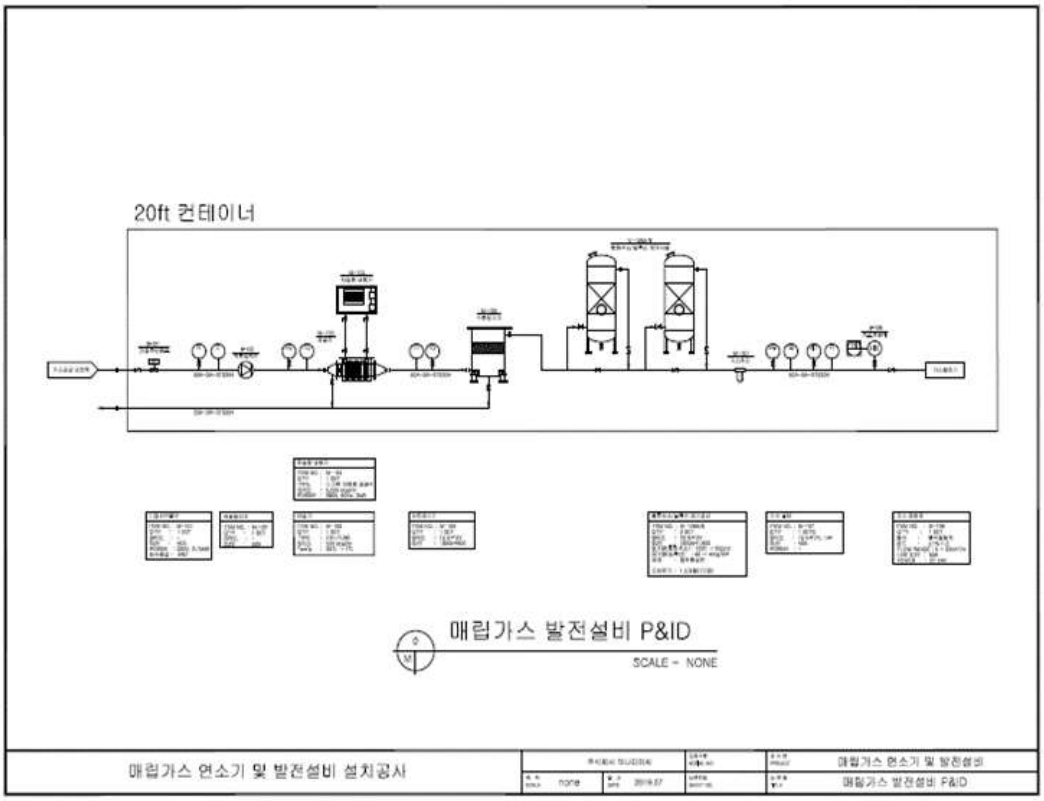


Figure 4.16: Phase (3) Landfill gas power generation system

500 kW LFG Generator
(Operating time : 1day X 3 hr ~ 5 hr)

Figure 4.17: Phase (3) Landfill gas generation

Figure 4.18: Open type generator

Figure 4.19: Sound proof generator (non-weather proof)

Figure 4.20: Sound and weather proof type generator

4.11.1 Advanced control system

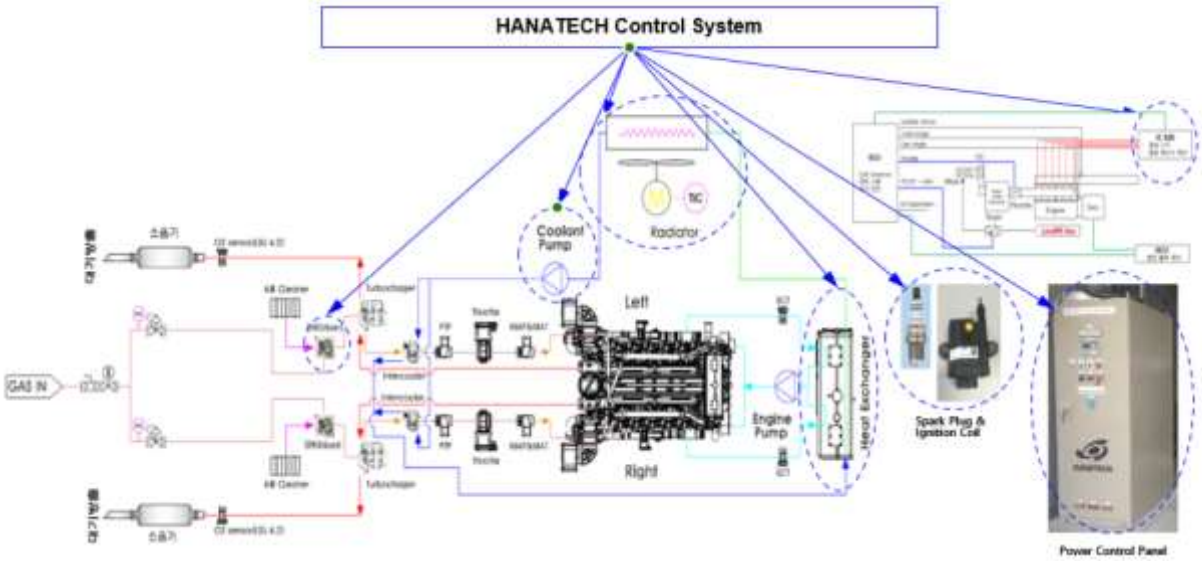


Figure 4.21: Advanced engine control system for power generation efficiency

Radiator : Improvement and development of thermal capacity for open type
Inter-cooler : Improvement of mixer cooling performance
Increase ignition system (Ignition coil, Spark plug, etc) capacity : Estimate of combustion phenomena due to engine rev change
Optimization development of ECU software, ignition software, gas management control software, etc
Optimization development of synchronous generator, power company connection system

4.12 Alternatives selection

The no alternative development option would prevent all potential environmental and social impacts due to the Landfill Gas Recovery and Generation Project at the Kyar Ni Kan landfill site.

The proposed project activity faces a number of barriers of which the economic unattractiveness, lack of technical know-how, lack of availability of equipment. The implementation of this project activity will assist the Government of Myanmar in demonstrating the practice of landfill gas recovery, in building of local know-how about LFG recovery and flaring & generator system about correct landfill site management after closing time.

In addition, the conversion of unsanitary landfills to sanitary landfills requires additional equipment, such as leachate treatment and soil cover, which requires significant financial support. Such sanitary landfills are a prerequisite for an LFG power plant. On the other hand, under the landfill situation in Myanmar, private companies can't invest and earn profits
.
Meanwhile, the implementation of the project activities will also demonstrate how the UN CDM process could assist in making the practice of LFG recovery economically viable for only the Korean companies with the strongest sales revenue of UN CDM CERs.

Moreover, if the project proponent recognises and complies with the mitigation measures, HSE regulations and management plan described in the EMP accordingly, the overall impacts likely affected by the project activities (construction, operation and decommissioning phases) become rated as insignificant. In the absence of the project activity, biomass and other organic matter are left to decay within the project boundary, and methane is emitted to the atmosphere and the national grid will continue to produce electricity with the current mix of power sources, including natural gas and coal.

Chapter 5

Description of the Surrounding Environment

5. Description of the surrounding environment

5.1 Introduction

This chapter reports a description of the surrounding environment of project based on a review of the valuable data related to the existing baseline air, water, noise, soil and waste monitored at and around the proposed project site. The more detailed and in-depth analysis will be provided accordingly in the sub sections.

5.2 Local climate and meteorology

The Mandalay lies on 83m above the sea level and its climate is a local steppe climate. A steppe climate, with cold winters and hot, dry summers, and little rainfall throughout the year.

Table 5.1: Meteorology data of Mandalay

Meteorology	Meteorology Data	Station	Unit	Hour	Year
Minimum Temperature in a year	22.5	Mandalay	°C	_	2018
Minimum Temperature in a year (2018)	33.7	Mandalay	°C	_	2018
Average annual pressure	1010.2	Mandalay	hPa	09:30	2018
Average annual pressure	1005.7	Mandalay	hPa	18:30	2018
Average annual Dry Bulb	26.6	Mandalay	°C	09:30	2018
Average annual Dry Bulb	30	Mandalay	°C	18:30	2018
Average annual Wet Bulb	23	Mandalay	°C	09:30	2018
Average annual Wet Bulb	24.5	Mandalay	°C	18:30	2018

Average annual Dew Point	21	Mandalay	°C	09:30	2018
Average annual Dew Point	21.7	Mandalay	°C	18:30	2018
Average annual wind speed	1.9	Mandalay	m.p.h	09:30	2018
Average annual wind speed	1.2	Mandalay	m.p.h	18:30	2018
Average annual wind direction	South and South East	Mandalay		09:30	2018
Average annual wind direction	CALM	Mandalay		18:30	2018

Source: Meteorology Department, Mandalay (2018)

(i) Surface wind speed and flow directions (blowing to) in Mandalay

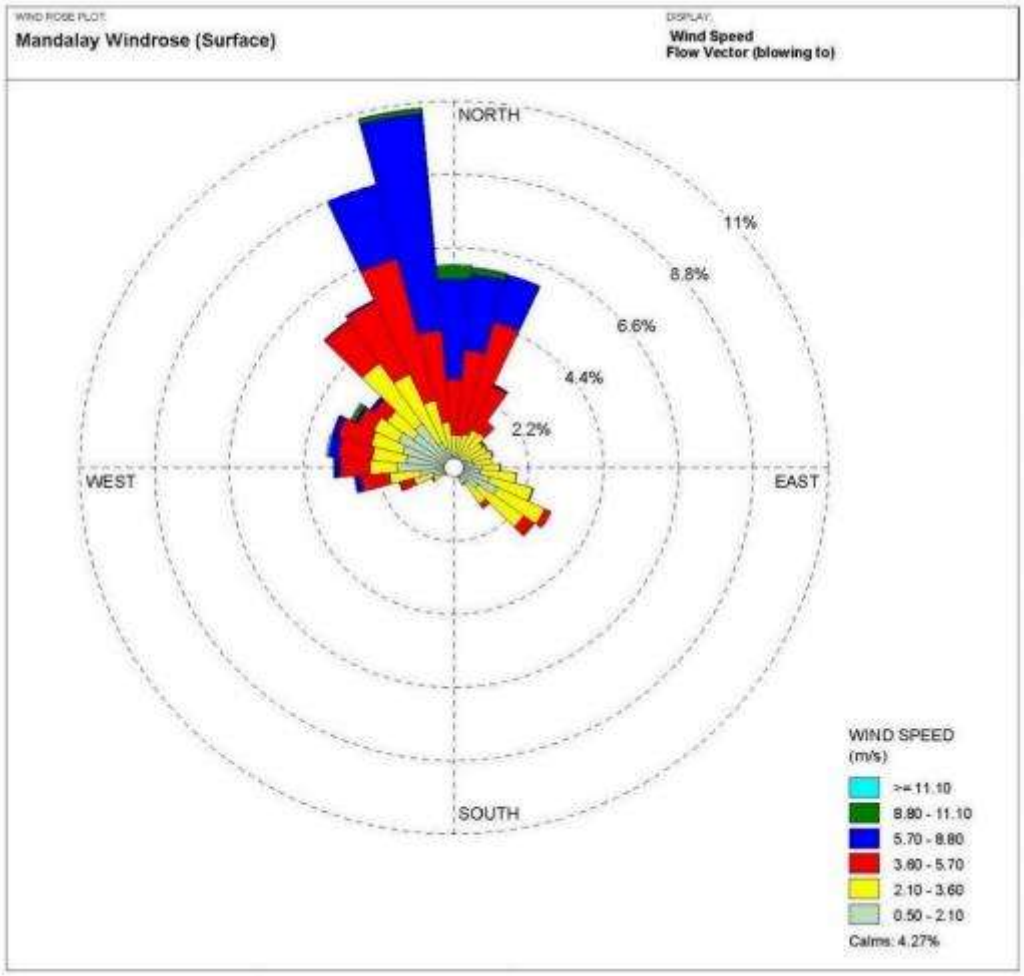


Figure 5.1: Surface wind speed and flow directions (blowing to) in Mandalay (Source: WRF-MMIF form Mandalay)

5.2.1 Patheingyi Township

The Patheingyi township where the project site located has a hot and humid climate with opinion temperature 37°C and minimum temperature 29°C (2019). The Patheingyi township experiences monsoon rains and is considered to be a tropical savannah, averaging 624 mm of rain annually (2019).

(i) Onsite meteorology

The onsite meteorology data measured indicated temperature, relative humidity, and wind speed and wind direction. Table 5.2 shows the average temperature was around 23° C and relative humidity was 47%. These parameters do effect on the air quality status.

Table 5.2: Meteorology data obtained from air quality sampling stations at Kyar Ni Kan Landfill Site

Parameters	Kyar Ni Kan Lanfill Site
Temperature (Degree C)	23[a]±3[b] 23[c](20[d]-25[e])
Relative Humidity (%)	47[a]±14[b] 47[c](33[d]-61[e])

a Average b SE c Median d Min e Max

5.3 Existing baseline ambient air quality

5.3.1 Introduction

The baseline ambient air monitoring was carried out at the Kyar Ni Kan lndfill site as well as the vicinity located within 2 km of the project site in September, 2020 in order to reveal the existing air quality status at and around the proposed project.

5.3.2 Objective

The objectives of the monitoring are:
• To reveal the existing baseline ambient air quality of the proposed project site
• To provide the data in order to assess the air impact likely affected by the project activities

5.3.3 Ambient air monitoring location

Locations of air sampling stations are listed in Table 5.3. The air quality sampling methodology used for this project is described in the subsection which follows,

Table 5.3: Air sampling locations for baseline survey

Points	Locations	Coordinates		Start Date	End Date
		N	E		
1	Inn Jal village	22° 4'1.90"N	96°10'6.33"E	14.9.2020	15.9.2020
2	Kyar Ni Kan landfill gate	22° 5'2.58"N	96° 9'40.27"E	14.9.2020	14.9.2020

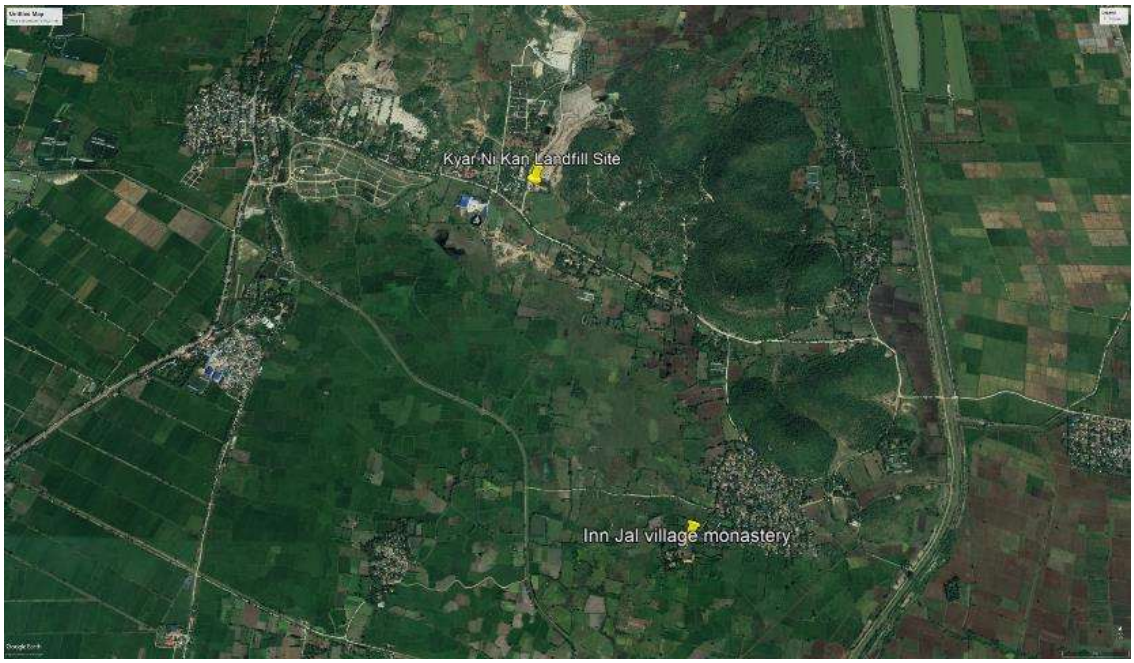


Figure 5.2: Google map of ambient air sampling locations

5.3.4 Existing baseline ambient air quality

The table 5.4 presents the average findings resulting from all measurements carried out at and around the Kyar Ni Kan landfill site.

Table 5.4: The 24hr average air parameters at and around the Kyar Ni Kan landfill site

Air Monitoring Location	CO ($\mu g/m^3$)	NO2 ($\mu g/m^3$)	SO2 ($\mu g/m^3$)	O3 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)
Kyar Ni Kan Landfill Site	**$92^a \pm 12^b$ $92^c(80^d\text{-}103^e)$ (24hr)** **$115^a \pm 48^b$ $0^c(0^d\text{-}884^e)$ (1hr)** **$105^a \pm 49^b$ $85^c(10^d\text{-}240^e)$ (8hr)**	**$6^a \pm 2^b$ $6^c(4^d\text{-}8^e)$ (24hr)** **$7^a \pm 1^b$ $6^c(0^d\text{-}22^e)$ (1hr)**	**$6^a \pm 5^b$ $6^c(1^d\text{-}10^e)$ (24hr)**	**$30^a \pm 10^b$ $30^c(20^d\text{-}40^e)$ (24hr)** **$33^a \pm 6^b$ $32^c(22^d\text{-}47^e)$ (8hr)**	**$20^a \pm 10^b$ $20^c(10^d\text{-}30^e)$ (24hr)**	**$4^a \pm 1^b$ $4^c(3^d\text{-}5^e)$ (24hr)**

National Environmental Air Quality Guideline (ECD)	30,000 (µg/m^3) (1hr)/ 10,000 (µg/m^3) (8hr)	40 (µg/m^3) (annual) /200 (µg/m^3) (1hour)	20 (µg/m^3) (24 hour)	100 (µg/m^3) (8hr)	50(µg/m^3)	25 (µg/m^3)

a Average b SE c Median d Min e Max

5.3.5 Baseline gas quality at and around Kyar Ni Kan landfill Site

The table 5.5 presents the average gases levels resulting from all measurements carried out at and around the Kyar Ni Kan landfill site.

Among the parameters focused, the average gases levels of all measurements were well below the Environmental Emission Guideline (EQEG) stated by ECD.

Table 5.5: Baseline gas quality at and around Kyar Ni Kan landfill site

Substance (µg/m3)	Kyar Ni Kan Landfill Site	National Environmental Air Quality Guideline (ECD)/
NO2	**7^a±1^b (1hr) 6^c(0^d-22^e)**	**40 µg/m3 (annual) /200 µg/m3 (1hr)**
SO2	**6^a±5^b (24hr) 6^c(1^d-10^e)**	**20 µg/m3 (24hr)**
CO	**115^a±48^b (1hr) 0^c(0^d-884^e) 105^a±49^b (8hr) 85^c(10^d-240^e)**	**30,000 µg/m3 (1hr) 10,000 µg/m3 (8hr)**
O3	**33^a±6^b (8hr) 32^c(22^d-47^e)**	**100ug/m3(8hr)**

a Average b SE c Median d Min e Max

5.3.6 Baseline Air particulates at and around Kyar Ni Kan landfill site

Table 5.6 presents the 24 hr average particulates levels resulting from all measurements carried out at and around the Kyar Ni Kan Landfill Site.

The 24 hr average PM10 and PM2.5 concentrations were well below the National Environmental (emission) guideline.

Table 5.6: Baseline PM10 and PM2.5 concentrations at and around Kyar Ni Kan landfill site

Substance (µg/m3)	Kyar Ni Kan Landfill Site	National Environmental Air Quality Guideline (ECD)/WHO Guideline (24hr)
PM10	20[a]±10[b] 20[c](10[d]-30[e]) (24hr)	50 µg/m3
PM2.5	4[a]±1[b] 4[c](3[d]-5[e]) (24hr)	25 µg/m3

a Average b SE c Median d Min e Max

(i) Point (1): The existing baseline ambient air monitoring at Kyar Ni Kan landfill site

Figure 5.3: Map of ambient air monitoring location at Kyar Ni Kan landfill site

Figure 5.4: Ambient air monitoring station at Kyar Ni Kan landfill site

The point 1 is located at the Kyar Ni Kan landfill site. Regarding particulates, Table 5.7 presents both the 24hr average levels of PM10 (30 µg/m^3) and PM2.5 (5 µg/m^3) met the l Environmental Quality (Emission) Guideline (ECD).

In terms of gases level, 24hr average levels of SO2 (1 µg/m3), one-hour average level of NO2 (19 µg/m3), one-hour average of CO (573 µg/m^3), 8 hours average CO (92 µg/m3) and 8 hours average of O3 (20 µg/m^3) met the guidelines.

The meteorology findings (Temperature, Relative Humidity, Wind Speed and Wind Direction) during the monitoring were presented below. (Table 5.7)

Table 5.7: Ambient air monitoring at Kyar Ni Kan landfill site

Parameters	Concentration (8hr average) except some Gases (NO2, CO and O3)*	National Environmental Air Quality Guideline (ECD)/WHO Guideline (24hr average)
PM10	30^a(3^b-$1,000^c$) µg/m^3	50 µg/m^3
PM 2.5(µg/m^3)	5^a(2^b-100^c) µg/ m^3	25 µg/m^3

NO_2*	$8^a(0^b\text{-}56^c)$ µg/m^3(24 hr) 19 µg/m^3 (one hr)	40 µg/m^3 (annual) /200 µg/m^3 (one hour)
SO_2	$1^a(0^b\text{-}42^c)$ µg/m^3	20 µg/m^3
CO *	$80^a(0^b\text{-}1{,}718^c)$ µg/m^3 (24hr) 573 µg/m^3 (one hr) 92 µg/m^3 (8 hr)	30,000 µg/m^3 (one hr) 10,000 µg/m^3 (8 hr)
O_3*	$20^a(0^b\text{-}40^c)$ µg/m^3 (24hr) 20 µg/m^3 (8 hr)	100 µg/m^3 (8hr)
Meteorology		
T (Degree C)		$20^a(0^b\text{-}37^c)$
RH		$33^a(0^b\text{-}68^c)$
Remark: No special findings.		

[a] Average [b] Min [c]Max

Referring to National Environmental Air Quality Guideline (ECD), the color codes are categorized in order to reveal the general air quality status around the project area.

Green – meets the standards
Yellow (slightly over)
Orange (exceeding)

(ii) Point (2): The existing baseline ambient air monitoring at Inn Jal village

Figure 5.5: Map of ambient air monitoring location at Inn Jal village

Figure 5.6: Ambient air monitoring station at Inn Jal village

The point 2 is located at the Inn Jal village which is nearest to the proposed project site. Regarding particulates, Table 5.8 presents both the 24hr average levels of PM10 (10 µg/m^3) and PM2.5 (3 µg/m^3) met the National Environmental Quality (Emission) Guideline (ECD).

In terms of gases level, 24hr average levels of SO2 (10 µg/m3), one-hour average level of NO2 (19 µg/m3), one hour average of CO (1,145 µg/m^3), 8 hour average CO (229 µg/m3) and 8 hour average of O3 (40 µg/m^3) met the guidelines.

The meteorology findings (Temperature, Relative Humidity, Wind Speed and Wind Direction) during the monitoring were presented below. (Table 5.8)

Table 5.8: Ambient air monitoring at Inn Jal village

Parameters	Concentration (24hr average) except some Gases (NO2, CO and O3)*	National Environmental Air Quality Guideline (ECD)/WHO Guideline (24hr average)
PM10	10[a](2[b]-400[c]) µg/m^3	50 µg/m^3
PM 2.5(µg/m^3)	3[a](1[b]-40[c]) µg/ m^3	25 µg/m^3

NO_2*	4 (0^b-132^c) µg/m^3(24 hr) 19 µg/m^3 (one hr)	40 µg/m^3 (annual) /200 µg/m^3 (one hour)
SO_2	10^a(0^b-37^c) µg/m^3	20 µg/m^3
CO *	103^a(0^b-2290^c) µg/m^3 (24hr) 1,145 µg/m^3 (one hr) 229 µg/m^3 (8 hr)	30,000 µg/m^3 (one hr) 10,000 µg/m^3 (8 hr)
O_3*	40^a(0^b-80^c) µg/m^3 (24hr) 40 µg/m^3 (8 hr)	100 µg/m^3 (8hr)
Meteorology		
T (Degree C)		25^a(0^b-35^c)
RH		61^a(0^b-83^c)
Wind Speed (kph)		2^a(0^b-11^c)
Wind Direction (Degree from)		142(SE)
Remark		
No specific findings.		

[a] Average [b] Min [c] Max

Referring to National Environmental Air Quality Guideline (ECD), the color codes are categorized in order to reveal the general air quality status around the project area.

Green – meets the standards
Yellow (slightly over)
Orange (exceeding)

5.3.7 LFG methane emission of Kyar Ni Kan landfill site

Figure 5.7: Google map of the methane emission at Kyar Ni Kan landfill site

In terms of percentage of methane, carbon dioxide, oxygen hydrogen sulphide emission and meteorology were presented below. (Table 5.9, 5.10 and 5.11)

Table 5.9: Methane emission at Kyar Ni Kan landfill site

Point	Day (Time)	Measuring of LFG (%)					Weather condition		
		CH_4	CO_2	O_2	H_2S (ppm)	BAL	Weather	Temperature (Min/Max(ºC))	Rainfall (mm)
K1	5.28(16:25)	53.3	41.2	0.2	18	5.3	Sunny	35/20	0
	5.29(12:10)	53.9	41.2	0	50	4.9	Sunny	38/20	0
	5.30(15:30)	52.9	40.8	0.1	50	6.1	Sunny	34/21	0
K2	5.28(16:27)	50.5	40.7	0	14	8.8	Sunny	35/20	0
	5.29(12:10)	55.6	35.9	0	21	4.9	Sunny	38/20	0
	5.30(15:35)	54.4	39.1	0	42	6.4	Sunny	34/21	0
K3	5.28(16:29)	55.4	36.1	0	35	6.5	Sunny	35/20	0
	5.29(12:15)	57.5	37.6	0	21	4.9	Sunny	38/20	0
	5.30(15:40)	56.0	37.5	0	20	6.5	Sunny	34/21	0
K4	5.28(16:35)	55.5	39.0	0	100	5.4	Sunny	35/20	0
	5.29(12:20)	55.7	38.2	0	50	4.9	Sunny	38/20	0

	5.30(15:45)	55.1	38.3	0	31	6.7	Sunny	34/21	0
K5	5.28(16:40)	55.7	38.8	0	27	5.5	Sunny	35/20	0
	5.29(12:25)	53.4	37.6	0	18	9.4	Sunny	38/20	0
	5.30(15:50)	54.9	38.4	0	35	6.7	Sunny	34/21	0

Table 5.10: Methane emission at Kyar Ni Kan landfill site

Point	Day (Time)	Measuring of LFG (%)					Weather condition		
		CH_4	CO_2	O_2	H_2S (ppm)	BAL	Weather	Temperature (Min/Max(ºC))	Rainfall (mm)
K1	6.25(14:45)	53.8	41.9	0.6	16	3.7	Rain	28/23	13
K2	6.25(14:55)	54.5	39.0	0.8	38	5.7	Rain	28/23	13
K3	6.25(15:10)	54.8	36.6	1.3	30	7.3	Rain	28/23	13
K4	6.25(15:20)	57.6	39.9	0	503	25	Rain	28/23	13
K5	6.25(15:30)	53.4	38.3	0.5	54	7.9	Rain	28/23	13

Table 5.11: Methane emission at Kyar Ni Kan landfill site

Point	Day (Time)	Measuring of LFG (%)					Weather condition		
		CH_4	CO_2	O_2	H_2S (ppm)	BAL	Weather	Temperature (Min/Max(ºC))	Rainfall (mm)
K1	9.3(11:40)	55.3	42.9	0.3	9	1.5	Rain	31/24	0
K2	9.3(11:45)	45.3	30.4	2.9	5	21.4	Rain	31/24	0
K3	9.3(11:50)	57.7	37.7	0.3	17	4.3	Rain	31/24	0
K4	9.3(11:55)	57.6	39.4	0	261	3	Rain	31/23	0
K5	9.3(12:00)	56.2	38.9	0.3	25	4.6	Rain	31/23	0

(Source: Feasibility study of landfill gas collection and flaring plant for Mandalay city, Myanmar, 16 January, 2019)

5.4 Carbon emission from construction phase

5.4.1 Introduction

Carbon dioxide (CO2) is the primary greenhouse gas emitted through human activities. Many industrial processes emit CO2 through fossil fuel combustion. Several processes also produce CO2 emissions through chemical reactions that do not involve combustion, for example, the production and consumption of mineral products such as cement, the production of metals such as iron and steel, and the production of chemicals. The main human activity that emits CO2 is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation, although certain industrial processes and land-use changes also emit CO2.

(i) Generator Usage

During the construction phase, the power requirements for the project activities will be depending on the national grid line but one generator will be standby if there is electricity failure. Thus, there will be no CO_2 emission from power requirements during the construction phase.

In terms of the CO2 emission from the propose project, the electricity sector of the proposed project does not directly produce the emission of CO2 and GHG. During the operation phase, the proposed project will have a generator plant with a maximum capacity of 500kW to generate electricity. The proposed project will use landfill gas fuel for generator.

(ii) Vehicles usage

The vehicles usage of the proposed project is one of the major sources of emission of CO2 and GHG by using diesel fuel for Dozer, Waste Compactor, Wheel Loader, Wheeler Dump Truck, Material Handler and Ferry in the construction process (6 months).

Table 5.12: Characteristics of vehicles usage from proposed project

No	Type of car	Type of fuel	Quantity of car	Fuel usage per 6 months (liter)
1	Dozer	Premium diesel	1	27,360
2	Waste Compactor	Premium diesel	1	11,232
3	Wheel Loader	Premium diesel	2	54,720
4	Wheeler Dump Truck	Premium diesel	3	33,696
5	Material Handler	Premium diesel	1	27,360
6	Ferry	Premium diesel	1	8,316
Total			9	162,684

Total amount of fuel consumption from vehicles sector is 162,684 liters per 6 months.
To obtain the number of grams of CO2 emitted per liter of diesel combusted, the heat content of the fuel per liter is multiplied by the kg CO2 per heat content of the fuel.

1Litre of Diesel = 2.68 kg of CO2

CO_2 emission (diesel usage) = 162,684 liters (assumed) x 2.68
= 435,993 kg of CO2 (435.993 metric tons of CO2)

The ***total emission of CO2 from vehicles sector is 435.993 metric tons of CO2.***

In the construction phase (6 months), total emission of CO2 from vehicles usages is 435.993 metric tons of CO2.

Source:https://www.drivingtests.co.nz/resources/fuel-co2-calculator-carbon-dioxide emissions-in-kg.

5.4.2 Emission reduction in Operation phase

(i) Landfill Methane Recovery

$$BE_y = \eta_{PJ} \times BE_{CH4,SWDS,y} - (1 - OX) \times F_{CH4,BL,y} \times GWP_{CH4}$$ Equation (1)

$$BE_{CH4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times 16/12 \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1} \sum_{j} (W_{j,x} \times DOC_j \times e^{-kj \times (y-x)} \times (1 - e^{-kj}))$$ Equation (1)

(ii) Grid connected to renewable electricity generation

$$BE_y = EG_{PJ,y} \times EF_{grid,y}$$ Equation (1)

(iii) Project emissions for Landfill Methane Recovery

$$PE_y = PE_{Power,y} + PE_{flare,y} + PE_{process,y}$$ Equation (2)

(iv) CO_2 emissions from electricity used by the project activity facilities ($PE_{power,y}$)

$$PE_{Power,y} = PE_{EC,y} = EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$$

(v) Calculation of project emissions from flaring

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

(vi) Landfill Methane Recovery

$$ER_{y,estimated} = \eta_{PJ} \times BE_{CH4,SWDS,y} - PE_y$$

$$ER_{y,calculated} = (1 - OX) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} - PE_y - LE_y$$

$$F_{CH4,PJ,y} = D_{CH4,y} \times w_{CH4,y} \times \sum_i LFG_{i,y}$$

(vii) Grid connected to renewable electricity generation

$$ER_y = BE_y - PE_y - LE_y$$

(viii) Grid connected to renewable electricity generation

$$PE_{Power,y} = PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

By the calculation of above equations,

GHG reduction rate of proposed project = 20,000 tCO_2-equivalent per year
= 244,199 tCO_2-equivalent per 10 years

The project aims at investing in a biogas collection system, a blower and flaring system at the landfill site. The project activity will result in GHG emission reductions by combusting of the

recovered methane contained in the landfill gas. It is estimated that the project activity will avoid the emission of approximately 244,199 tCO_2eq during 10 years. These resulting emission reductions from the project activity are less than 20,000 tCO_2eq per year.

Source: **Industry Begins Grappling With Rising Fuel Costs**
https://www.constructionequipmentguide.com/industry-begins-grappling-with-rising-fuel-costs/7008#
Characterization of Municipal Solid Waste Collection Operationshttps://www.sciencedirect.com/science/article/am/pii/S0921344916301860

Forklift fuel consumption and efficiency
https://www.toyotaforklift.com/resource-library/material-handling-solutions/parts-services/forklift-fuel-consumption- .

5.5 Noise Levels

5.5.1 Introduction

The baseline ambient noise quality monitoring was carried out at the Inn Jal village which is located nearest to the proposed project site in September, 2020 in order to reveal the existing baseline noise quality status around the proposed project.

5.5.2 Objective

The objectives of the monitoring are:
• To reveal the existing baseline ambient noise quality around the proposed factory

5.5.3 Ambient noise monitoring location

Locations of air sampling stations are listed in Table 5.12. The air quality sampling methodology used for this project is described in the subsection which follows,

Table 5.13: Noise sampling locations for baseline survey

Points	Locations	Coordinates		Start Date	End Date
		N	E		
1	Inn Jal village	16°50'11.07"N	96°17'18.07"E	14.9.2020	15.9.2020

(i) Point (1): The existing baseline ambient noise monitoring at the Inn Jal village

Figure 5.8: Map of ambient noise monitoring location at the Inn Jal village

Figure 5.9: Noise monitoring station at the Inn Jal village

Table 5.14: The 24hr average noise level of the Inn Jal village

Area	Whole Day Average Noise Level (dB)	Day Time Noise Level (dB)	Noise standard value of EQG for Residential (Day Time)
Inn Jal village	$51^{a}\pm0.3^{b}$ $45^{c}(22^{d}\text{-}68^{e})$	$53^{a}\pm0.3^{b}$ $51^{c}(27^{d}\text{-}68^{e})$	55
		Night Time Noise Level (dB)	**Noise standard value of EQG for Residential (Night time)**
		$36^{a}\pm0.2^{b}$ $33^{c}(22^{d}\text{-}47^{e})$	45

Based on the findings, the 24hr average noise levels (both day and night time) at the Inn Jal village compound met the EQEG. Generally, these levels were mainly captured from vehicles (Cars), and human activities, the noise level around of the proposed project area is assumed as acceptable level.

5.6 Vibration Levels

5.6.1 Introduction

The baseline ambient vibration quality monitoring was carried out at the Inn Jal village which is located nearest to the proposed project site in September, 2020 in order to reveal the existing baseline noise quality status around the proposed project.

5.6.2 Objective

The objectives of the monitoring are:
• To reveal the existing baseline ambient vibration quality around the proposed factory
• To provide the data in order to assess the air impact likely affected by the project activities

5.6.3 Ambient vibration monitoring location

Locations of air sampling stations are listed in Table 5.14. The vibration quality sampling methodology used for this project is described in the subsection which follows,

Table 5.15: Vibration sampling locations for baseline survey

Points	Locations	Coordinates		Start Date	End Date
		N	E		
1	Inn Jal village	22° 4'1.90"N	96°10'6.33"E	14.9.2020	15.9.2020

(i) Point (1): The existing baseline ambient vibration monitoring at the Inn Jal village

Figure 5.10: Map of ambient vibration monitoring at the Inn Jal village

Figure 5.11: Vibration monitoring station at the Inn Jal village

Table 5.16: The 24hr average vibration level of the Inn Jal village

Area	Whole Day Average Vibration Level (m/s^2)	whole-body vibration (WBV) Daily exposure limit value (ELV) (ms2) A (8).
Inn Jal village	Below the detection limit <0.5m/s^2	1.15 m/s^2

Speed measurement range: 0.5 ~ 199.9m / s
Accelerometer area: 0.5 ~ 199.9 m /s2 (Peak)

5.7 Geology and hydrogeology

5.7.1 Geology

The topsoil type of Patheingyi township is mostly clay soil. The lithology of Kyar Ni Kan landfill site is a pleistocene (0 - 2.588 Ma) and most quaternary sedimentary rocks are found. There are outcrops of scheelite-bearing calc-silicate rocks and marbles.

The type and density of the native soil is also important. In generally, very fine soils (clays and silts) typically have lower capacities than coarse granular soils (sands and gravels). However, some clays or silts have higher bearing capacity than the values.

Mechanically compacting the soil can also raise its bearing capacity. The soil compaction is the process in which stress is applied to a soil causes densification as air is displaced from the pores between the soil grains.

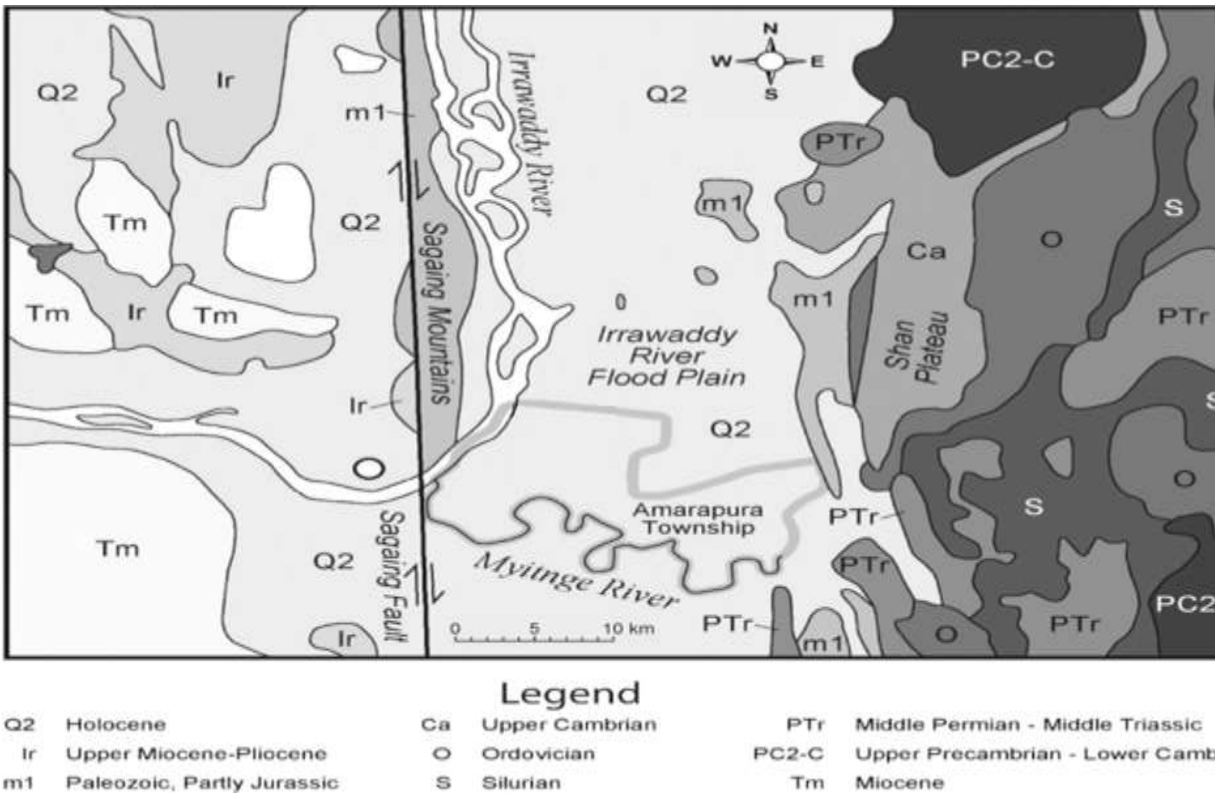


Figure 5.12: Geologic map of Mandalay

(Source: Water quality and physical hydrogeology of the Amarapura township, Mandalay, Myanmar, Michael Grzybowski et.al, 2018)

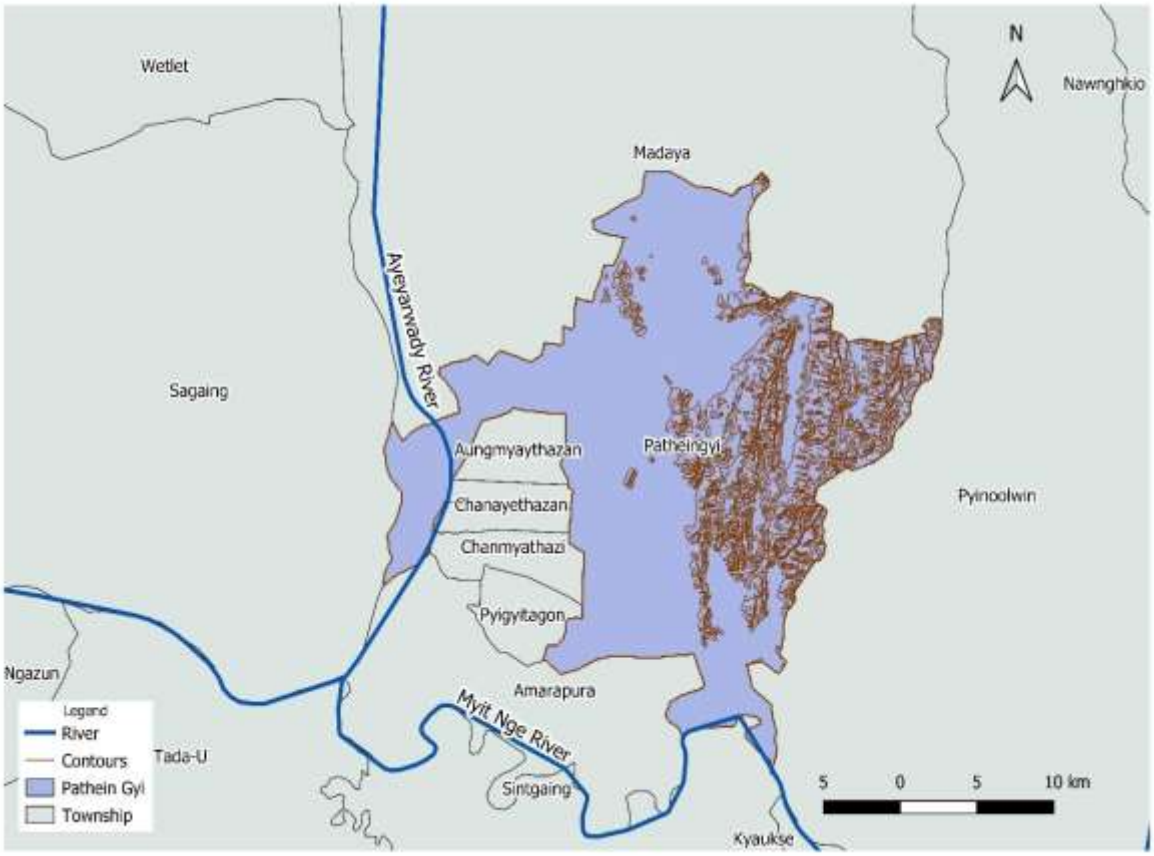


Figure 5.13: Hydrological map of Patheingyi Township

5.7.2 Hydrogeology

The existing condition of soil and aquifer layers where many local inhabitants use as their source of water for cooking, cleaning, and drinking are presented as follows:

Table 5.17: Soil and aquifer layers in Mandalay

SOIL LAYER	BED TYPE	CLAY/SOIL TYPE	DEPTH	AQUIFER LAYER	AQUIFER TYPE	WELL TYPE
1st Layer	Alternating bed	Rich in clay	30-40 m	1st Aquifer	Phreatic (unconfined) Aquifer	Dug well
2nd Layer	Alternating bed	Rich in sand	70-72 m	2nd Aquifer	Shallow Confined Aquifer (partially	Shallow tube well

					unconfined),	
3rd Layer	Clay bed	Hard clay, almost blue	90-97 m	-	-	
4th Layer	Send bed and Alternating bed	Rich in sand	170 m	3rd Aquifer	Deep Confined Aquifer	Deep tube well

The 1st, 2nd and 4th layers are consistent with 1st to 3rd aquifers respectively. The bottom clayey layer of the first Layer, and clay bed of the 3rd Layer play a role of confining layers. Consequently, groundwater of the 1st aquifer is phreatic or unconfined and tapped by dug wells, while groundwater of the 2nd and 3rd aquifers is confined and drawn by installed shallow and deep tube wells.

The 2nd aquifer, however, could partially be unconfined depending on the geological situations. The 1st to 3rd aquifers will also be called here Phreatic, Shallow Confined and Deep Confined Aquifers respectively.

In the 3rd aquifer, two to three aquifers are sometimes found up to about 170m in depth, and in many places of Mandalay city, the lower part of the 3rd Aquifer shows alternation of sand and clay.

In the Patheingyi township, most of the households use improved sources of drinking water (tap water/piped, tube well, borehole, protected well/spring and bottled water/water purifier). And also, the Se Taw Gyi channel, from which most locals obtain their raw water for cooking and cleaning.

5.8 Soil Quality

Soil sampling was carried out at the nearest village firm in accordance with the sampling methodology in order to reveal the existing soil quality status in September 2020.

5.8.1 Objectives

To reveal the baseline situation of soil quality of the village firm nearest to the proposed project site

The total (15) soil parameters including chemical and physical parameters which are significantly important for the environmental health were analyzed and compared with the the FAO soil standards accordingly.

Based on the findings, the existing soil is not polluted with heavy metals which are harmful to the plants and animals. (Table 5.15)

Figure 5.14: Google map of soil sampling from the Kyarni Kan landfill site

Figure 5.15: Soil sampling at Kyar Ki Kan Kyar Ni Kan landfill site

Table 5.18: Soil analysis of Kyar Ni Kan landfill site

Sr.no	Parameters	Unit	Results	FAO Soil Bulletin 65 & Dutch Standards	Remark
1	Moisture	%	1.72		
2	pH	(1:2.5)	8.3		
3	EC	mS/cm	0.12		
4	Total N	%	0.25		
5	Available P	ppm	7.93		
6	Available K_2O	mg/100g	15.25		
7	Exchangeable cations K^+	meq/100g	0.32		
8	Cadmium	ppm	ND	0.8	
9	Chromium	ppm	ND		
10	Lead	ppm	3.24	85	**Normal**
11	Zinc	ppm	1.84	15-150	**Normal**
12	Copper	ppm	2.06	20-300	**Normal**
13	Iron	ppm	55.1	15-150	**Normal**
14	Manganese	ppm	89.88		
15	Texture				
	Sand	%	46.7		
	Silt	%	31.03		
	Clay	%	22.27		

5.9 Current waste generation at the Kyar Ni Kan land fill site

Out of the total waste generation in the country, approximately 55% is generated by three major cities including Mandalay which is generating approximately 955 tons/day (Quick study on waste management in Myanmar: Current situation and key challenges, IGES, 2016). The following figures 5.x and 5.x present increasing trend of waste generation and waste characteristics indicating that nearly 80% is organic wastes in Mandalay respectively.

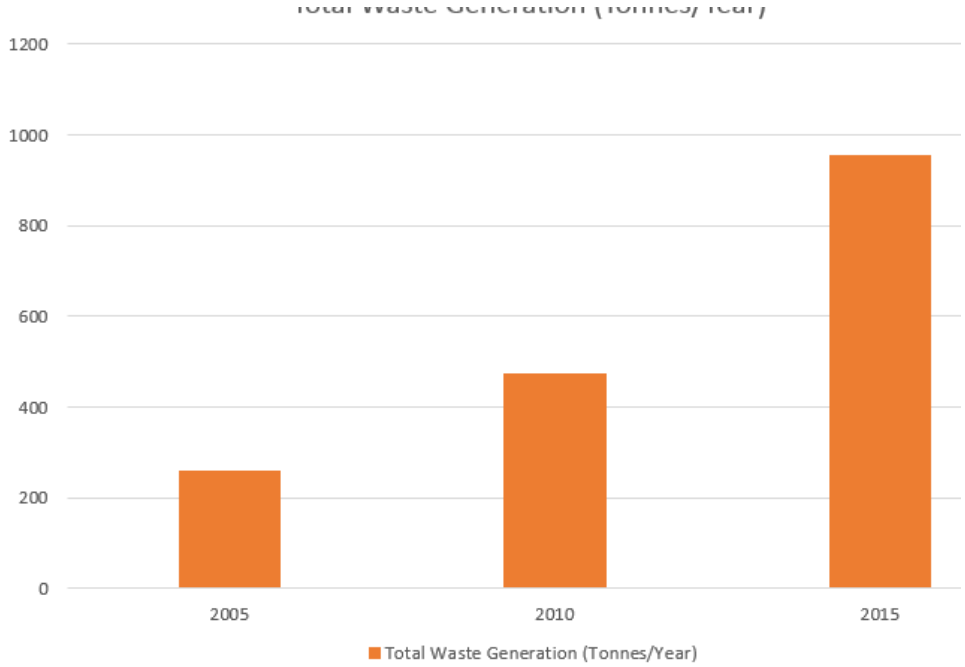


Figure 5.16: Increase of waste generation in Mandalay (Source: MCDC, 2016)

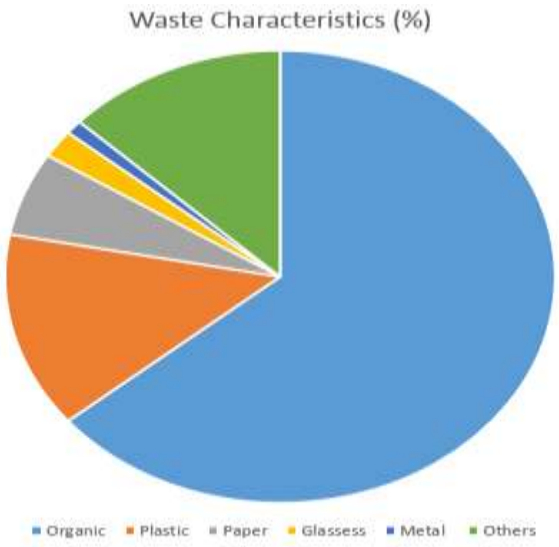


Figure 5.17: Waste characteristics in Mandalay. (Source: MCDC, 2016)

There are two main final waste disposal sites in Mandalay, among these sites, Kyar Ni Kan land fill site in which the LFG recovery project site will be operated is 17 km far apart from the city. Land area covering 17.17 acres is receiving domestic wastes approximately 500 tons/day average. It has been used for 2 years starting from 2010 to 2012 and now total waste disposal receiving from the townships of Aung Mye Thar Zan, Chan Aye Thar Zan and Maha Aung Myay has been 309,600 tons of MSW.

The Kyar Ni Kan landfill site has been stopped to use for 2 yrs due to the cost burden for transportation. And then, a dump site closer to Mandalay was opened. Nevertheless, it is causing problems since the city expands to surround it. Thus, 24 Dec 2013, the former landfill open dump site has been resumed till now.

In general, the current waste collection system includes primary and secondary collection. Primary collection takes place in different forms such as door-to-door (bell collection), block, and container collection methods. The primary waste collection system is carried out either or in combination of push carts and tri-bicycles while secondary collection system is performed mainly with tipper trucks (dumpers).

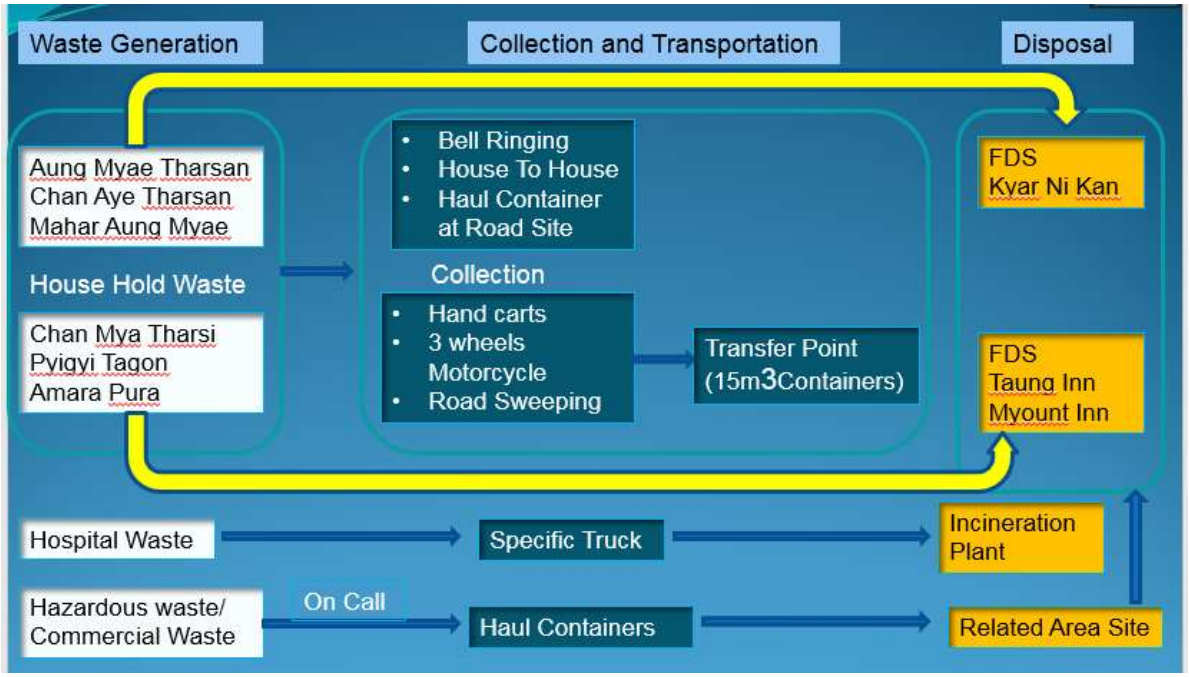


Figure 5.18: Waste stream, collection and transportation to Kyar Ni Kan landfill site Source: (Quick study on waste management in Myanmar: Current situation and key challenges, IGES, 2016).

5.10 Existing situation of potable water and surface quality

5.10.1 Introduction

Water is not only necessary for Man's survival on Earth but also is an essential component for the improvement of the quality of life of the people living in developing countries (Biswas and Asce, 1980). Water is one of the essential needs for the industrialization process and human health. However, the waste or by-products discharged from them are severely disastrous to the environment consists various kinds of contaminants which contaminate the surface water, ground water and soil.

5.10.2 Objectives

a. To reveal the baseline situation of surface and ground water located nearest to the proposed project site

5.10.3 Surface water analysis

Looking at surface water. the water sample from the Se Taw Gyi creek which is located within 2km of the proposed project site was collected for physical, chemical and bacteriological characteristics analysis.

Figure 5.19: Google map of water sampling from the Kyarni Kan landfill site

Figure 5.20: Surface water sample collection from Se Taw Gyi Creek

Table 5.19: The Surface water results along with the permissible limits of Se Taw Gyi Creek

No.	Test Parameters	Unit	Surface Water	WHO Drinking Standard	US EPA Drinking Standard	NEQG Guideline	Remark
1	Color	mg/L	Clear/5	NA	NA	NA	**Normal**
2	Turbidity	NTU	-	NA	NA	NA	**Normal**
3	pH		8.2	6.5-8.5	6.5-8.5	6-9	Normal
4	Total solids	mg/L	225	NA	NA	NA	
5	Total Hardness	mg/L	100	NA	NA	NA	
6	Total alkalinity	mg/L	100	NA	NA	NA	
7	Calcium	mg/L	24	NA	NA	NA	
8	Magnesium	mg/L	10	NA	NA	NA	
9	Chloride	mg/L	20	NA	250	NA	Normal
10	Sulphate	mg/L	19	NA	250	NA	Normal
11	Iron	mg/L	Nil	NA	0.3	3.5 mg/L	Normal
12	Total Coliform	CFU/ML	5/5	NA	NA	400/100ml	

NA= Not Available

According to the WHO drinking water standards, the surface water of the selected villages more or less met the standards except bacteriological result indicating that the surface water is needed to be disinfected for drinking purpose.

5.10.4 Ground water analysis

In terms of the potable water sources, there are some villages near the project site. Among them, two ground water samples were taken from the households which are located form the nearest two villages in order to reveal the existing ground water status.

The total (12) water parameters including chemical, physical and bacteriological parameters which are significantly important for the human health and surrounding environment were analyzed from each source accordingly.

Figure 5.21: Ground water sample collection from the Kyar Ni Kan village

Figure 5.22: Ground water sample collection from the Inn Jal village

Table 5.20: The Ground water results along with the permissible limits of Kyar Ni Kan village

No.	Test Parameters	Unit	Ground Water (Tube Well)	WHO Drinking Standard	US EPA Drinking Standard	NEQG Guideline	Remark
1	Color	mg/L	Clear/5	NA	NA	NA	Normal
2	Turbidity	NTU	-	NA	NA	NA	Normal
3	pH		7.5	6.5-8.5	6.5-8.5	6-9	Normal
4	Total solids	mg/L	1150	NA	NA	NA	
5	Total Hardness	mg/L	420	NA	NA	NA	
6	Total alkalinity	mg/L	650	NA	NA	NA	
7	Calcium	mg/L	40	NA	NA	NA	
8	Magnesium	mg/L	77	NA	NA	NA	
9	Chloride	mg/L	140	NA	250	NA	Normal
10	Sulphate	mg/L	192	NA	250	NA	Normal
11	Iron	mg/L	Nil	NA	0.3	3.5	Normal
12	Total Coliform	CFU/ML	5/5	NA	NA	400/100ml	

NA= Not Available

Table 5.21: The Ground water results along with the permissible limits of Inn Jal village

No.	Test Parameters	Unit	Ground Water (Tube Well)	WHO Drinking Standard	US EPA Drinking Standard	NEQG Guideline	Remark
1	Color	mg/L	Clear/5	NA	NA	NA	**Normal**
2	Turbidity	NTU	-	NA	NA	NA	**Normal**
3	pH		7.3	6.5-8.5	6.5-8.5	6-9	Normal
4	Total solids	mg/L	985	NA	NA	NA	
5	Total Hardness	mg/L	520	NA	NA	NA	
6	Total alkalinity	mg/L	450	NA	NA	NA	
7	Calcium	mg/L	72	NA	NA	NA	
8	Magnesium	mg/L	82	NA	NA	NA	
9	Chloride	mg/L	100	NA	250	NA	Normal
10	Sulphate	mg/L	230	NA	250	NA	Normal

11	Iron	mg/L	Nil	NA	0.3	3.5 mg/L	Normal
12	Total Coliform	CFU/ML	3/5	NA	NA	400/100ml	

NA= Not Available

All the ground water results were compared with WHO drinking standard, US EPA drinking standard and NEQG Effluent Guidelines. According to the WHO drinking water standards, the ground water of the selected villages more or less met the standards except bacteriological result indicating that the ground water is needed to be disinfected for drinking purpose.

5.11 Biological environment

5.11.1 Executive summary

The project area is situated in the Patheingyi township, Mandalay Region which is in the upper part of Myanmar. The baseline studies were conducted in order to identify biodiversity as well as ecosystem services.

The flora survey was carried out by the forest inventory method to identify the species composition, density and distribution. A total of 33 plant species were observed during the survey. Regarding the fauna survey area, according to both field surveys and community interviews, 20 species of bird, 11 species of mammal, 21 species of reptile/amphibian, and 15 species of fish were identified.

5.11.2 Introduction

(i) Mandalay region

Mandalay is the second-largest city in Myanmar, after Yangon which is located on the east bank of the Ayeyarwady River , 716km (445 mi) north of Yangon. The city has a population of 1,225,553 (2014 census). The rain shadow of the Arakan Mountains is so powerful that the city qualifies as having a hot semi-arid climate, although it does border on a tropical wet and dry climate. Mandalay features noticeably warmer and cooler periods of the year. Average temperatures in January, the mildest month, hovers around 21 C or 69.8 F while the hottest month, April, averages 31 C or 87.8 F.

Mandalay was founded in 1857 by King Mindon, replacing Amarapura as the new royal capital of the Konbaung dynasty. It was Burma's final royal capital before the kingdom's annexation by the British Empire in 1885. Under British rule, Mandalay remained commercially and culturally important despite the rise of Yangon, the new capital of British Burma.

Mandalay region lies at the basal joint of two major forest mountain ranges, Shan Yoma and Ayakan Mountain Range (Yakine Yoma). Then, these two ranges are catchment areas of

Irrawaddy river. Mindon Min (most king of Myanmar) has a great reputation for the protection forest and he believed in environmentalism. As a consequence, forest along with the Shan Yoma are deep Tropical mixed deciduous forest and also rich in biodiversity once in there.

The extensive logging has caused the present deforestation and increased erosion in the area. Due to illegal logging and overexploitation of natural resources, however, the landscape is now remaining just as the secondary forest. Till as secondary forests, resources serve as a source of fishing, hunting animals, fruits from pants, to the local people.

Today, Mandalay is the economic centre of Upper Myanmar and considered the centre of Myanmar culture. Despite Naypyidaw's recent rise, Mandalay remains Upper Myanmar's main commercial, educational and health center.

(ii) Patheingyi Township

The Patheingyi Township is located in the eastern part of Mandalay, Myanmar. The township is bounded by Aungmyethazan Township and Chanayethazan Township in the west. Incorporated into the Mandalay city's limits, Patheingyi represents the eastward march of Mandalay's urban sprawl. Although Patheingyi is still largely made up of rice paddy fields, nowadays, a number of universities have been developed in the township.

This township has an area of 231.55 square miles. The elevation above sea level is 250 ft. There is tropical climate and three seasons are summer, rainy and spring. The highest temperature was about 40°C and the lowest temperature was about 10°C. The population of the township was approximately 241,450(Gender: Male 61,804 / Female 69,269 and Urbanization: Rual 229,746 / Urban 11,794) according to the 2014 Myanmar Population and Housing Census.

There are two Reserved Forest in this township named Taung Kyun and Sa-Khan-Gyi and the total area is 33,344 Ac. Another total two areas which are Protected Public Forest named Yan-Kin-Taung and Mae-U-Taung is 1835.38 Ac. The private commercial plantation is about 1,024.7 Ac. The geomorphology of the area comprises of reserved forests between mountains. Due to shifting cultivation, urbanization and charcoal production, the natural forest had been lost in this township except the protected forest.

5.11.3 Protected Area in Myanmar

According to the World Database Protected Area (WDPA, February 2018), there are 11 National designations and 2 International designations are being observed in Myanmar. The name and number of National designations are Nature Reserve (2), National Park (6), Protected Area (4), National Park and ASEAN Heritage Park (4), Wildlife Sanctuary (27), Bird Sanctuary (3), Wildlife

Park (1), Mountain Park (1), Wildlife Sanctuary and ASEAN Heritage Park (2), Elephant Range (1) and Wildlife Sanctuary (1).

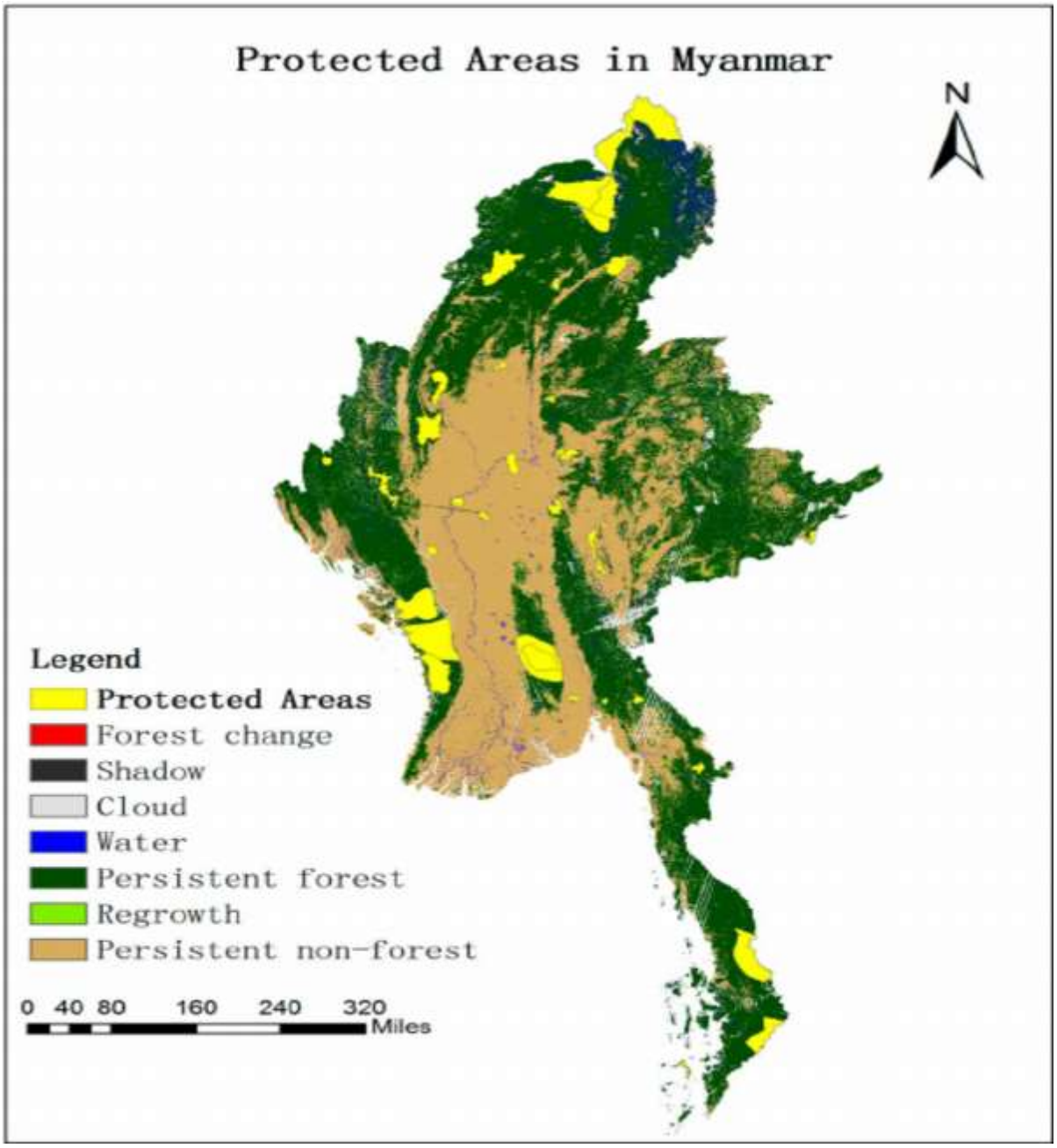


Figure 5.23: Protected Area in Myanmar

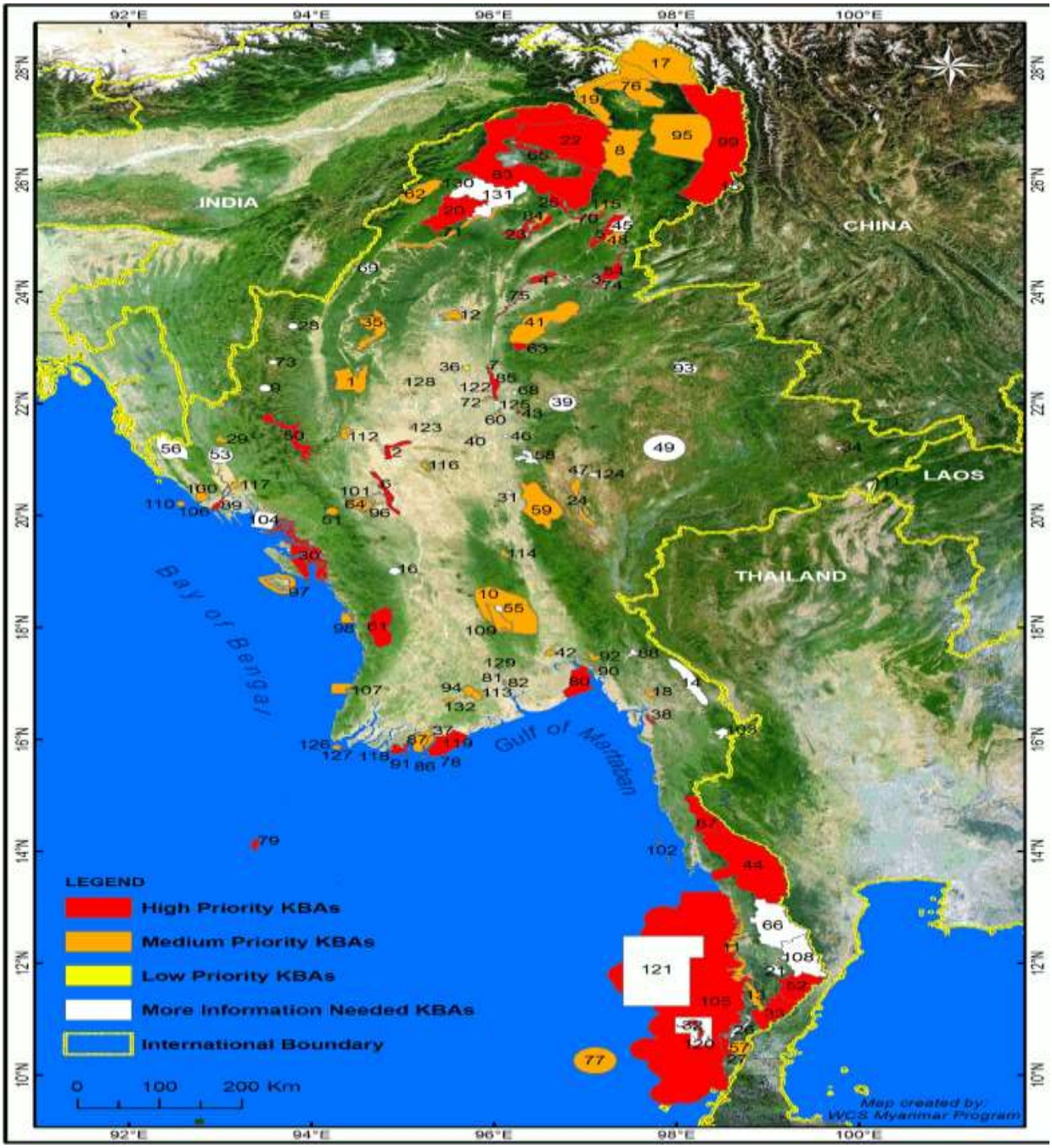


Figure 5.24: Protected Areas and Key Biodiversity Areas (KBAs) in Myanmar

5.11.4 The project area

The project area is located in the Patheingyi Township, Mandalay, the central part of Myanmar.

Figure 5.25: Kyar-Ni-Kan location map and sample plot

Figure 5.26: Kyar-Ni-Kan landfill site

5.11.5 The Vegetation

The Kyar-Ni-Gan Site is located near the Taung Kyun Reserved Forest which is Deep Tropical Mixed Deciduous Forest and also rich in biodiversity once in there. The unique features of the

forests are the ***In, Kyun, Pyin-ka-doe, Bamboo, Tamalan, and Kyoe*** which are the dominant species in this site. The regeneration of ***Pyin-ka-doe*** trees are found everywhere in the forests.

5.11.6 Aim and objective

1. To collect, identify and list the plants and animals (Biodiversity data) in the area.
2. To record the dominant tree species and evaluate the vegetation types (forest type).
3. To record the animal species and determine the habitat type.
4. To collect the ecological data and evaluate the existing ecosystems in the project area.
5. To identify and records the endanger species according to IUCN Red List.
6. To record and list the Myanmar protected species in the area.

5.11.7 Field finding

(i) Observation of flora

The Kyar-Ni-Kan site is located near the Taung Kyun Reserved Forest which comprises the Dry Hill Forest and the Deep Tropical Mixed Deciduous forest. According to the survey, private company has extended the Reserved Forest by establishing the commercial plantation at the buffer zone.

In order to cover up the whole area, secondary data was examined in light of habitat conditions present in the project site.

In Myanmar, there are an estimated 50 threatened plant species, out of which, 18 critically endangered, 16 Endangered and 16 Vulnerable based on the classification from IUCN Red List. Native vegetation cover within the exploration block has been subject to a prolonged period of alteration and human activity.

Timber harvesting, clearing for agriculture and plantations and livestock grazing have occurred near the project area. A list of tree species noted during the reconnaissance of each sample areas is provided in table 5.22.

Figure 5.27: Dry Hill Forest

(ii) Endemic Species

Myanmar is reportedly home to over 1,071 endemic species of flora. The project area was dense forest in the past. During the field reconnaissance, the endemic ***Dipterocarpus tuberculatus, Acacia catechu*** were noted. Confirmation of the presence of uncommon local endemics would require intensive potentially multi-season surveys.

(iii) Iconic Species

The main iconic floras found near the proposed project site are the more mature ***Dipterocarpus spp***.

(iv) Alien Invasive Species

During the biodiversity reconnaissance, according to the local community representatives who were asked whether they had any unusual weed problems, there is any new species of plant or animal in the area. In all cases, the community representatives reported that they did not have any major weed problems, nor had they noticed any new species in the areas.

Significant invasive plant species previously reported for Myanmar include ***Prosopis spp., Acacia auriculiformis, Ageratum conyzoides, Leucaena leucocephala, Eucalyptus spp,Casurina equisetifolia, Chromolaena odorata, Hyptis suaveolens, Lantana camara, Mimosa diplotricha, Mikania micrantha, Sorghum halepense, Paspalum conjugatum, Imperata cylindrica, Echinochloa crus-galli, Eleusine indica*** and ***Pennisetum polystachion*.**

Globally threatened status of Flora species was categorized using The IUCN Red List of Threatened Species as shown in below:

Status	Code
Critically Endangered	(CR)
Endangered	(EN)
Vulnerable	(VU)
Near Threatened	(NT)
and Least Concern	(LC)

Source: IUCN Red List of Threatened species, Version 3.1. Accessed from www.iucnredlist.org on 01 November 2016

Table 5.22: List of tree species noted during the biodiversity survey

No	Local Name	Scientific Name	Habitat	IUCN Status
1	Kyun	***Tectona grandis***	T	NE
2	Tamar	***Azadirachta indica***	T	LC
3	Pyin Ka Doe	***Xylia xylocarpa***	T	NE
4	Shar	***Acacia catechu***	T	NE
5	Padauk	***Pterocarpus indicus***	T	LC
6	Kyoe	***Schneichera oneosa***	T	NE
7	In	***Dipterocarpus tuberculatus***	T	NT
8	Nabe	***Lennea grandis***	T	NE
9	Thit Sae	***Liquidambar styraciflua***	T	NE
10	Thit Yar	***Shorea obtusa***	T	NT
11	Kok-Ko	***Albizzia lebbek***	T	NE
12	Yae-ma-nae	***Gmelia arborea***	T	NE
13	Hta-naung	***Acacia leucophloea***	T	LC
14	Eucalypt	***Eucalyptus***	T	NE
15	Nyaung	***Ficus benghalensis***	T	NE
16	Htauk-kyant		T	
17	Chin Byit		T	
18	Phat-than	***Haplophragma adenophyllum***	T	NE
19	Tha-phan	***Ficus glomerata***	T	NE
20	Tha-yet	***Mangifeta indica***	T	NE
21	Zee-phyu	***Emblica officinalis***	T	NE

22	Phan Khar	***Terminalia chebula***	T	NE
24	Dahat	***Tectona hamiltoniana***	T	NE
25	Ma-gyi	***Tamarindus indica***	T	LC
26	Yone	***Anogeissus accuminata***	T	NE
27	Zee	***Ziziphus mauririana***	S	LC
28	Phyouk-Sate	***Holoptelea integrifolia***	T	NE
29	Shaw-Phyu	***Sterculia versicolor***	T	NE
30	Sein -Pan	***Jacaranda acutifolia***	T	NE
31	Ngu	***Cassia fistula***	T	NE
32	Ban-dar		T	
33	Baw-Sa-Gaing		T	
Note: [1]Aq F=Aquatic Fern, Aq H= Aquatic Herb, B= Bamboo, CL= Climber, E=Epiphyte, F=Fern, G= Grass, H=Herbs, Mo=Moss, Mu=Mushroom, S=Shrubs, ST=Small Tree, T=Tree, LC = Least Concern, NE = Not Evaluated, EN = Endangered Species, VU = Vulnerable, NT = Near Threatened, DD = Data Deficient, CR = Critically Endangered				

5.11.8 Field finding and observation of fauna

According to the findings from the interview with the local people who live in the Amarapura township about fauna of their surroundings, 20 species of bird, 11 species of mammal, 21 species of reptile/amphibian and 15 species of fish were potentially identified.

Suitable habitat for a number of these species was noted in the area; however, confirmation of the actual occurrence of these species would require extensive, multi-season surveys.

(i) Mammals

The threatened mammal species that were identified in the biodiversity site assessment and interviews included the Irrawaddy Hlini Pine (***Orcaella brevirostris*),** Kway-aa (***Cuon alpinus*** – **EN**), Shwe Kyar-kyaung (***Prionailurus viverrinus* –EN*),*** Phyan ***(Cynogale bennettii*** – **EN**), Kyaung-nga-cheik (***Viverricula indica* – LC*),*** Taw Kyaung (***Felis chaus* – LC*),*** Kyaung Ka Doe (***Viverricula indica* – LC*).*** **The data** defiecient one is Gyi **(*Muntiacus feae).*** Two species of Vulnerable (VU) species **(*Cervus unicolor),*** Pyaung ***(Bos Gaurus)*** and One species of Near Threatened (NT) species (***Pteropus vampyrus)*** were identified during the site visit and interviews.

Protection of mammals from impacts potentially affected by the development relies on avoidance of critical habitats and implementation of designs and practices which reduce the potential project specific hazards which may impact wildlife species.

Table 5.23: Field findings/Interviewing mammal species list during biodiversity survey

No	Local name	Scientific name	Common name	IUCN list
1	Da Yel	***Cervus unicolor***	Sambar Deer	VU
2	Kway-aa	***Cuon alpinus***	Dhole	EN
3	Gyi	***Muntiacus feae***	Fea's muntjac	DD
4	Kyar-kyaung	***Prionailurus viverrinus***	Fishing cat	EN
5	Taw Kyaung	***Felis chaus***	Jungle cat	LC
6	Kyaung Ka Doe	***Viverricula indica***	The small Indian Civet	LC
7	Lin-sawe	***Pteropus vampyrus***	Common flying fox	NT
8	Kyaung-nga-cheik	***Viverricula indica***	The small Indian civet	LC
9	Phyan	***Cynogale bennettii***	Otter Civet	EN
10	Pyaung	***Bos Gaurus***	Gaur	VU
11	Irrawaddy Hlin Pine	***Orcaella brevirostris***	Irrawaddy Dolpin	CR
Note: LC = Least Concern, NE = Not Evaluated, EN = Endangered Species, VU = Vulnerable, NT = Near Threatened, DD = Data Deficient, CR = Critically Endangered				

(ii) Fish

No specific references were identified for the Central Myanmar as well as the project area. However, given the patterns of human exploitation, any species of fish present in these areas would be very vulnerable. Fish is important food source of the local people. According to the biodiversity interview surveys, one species of Near Threatened (NT) species (***Channa harcourtbutleri***) , twelve species of Least Concern species (***Notopterus notopterus*** , ***Cirrhinus mrigala*** , ***Cirrhinus rubirostris. Puntius sophore***, ***Lepidocephalichthys berdmorei***, ***Mystus bleekeri, Clarias gariepinus, Heteropneustes kemratensis, Monopterus albus, Mastacembelus alboguttatus, Oreochromis niloticus, Channa gachua*** and Not Evaluated (NE) two species (***Macrognathus auresu and Oreochromis sp.***) were identified in the project area.

Table 5.24: Fish species list during biodiversity survey

No	Local name	Scientific name	Common name	IUCN list
1	Nga-phae	***Notopterus notopterus***	Bronze Feather back	LC
2	Nga chin phyu	***Cirrhinus mrigala***	Carp	LC
3	Nga chin ni	***Cirrhinus rubirostris***	NA	LC
4	Nga-khone-ma	***Puntius sophore***	Pool Barb	LC

5	Nga-thalae-doe	***Lepidocephalichthys berdmorei***	Pepper loach	LC
6	Nga-zin-yaing-kywe	***Mystus bleekeri***	Day's mystus	LC
7	Nga Khu	***Clarias gariepinus***	North African Catfish	LC
8	Nga-gyi	***Heteropneustes kemratensis***	Airsac Catfish	LC
9	Nga-shint	***Monopterus albus***	Asian swamp Eel	LC
10	Nga-mway-htoe	***Macrognathus auresu***	N/A	NE
11	N/A	***Channa harcourtbutleri***	Burmese snakehead	NT
12	Nga La Mway	***Mastacembelus alboguttatus***	Boulenger's spiny eel	LC
13	Shwe ni	***Oreochromis sp.***	Red Tilapia	NE
14	Tilapia	***Oreochromis niloticus***	Nile tilapia	LC
15	Nga Yant Gaung Toe	***Channa gachua***	Dwarf Snakehead	LC
Note: LC = Least Concern, NE = Not Evaluated, EN = Endangered Species, VU = Vulnerable, NT = Near Threatened				

(iii) Birds

The threatened bird species that were identified in the biodiversity site assessment and interviews included 5 Least Concern bird species (***Accipiter trivirgatus, Passer domesticus, Pandion haliaetus, Gracula breligiosa and Gallus gallus)*** and 7 Vulnerable bird species (***Grus Antigone, Rhyticeros subruficollis, Aquila clanga, Mulleripicus pulverulentus, Otus sagittatus, Leptoptilos javanicus, Gallinago nemoricola)***. And also 2 Endanger species (***Pavo muticus, Asarcornis scutulata*****)** and three near threatened species (***Harpactes duvaucelii, Chrysophlegma mentale and Falco jugger*** **)** were noted during the interviews. The other three is Not Evaluated species.

Protection of bird species from unnecessary development impacts relies on avoidance of important habitats and creation of hazards that attract or otherwise place birds at risk (e.g., contaminated waste water pits, spills, unshielded or higher risk lighting, garbage etc.

Table 5.25: Bird species during the biodiversity survey

No	Local name	Scientific name	Common name	IUCN list
1	Daung	***Pavo muticus***	Green Peafowl	EN
2	Joe Jar	***Grus antigone***	Sarus Crane	VU
3	Aukchin	***Rhyticeros subruficollis***	Plain-pouched hornbill	VU
4	Thein	***Accipiter trivirgatus***	Cresred goshawk	LC
5	Thein-nget	***Aquila clanga***	Greater spotted eagle	VU

6	Sar-kalay	***Passer domesticus***	House sparrow	LC
7	Joe	***Streptopelia chinensis***	Spotted dove	NE
8	Htat Ta Yu	***Harpactes duvaucelii***	scarlet-rumped trogon	NT
9	Thit-tauk-nget	***Mulleripicus pulverulentus***	Great slaty woodpecker	VU
10	Thit-tauk	***Chrysophlegma mentale***	Javan yellownape	NT
11	Zee-gwet	***Otus sagittatus***	White fronted scops owl	VU
12	Won-let	***Pandion haliaetus***	Osprey	LC
13	Thein-nget	***Falco jugger***	Laggar falcon	NT
14	Thar-li-kar	***Gracula breligiosa***	Common hill myna	LC
15	Done Hmee Kwat	***Leptoptilos javanicus***	Lesser Adjutant Stork	VU
16	Yay-kyet	***Accipiter badicus***	N/A	NE
17	Pandali	***Asarcornis scutulata***	White-winged Wood duck	EN
18	Snike	***Gallinago nemoricola***	Wood snipe	VU
19	Taw-kyet	***Gallus gallus***	Red gunglefowl	LC
20	Zayat	***Acriditheres tristis***	N/A	NE
Note: LC = Least Concern, NE = Not Evaluated, EN = Endangered Species, VU = Vulnerable, NT = Near Threatened				

Figure 5.28: Streptopelia *chinensis*

Figure 5.29: Otus sagittatus

Figure 5.30: ***Gallus gallus***

Figure 5.31: ***Mulleripicus pulverulentus***

5.11.9 Amphibians and reptiles

The threatened amphibian and reptile species that were identified in the biodiversity site assessment and interviews included two Endangered Species (***Manouria emys, Batagur trivittata)*** ,3 Nearly Threatened ***species (Limnonectes (Rana) blythii and Lygosoma bowringii, Glyphoglossus molossus)*** and 2 Vulnerable species ***(Ophiophagus hannah and Python bivittatus)*** and 9 Not Evaluated species (***Varanus salvator, Python reticulates, Calotes versicolor, Dendrelaphis pictus, Daboia russelii, Lycodon capucinus, Xenochrophis piscator, Ptyas korros and Sphenomorphus maculatus)*** and 5 Least Concern species are ***Amolops indoburmanensis, Bufo melanostictus, Kaloula pulchra, Naja kaouthia, Rhabdophis subminiatus)***

Most of the tortoises are being threatened to some extent by a combination of subsistence and commercial harvesting, over-collection for the pet trade, and to a lesser extent, habitat destruction. Conversion of natural vegetation to agricultural land is primarily a threat to tortoises.

Table 5.26: Amphibian and reptile species during the biodiversity survey

No	Local name	Scientific name	Common name	IUCN list
1	Yae Lake	***Manouria emys***	Asian Forest Tortoise	EN
2	Phar Thin	***Amolops indoburmanensis***	Indoburman Torrent Frog	LC
3	Sar-far	***Limnonectes (Rana) blythii***	Giant river frog	NT
4	Phar Pyote	***Bufo melanostictus***	Asian Common Toad	LC
5	N/A	***Glyphoglossus molossus***	Big lipped Burrowing Frog	NT

6	Zaw-ti-ka	***Varanus salvator***	Clouded monitor	NE
7	Far-pyout	***Kaloula pulchra***	Asian painted forg	LC
8	Sa-ba-gyi	***Python reticulates***	Reticulated python	NE
9	Tatu	***Calotes versicolor***	Garden lizard	NE
10	Ngan-taw-gyar	***Ophiophagus hannah***	King cobra	VU
11	Mway-hauk	***Naja kaouthia***	Monocled cobra	LC
12	Myet-shaw	***Dendrelaphis pictus***	Painted bronzeback	NE
13	Pa-dat -lel-ni	***Rhabdophis subminiatus***	Red necked kneelback	LC
14	Ma-bway	***Daboia russelii***	Russels viper	NE
15	Sa-ba-own	***Lycodon capucinus***	Island wolf snake	NE
16	Burmese Sa Ba Own	***Python bivittatus***	Burmese Python	VU
17	Yay-mway	***Xenochrophis piscator***	Checkered keelback	NE
18	Lin-mway	***Ptyas korros***	Javan rat snake	NE
19	Kin-lake	***Lygosoma bowringii***	Bowring's supple skink	NT
20	Burmese roofed turtlle	***Batagur trivittata***	Burmese roofed turtle	EN
21	Kin-lake-kyar	***Sphenomorphus maculatus***	Spotted forest skink	NE
Note: LC = Least Concern, NE = Not Evaluated, EN = Endangered Species, VU = Vulnerable, NT = Near Threatened				

Figure 5.32: ***Varanus salvator***

Figure 5.33: ***Sphenomorphus maculatus***

Figure 5.34: *Batagur trivittata*

Figure 5.35: *Kaloula pulchra*

5.11.10 Cultural Heritage

Tha Khin Ma Taung ancient pagoda and Phoe Doe ancient pagoda are situated on the way from Mandalay to Kyar Ni Kan Landfill Site. Horticulture is main business for local people living around the project area. They grow subsidence agriculture for strategic crop and go fishing and collecting minor forest products in terms of their other alternatives.

Figure 5.36: Ancient Pagoda around the Kyar Ni Kan Landfill Site

Chapter 6

Impact and Risk Assessment and Mitigation Measures

6 Identification and assessment of potential environmental impacts

All potential environmental and social impacts from construction phase, operation phase and decommissioning phase are identified to develop preventive mechanisms and management plans. While short term impacts are assessed, compulsory regular monitoring and evaluation procedures by qualified independent body will address long term issues. This chapter comprises pollution types, sources, issues, affected parties, and finally, classifications of impacts. The objectives of this assessment are to assess the impacts of the Landfill Gas to Energy project developments and operation on the natural environment and human beings and to develop a proper management plan which is to eliminate or reduce adverse impacts on the surrounding environment.

The impacts on the environment from various project activities can be categorized as follow; Impacts on Environmental Resource

- Impact on Air Quality
- Impact on Noise and Vibration Levels
- Impact on Surface Water Quality
- Impact on Ground Water Quality
- Impact on Soil
- Oil and Fuel Spills
- Impacts on Ecological Resources
- Forest
- Wildlife
- Aquatic Animal/ Fish
- Impact on Human Environment
- Health and Safety
- Socio-economics Impact on Waste Disposal

6.1 Construction phase

During pre-operation phase of Landfill Gas recovery and electricity generation project to be built at the Kyar Ni Kan propose project site, the collection system will be installed comprehensively over the closed areas of the landfill. Installations will include initially approximately 80 vertical extraction wells of high-density polyethylene pipes (HDPE). The wells will have a depth of around 10 meters (33ft). The diameter of these pipes will be 200mm (0.65ft) and 50% of its surface will be perforated.

Also, these pipes will end with a perforated top and will rest over a bed of rocks of 0.6m (24 inch) wide. The pipelines will be surrounded by gravel of 1.5 to 3.0 inch that would serve as a filter between the pipelines and solid waste. 60% of the pipeline length will be covered with this gravel. These pipes will be coupled to a high-density polyethylene pipe grid to transport the LFG to the flare & generator plant and LFG control plant. The diameters of the pipes that compose the grid will be 65mm (2 1/2 inch), 100mm (4 inch) and 200mm (8 inch). These pipes are joined through thermos fusion. The system is hermetically sealed to compensate all the pressure forces existent in the grid.

The project also includes an automatic flare & generator plant composed by blowers, moisture separator and enclosed flaring & generator plant, and the LFG measuring and recording

equipment. Those will be constructed and installed in pre-operation phase of the proposed project.
The project includes the following components:

- Construction of new landfill gas collection wells
- Installation of new landfill gas condensate collection/injection wells
- Installation of lateral piping within each cell to a collection header for the cell
- Installation a main header pipe which collects gas from all cell collection headers
- Installation of blowers to create a pull on the landfill gas
- Installation of two landfill gas conditioning and compression skids
- Installation of the enclosed landfill gas flares
- Installation of two engine-generator sets
- Construction of a building to house Project equipment
- Creating and staffing a landfill gas operations position to monitor and maintain the gas wells
- and monitoring equipment
- Conducting appropriate maintenance on all Project equipment

6.2 Environmental and social impacts during the pre-operation phase

6.2.1.1 Potential impacts on air during the construction phase

Air quality impacts associated with construction of the proposed project would include fugitive dust and emissions from fossil-fuel-fired construction equipment, open burning and temporary fuel transfer systems and associated storage tanks. There may also be particulate and gaseous emissions including PM10, PM 2.5, NO2, CO2, SO2, VOC, Methane, O3 etc. from generators**, which will be standby if there is electricity failure,** and combustion of fuel for vehicle movements. Generally, this will adversely affect localized air quality for a short period and may lead to health risks associated with air pollution. Criteria pollutant and air emissions that would arise from the construction of the proposed project are quantified and summarized below.

- Land clearing, excavation, leveling and earth work
- Heavy construction equipment/vehicles such as diesel-powered bulldozers and loaders would be used throughout the entire construction phase
- Vehicle traffic on paved and unpaved roads
- Construction activities, concrete work
- Burning of slash materials such as hay, grass, trees, etc.
- Temporary fuel transfer systems and storage tanks have the potential to release VOC emissions
- Worker accommodation, including cooking operations

Adjacent to the construction site and along the transportation route, natural habitat, residents, and construction crew will be potentially affected.

6.2.1.2 Impact significance on air quality during the construction phase

a) Impact significance on air quality by particulates

The construction activities may lead to abundant of particulate matters such as the dusts from the transportation of materials and concrete particles used in construction.

The magnitude of impact on air quality by particulates is "***High***".
The area of impact will be not only within the area of construction activities but also in the vicinity area according to wind direction. Therefore, the extent of the air quality impact from particulates is "***Medium***".

The period of impact occurrence will be within the construction period and the duration of the impact by particulate matters through construction is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***".

Particulate matter is directly linked to the potential for causing health problems. The importance of the impact on air is considered as "***Medium***".

Therefore, the impact from particulate matters by the Landfill Gas to Energy project construction will be moderate and the significance of the impact will be "***Medium***".

Table 6.1: Impact significance on particulates during construction period

Characteristics					
Magnitude	Extent	Duration			
3 (High)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 3+2+1 = 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

b) Impact significance on air quality by gas emission

During construction phase of the project, emission from machines and equipment, generator and emission from vehicles transporting construction materials will be occurred and they will affect ambient air quality during construction of Landfill Gas to Energy project. Air quality degradation can be the main source of health effect on people.

The magnitude of impact on air quality by gas emission is "***Medium***".

The area of impact will be within the area of project compound and vicinity area. Therefore, the extent of the impact on air quality is "***Medium***".

The period of impact occurrence will be within the project period and this impact will affect along the working hours. The duration of the impact of gas emission is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***".

Air quality degradation can have adverse effect on human health and can also have damage to animal life and vegetation depending on volume of emission. Therefore, the importance of the impact on air quality by gas emission is considered as "***Medium***".

Therefore, the impact of gas emission by the Landfill Gas to Energy projects will be moderate and the significance of the impact will be "***Medium***".

Table 6.2: Impact significance on gas emission during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.1.3 Mitigation measures for air quality during the construction phase

During the construction phase, the following mitigation measures are recommended to minimize ambient air quality impacts.

- Apply dust and pollutant controls near emission activities such as LFG well construction and drilling, waste compaction, capping and earth works e.g. water sprinkling.
- Wind breaks should be constructed around the main construction activities and in the locality of potentially dusty works.
- Avoid excavation works in extremely dry weathers.
- Construction materials on site to be covered to prevent to be blown off by wind.
- Stockpiling of material, for example, rocks, sand and soils should be minimized.
- Stockpiles should be located as far away from receptors as possible.
- Vegetation of stockpiles should be used where a stockpile is not to be used for a month to stabilize the surface and prevent dust generation.
- Pave, apply water when necessary, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Visual monitoring of dust deposition onto surfaces on and off-site should be regularly conducted.
- Soil erosion and dust control management measures also assist in the management of air pollution from construction operations.
- Prohibit open burning of any waste at project site.
- Air pollution from vehicles will be minimized by using low emission equipment and vehicles.
- Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles.

- Ensure that all construction equipment and vehicles are maintained in accordance with the manufacture's recommendations.
- Minimizing the movement of vehicles and construction machineries particularly outside the premise of the project site to avoid further destruction.
- Vehicle idling time shall be minimized.
- Ensure strict enforcement of on-site speed limit regulations.
- Turn equipment off when not in use.

After mitigation measure, the impact on air quality will become less significant.

Table 6.3: After mitigation measures, impact significance on air quality during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.2 Impact assessment and mitigation measures for noise level

6.2.2.1 Potential impacts on noise

The construction works on site will most likely result in noise nuisance due to mobilization and operation of construction machines (mixers, tippers, cranes and backhoe), incoming vehicles to deliver construction materials, and communicating workers.

Construction noise levels are rarely steady in nature, but instead fluctuate depending on the number and type of equipment in use at any given time. There would be times when no large equipment is operating and noise would be at or near ambient levels.

Earthworks, pounding and impacting, shouting, loud radios, foundation and other normal construction activities all cause noise and vibration. Construction noise impact is short term pollution to local ambient noise quality. Generators which will be used for construction phase of the proposed project can also increase negative impacts to community and workers nearby the project area.

Noise and vibration will affect natural vegetation, animals, workforce, and communities in the areas.

Noise impacts will be considered significant if the project would result in the following: -

- Exposure of person to, or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Exposure of person to, or generation of, excessive ground-borne vibration or ground-borne noise levels.

- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

6.2.2.2 Impact significance on noise levels

Noisy activities on construction sites include use of jackhammers, dump trucks, cement mixers, cement cutters, electric saws, tamping machines and welding machines, as well as noise generated from hand tools such as sledgehammers and drills. The magnitude of impact from noise is "***Medium***".

The area of impact will be not only within the project but also in the vicinity area. Therefore, the extent of the impact on noise and vibration is "***Medium***".

The period of impact occurrence will be within the construction period. The construction workers and people in the vicinity area will have impact from noise of the proposed project and the duration of the impact from noise is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact noise by the Landfill Gas to Energy project will be moderate during the construction and the significance of the impact will be "***Medium***".

Table 6.4: Impact significance on noise level during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.2.3 Mitigation measures for noise quality

During proposed project construction, the following mitigation measures are recommended to minimize noise impact on individuals, sensitive areas and livestock.

- Use quiet equipment (i.e. equipment designed with noise control elements).
- Apply noise and vibration control technologies along with silencers or mufflers in waste compactor, LFG well drilling and construction machineries.
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors as far as practicable.
- Orientate equipment with high-noise in one direction so that this noise is emitted away from receptors as far as feasibly. Careful handling of material loading and unloading.

- Turn equipment off when not in use.
  Taking consideration to be careful sequencing and scheduling times.
- Limit pickup trucks and other small equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- Construction machinery and vehicles will undergo periodic maintenance to keep them in good working condition.
- Perform regular inspection and maintenance of preparation vehicles and equipment.
- Limit vehicles and machineries to an idling time and shut them off whenever possible. Schedule noisy construction activities and transportation during day-time hours.
- Combine noisy operations at the same time
- Locate noisy plant as far away from receptors as practicable.
- Avoid institutions sensitive to noise such as settlement, schools, health institution or other offices close to the project site.
- Provide PPE particularly hearing protection devices for those working in noisy areas.

After mitigation measure, the impact on noise quality will become less significant.

Table 6.5: After mitigation measures, impact significance on noise quality during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.3 Impact assessment and mitigation measures for vibration level

6.2.3.1 Potential impacts on vibration

The construction works on site for the LFG recovery and electricity generation will result in vibration impacts due to mobilization and operation of construction machines (mixers, tippers, cranes and backhoe), increased traffic and incoming heavy vehicles to deliver construction materials. Some equipment used in construction phase of project can create high vibration levels. Severity of a vibration impact is related to the type and location of the vibration source(s).
Hand Arm Vibration can be a significant health risk when workers use powered hand tools for significant lengths of time. Moreover, driving off road or operating a ride-on vehicle under extreme conditions can give rise to Whole Body Vibration (WBV) to drivers.

6.2.3.2 Impact significance on vibration levels

Vibration activities on construction sites include use of heavy trucks on rough terrain, construction machines and drills. The magnitude of impact from vibration is "***Medium***".

The area of impact will be within the project area. Therefore, the extent of the impact on vibration is "***Low***".

The period of impact occurrence will be within the construction period. The construction workers and people in the vicinity area will have impact from and vibration by the proposed project and the duration of the impact from vibration is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact of vibration by the proposed project will be moderate during the construction and the significance of the impact will be "***Medium***".

Table 6.6: Impact significance on vibration level during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+1+1 = 4			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.3.3 Mitigation measures for vibration impacts

During proposed project construction, the following mitigation measures are recommended to minimize vibration impact on individuals, sensitive areas and livestock.

- Construction activities must be carried out in such a way that vibrations arising will not cause damage to adjacent structures, residents and passers-by.
- Avoid combined of vibrating machines at the same time.
- Apply noise and vibration control technologies along with silencers or mufflers in waste compactor, LFG well drilling and construction machineries.
- Design construction activities to reduce vibration.
- Maximizing the distance between the source and receiver.
- Mechanically isolate the vibrating source or surface to reduce exposure.
- Faulty tools should not be used and tools should be maintained properly because tools which are worn, blunt or out of alignment will vibrate more.
- Ensure that construction machines, equipment and vehicles are well maintained to avoid excessive vibration.
- Maintaining wheels of vehicles and rail smoothness for transportation.
- Specifying vehicles with low unsprung weight, soft primary suspension, minimum metal-to-metal contact between moving parts of the truck, and smooth wheels.
- Install vibration damping seats.
- Perform regular inspection and maintenance of preparation vehicles.
- Limit vehicles to an idling time and shut them off whenever possible. Schedule transportation during day-time hours.
- Preventing workers from the effects of vibration by selecting appropriate vehicles and tool, by using of appropriate vibration-absorbing materials (in gloves, for example) and by providing good work practices with education programs.

- Training to workers is necessary to control exposure eg, selection, use, maintenance of equipment and restriction of duration of exposure.
- Limit the time spent by workers on a vibrating surface.
- Provide appropriate PPE to workers for those working in vibrating areas.
- Schedule work to reduce adverse effects.
- Consider and employ vibration monitoring and measurements if appropriate.
- Notify nearby residents and property owners that vibration-generating activity is imminent.
- Monitor and record vibration from the project activity.
- Respond to and investigate complaints by nearby community.

After mitigation measure, the impact on vibration will become less significant.

Table 6.7: After mitigation measures, impact significance on vibration during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.4 Impact assessment and mitigation measures for water quality

6.2.4.1 Potential impacts on water quality

In the construction phase, removal of vegetation and top soil level for the construction of the facilities including buildings for generators / camp, the ground surface for infrastructures including flare stack can cause sedimentation, and erosion to the nearby water courses. Sedimentation as a result of the erosion will reduce to water clarity and quality. In addition, potential sources of impacts to water during the construction phase include:

- Clearing land as well as land compaction for construction purposes
- Constructing landforms that change water flow paths
- Chemicals/Oil spills from the storage, use of diesel and hazardous materials that lead to contamination of water resources
- Release of suspended soil to the water flows
- Improper solid waste and wastewater management in the construction site
- Improper wastewater disposal from cleaning vehicles and equipment and
- Poor sanitation facilities that may result into surface water pollution through improper sewage management.

The proposed project will create increased water demand during construction phase for site preparation, dust spraying, construction activities, curing, domestic and other water requirements for labor and staff onsite. Increase in site runoff may also be ensued.

6.2.4.2 Impact significance on water quality

a) Impact significance on surface water quality

By the proposed project, the magnitude of the impact to quality of surface water is considered as "***Medium***".

The area of the potential impact will be not only within the area of construction activities but also in the vicinity area. So, the extent of all parameters for physical, chemical and biological results are noted as "***Medium***" level.

The period of potential impact duration can be short term duration. The duration of the impact for surface water is set as "***Low***".

Therefore, the characteristic of surface water impact by the proposed project is rated as "***Medium***".

The impact is expected to cause some disturbances potentially affecting communities locally and surrounding water bodies. The importance of the impact on surface water is set as "***Medium***".

The significant rating of impact is set as "***Medium***".

Table 6.8: Impact significance on surface water during construction phase

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

b) Impact significance on ground water quality

By the proposed project, the magnitude of the impact of physical, chemical and biological result of the ground water is considered as "***Medium***".

The area of the potential impact will be within the immediate area of project activities and project community. The extent of all parameters for physical, chemical (except hardness) and biological results are considered as "***Medium***" level.

The period of potential impact duration can be short term duration. The duration of the impact for ground water is set as "***Low***".

Therefore, the characteristic of ground water impact by the proposed project is rated as "***Medium***".

The impact is expected to cause some disturbances potentially affecting communities locally and surrounding water bodies. The importance of the impact on ground water is set as "***Medium***".

The significant rating of impact is set as "***Medium***".

Table 6.9: Impact significance on ground water during construction phase

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.4.3 Mitigation for water resources

The construction phase of the project will generate insignificant amount of wastewater that will bring
damage to the surface and ground water sources and soils.

The following mitigation measures should be practiced and used to reduce potential impacts for water resources from each specification.

- Limit water withdrawal to the amount that will not adversely affect the groundwater balance and the demand of the local community, by developing and conserving own source of water.
- Promote recycling and reuse of water as much as possible.
- Ensure taps are not running when not in use.
- Implement road drainage system and smooth road to limit erosion.
- Promptly detect and repair of water pipe and tank leaks.Proper recycling of water from other uses for sprinkling dusty pavements.
- All chemicals, paint, and fuel containers will be properly sealed and rigorous spill prevention mechanisms will be employed. Spills will be immediately treated to stop subsequent water pollution.
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage system of open stockpiles of construction materials.
- Open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms.
- Soil erosion and sediment control mechanisms will add positive effects on mitigation matters for water pollution.
- Conducting regular training, monitoring, and inspection schemes together with keeping track of water uses minimizes waste and leaks from faulty connections and faucets.
- Hazardous-materials handling procedures to reduce the potential for a spill during construction, and will include an emergency response program to ensure quick and safe cleanup of accidental spills.

After mitigation measure, the impact on water quality will become less significant.

Table 6.10: After mitigation measures, impact significance on water quality during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.5 Impact assessment and mitigation measures for soil quality

6.2.5.1 Potential impacts on soil quality

During this construction process, it may cause impact to soil system and its quality due to soil
erosion, clearing and preparation of project area. Earth moving and excavation activities will affect the natural surface flow regime of water.

Improper disposal of the excavated earth during installation of structures/equipment may result into temporary loss of topsoil productivity of that particular area. Further, clearing of vegetation and scarifying the site of topsoil with soil compaction during site preparation will result in reduced capacity of the land to retain water and increase surface water run-off during periods of rainfall.
Furthermore, as the construction of the project site includes covering existing landfill with a layer of sand, there will be negative impacts to soil depending where the sand is taken from.
Accidental spillage of construction materials/chemicals during handling and leakage from the storage area may lead to soil contamination.

6.2.5.2 Impact significance on soil quality

In construction period, it may cause impact to soil system because the existing soil and vegetation has to be removed and consequently soil erosion can take place.
The magnitude of impact on soil quality is "***Medium***".

The area of impact will be not only within the area of construction activities but also in the vicinity area.
Therefore, the extent of the impact on soil quality and structure is "***Medium***".

The period of impact occurrence will be remained after the project period and the duration of the impact on soil quality and structure is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristic is considered as "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, the impact on soil quality and structure by the Landfill Gas to Energy project is moderate and the significance of the impact will be "***Medium***".

Table 6.11: Impact significance on soil quality during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1= 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.5.3 Mitigation measures for soil

Mitigation measures should be applied to minimize soil pollution and waste management impacts of a project depending upon site and project-specific conditions. Many impacts can be reduced or avoided when considered during the design and construction phase. The following mitigation measures should be used.

- Careful planning to establish work zones, defining phases of construction, and active management of daily activities will be employed to minimize soil disturbance during the construction phase.
- The project area will be divided into smaller sectors and vegetation from the smaller sectors will be cleared sequentially to minimize soil exposure during construction.
- When required, topsoil will be carefully removed and saved for reuse.
- Reduce earth works for LFG plant construction as possible, especially in extremely dry weathers.
- Frequent water sprinkling and appropriate scheduling for truck and heavy equipment movements will also be arranged throughout the construction period.
- All chemicals, paint, and fuel containers will be properly sealed and rigorous spill prevention mechanisms will be employed. Spills will be immediately treated to stop subsequent soil pollution.
- A waste management plan (WMP) starting from waste reduction, waste separation, proper waste collection and transportation for the project should be developed that sets out plans and actions for construction wastes.
- Hazardous-materials handling procedures to reduce the potential for a spill during construction, and will include an emergency response program to ensure quick and safe cleanup of accidental spills.
- Careful plan and proper soil management at the area where the sand will be taken in order to cover the existing landfill. Transportation of sand to landfill site by effective and efficient methods, and remediation plan for original place where the sand is taken should be considered to reduce negative impacts on soil at original area.

After mitigation measure, the impact on soil quality will become less significant.

Table 6.12: After mitigation measures, impact significance on soil quality during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.6 Impact assessment and mitigation measures for waste disposal

6.2.6.1 Potential impacts by waste disposal

The construction activities generate substantial amounts of solid wastes including excavated materials from the earth work, bricks, concrete and other masonry materials, rock, wood, paints, treated and coated wood and wood products, land clearing debris and plaster.

In addition, lubricants and petroleum wastes, containers, cement paper bags and other packaging materials, scrap metal, glass, plastic containers and food remains will be created due to the construction activities. Filth generation can occur if waste/garbage generated during construction period is not handling.

6.2.6.2 Impact assessment on waste disposal

In construction phase of Landfill Gas to Energy project, the magnitude of waste during construction phase is "***Medium***".

The area of impact will be beyond the area of project compound. Therefore, the extent of the impact by waste during construction phase is set as "***Medium***".

The period of impact occurrence will be within the project construction period and the duration of the impact by waste is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, waste impact by the Landfill Gas to Energy project during construction phase will be moderate and the significance of the impact is considered as "***Medium***".

Table 6.13: Impact significance on waste disposal during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.6.3 Mitigation measures for waste disposal

Mitigation measures should be applied to reduce hazardous materials and waste management impacts of a project depending upon site and project-specific conditions. Many impacts can be reduced or avoided when considered during the design and construction phase.
The following mitigation measures should be used for proper waste disposal.

- Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.
- Construction materials will be managed in a way to avoid over-ordering, poor storage and maintenance, mishandling as well as improper operation procedures.
- Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste.
- Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements.
- Disposal of construction wastes in or off the construction site should be prohibited.
- The waste management system will comply with applicable regulation of the government, if any, or in its absence, good international practice.
- The waste management plan will identify disposal routes (including transport options and disposal sites) for all wastes generated during the construction phase.
- Waste segregation should be practiced at the workers camps with an emphasis placed on reducing, reusing and recycling of waste streams as appropriate.
- Construction wastes will be separated into reusable items and materials to be disposed of or recycled whenever possible. Hazardous waste will be stored in such a way as to prevent and control accidental release to the environment (e.g. secondary containment, sealed containers).
- Carefully select less hazardous materials and use the necessary amount only.
- Establish a designated hazardous waste collection site and make it secure.
- Do not clean the used hazardous material containers and mix wastes.
- A hazardous waste management system covering waste classification, separation, collection, storage, transfer and disposal should be set up and operated.
- Waste suitable for reuse will be stored on site and reintroduced to the construction process as and when required.

- Recyclables such as scrap steel, metals, plastics, and paper items will be collected for recycling wherever possible.
- Packaging materials, cans, and containers would be hauled back to manufactures for reuse in next shipments where economically feasible. Or sell back in local in which these will be recycled or reused for other commercial use. Use of plastic bags will be discouraged and explained to the workforce and local communities.
- Prohibit open burning of any waste at project site.
- Regular collection times will be arranged to prevent overflow in waste collection bins.
- Chain of custody documents should be used for construction waste to monitor disposal.

After mitigation measure, the impact on waste disposal will become less significant.

Table 6.14: After mitigation measures, impact significance on waste disposal during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.7 Impact assessment and mitigation measures for ecological resources

6.2.7.1 Forest

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. As a result of negative impact to air, soil, water, noise during pre-operation phase will affect biodiversity and forest to certain extent.

However, the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on these ecological resources will be considered as "less significant" in this construction phase complying with the mitigation and management measures elaborated above accordingly.

The forest nearby will be affected only to the certain extent but not significantly due to this project.

6.2.7.2 Impact significance on forest

During construction phase of proposed project, the magnitude of impact to forest will be "***Medium***".

The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the construction period so duration of impact will be "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to forest by the Landfill Gas to Energy project will be moderate during the construction and the significance of the impact will be "***Medium***".

Table 6.15: Impact significance on forest during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.7.3 Mitigation measures for forest

Complying with the mitigation and management measures for air, soil, water, noise and waste management which are elaborated above will reduce the negative impacts to forest by proposed project.

After mitigation measure, the impact on forest will become less significant.

Table 6.16: After mitigation measures, impact significance on forest during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.7.4 Wildlife

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. As a result of negative impact to air, soil, water, noise during pre-operation phase will affect biodiversity, forest and wildlife to certain extent.

However, the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on wildlife will be considered as "less

significant" in this construction phase complying with the mitigation and management measures elaborated above accordingly.
The wildlife nearby will be affected only to the certain extent but not significantly due to this project.

6.2.7.5 Impact significance on wildlife

During construction phase of proposed project, the magnitude of impact to wildlife will be "***Medium***".
The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the construction period, so duration of impact will be "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to wildlife by the Landfill Gas to Energy project will be moderate during the construction and the significance of the impact will be "***Medium***".

Table 6.17: Impact significance on wildlife during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.7.6 Mitigation measures for wildlife

Complying with the mitigation and management measures for air, soil, water, noise and waste management which are elaborated above will reduce the negative impacts to wildlife by proposed project.

After mitigation measure, the impact on wildlife will become less significant.

Table 6.18: After mitigation measures, impact significance on wildlife during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.7.7 Aquatic animal/ fish

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. The aquatic animals nearby will be affected only to the certain extent but not significantly due to this project.

Construction works of pre-operation phase will lead negative impacts to environment (water, air and soil) and subsequent negative impacts on aquatic animals.

Impacts by this project on aquatic animal/fish will be considered as "less significant" in this construction phase if the mitigation and management measures elaborated above will be complied accordingly.

6.2.7.8 Impact significance on aquatic animals/fish

During construction phase of proposed project, the magnitude of impact to **aquatic animals** will be "***Medium***".

The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the construction period, so duration of impact will be "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to aquatic animals by the Landfill Gas to Energy project will be moderate during the construction and the significance of the impact will be "***Medium***".

Table 6.19: Impact significance on aquatic animals/fish during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.2.7.9 Mitigation measures for aquatic animals/ fish

Mitigation measures which are mentioned above for air, soil, water, noise and waste management will reduce the negative impacts to wildlife by proposed project.

After mitigation measure, the impact on aquatic animals/ fish will become less significant.

Table 6.20: After mitigation measures, impact significance on aquatic animals/ fish during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.2.8 Impact assessment and mitigation measures on human environment

6.2.8.1 Impacts on human environment

a) Impacts on occupational health and safety

During construction of the proposed project, it is expected that construction workers are likely to have accidental injuries and hazards as a result of accidental occurrences, handling of hazardous waste, lack or negligence of the use of protective wear etc.

Significant hazards can be occurred due to the potential fall of materials or tools as well as temporary hazards such as **physical hazards** (landfall, fall into the site hole, methane ignition), dust emission and noise pollution. Moreover, accidents and injuries to workers can be caused by the heavy vehicle movement for the transport of construction materials and equipment. Workers are also likely to be exposed to diseases from contact with potentially harmful building materials.

The proposed project will appoint a lot of construction workers in construction phase. A potential social impact both during construction and operation of the project will be on the occupational health and safety of the staff.

Mitigation measures are described in the next sections and on their working conditions. Before the construction activities, there is need for the materials to be well inspected and harmonized to the occupational health and safety standards.

b) Impacts on Socio- economic

The social impact of this project is expected to be positive, as implementing this technology and committing with the CDM will deliver local community benefits as it will create a new source of jobs during the construction. Employment opportunities are of benefit both economically and in a social sense.

Several workers including casual laborers, masons, carpenters, joiners, electricians and plumbers are expected to work on the site from start to the end. Apart from casual labor, semi-skilled and unskilled labor and formal employees are also expected to obtain gainful employment during the period of construction. There may not have several informal businesses which come up during the construction periods of such projects, because the proposed project is located in the current landfill area which is supervised by related authority.

Through the use of locally available materials during the construction phase of the project including cement, concrete and ceramic tiles, timber, sand, ballast electrical cables etc., the project will contribute towards growth of the economy by contributing to the gross domestic product.

6.2.8.2 Impact assessment on human environment

a) Impact significance on occupational health and safety

There will be impact on health and safety and the magnitude of impact during construction phase of the project is "***Medium***".

The impact of the project can affect health and safety of the workers and people in the vicinity area. Therefore, the extent of the impact is "***Medium***".

The period of impact occurrence will be within the construction period and the duration of the impact on residential area is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, the impact on residential area by the Landfill Gas to Energy project during construction period will be moderate and the significance of the impact will be "***Medium***".

Table 6.21: Impact significance on occupational health and safety during construction period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

b) Impact significance on socio- economic

Landfill Gas to Energy project is located in Kyar Ni Kan landfill area and has a close boundary with Kyar Ni Kan villge, Aein Kyel and Aein Shay Min Htan Taw villages.

The local people can get job opportunities as construction workers and skilled labour, therefore, during construction phase, the impact by the proposed project on socio- economic will be positive impact.

6.2.8.3 Mitigation measures for occupational health and safety

The project will implement the following mitigation measures for Occupational Health and Safety:

- Ensure that boreholes drilled for vertical LFG wells are not left open to prevent workers from falling into boreholes.
- Provide workers with PPEs and trainings to avoid exposure of LFG and fugitive emission during drilling wells and constructing plant including severe winds or weather in landfill site.
- Minimize threats by bacteria, insects, germs and chemicals by providing workers with PPE and hygiene facilities as well as mask, glove, footwear, hand sanitizer and anti-bacterial solvent.
- Strictly enforce that workers adhere to the HSE manuals including safety net system and specific PPE use to avoid slips, falls, hits, fire, explosion and confined space threat.
- Suitable overalls, safety footwear, dust masks, gas masks, respirators, gloves, ear protection equipment etc. should be made available and construction personnel must be trained to use the equipment.
- Training to personnel will be imparted to generate awareness about effects of noise and importance of using PPEs.
- All workers will be provided with personal protection equipment (PPE) and will be obliged to wear them in work zones.
- Prohibit smoking and other ignition sources in areas with potential LFG emissions using warning signs.
- Designate restricted areas for danger zones with caution signs if necessary.
- Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated areas shall be provided.
- Particular works shall strictly follow work permit scheme.
- Promote safe and healthy working environment, health, and well-being of all employees.

- Implement all necessary measures to ensure health and safety of workers.
- Well stocked first aid box which is easily available and accessible should be provided.
- Specific preparation of PPE as well as fall protection equipment, safety suits, helmets, glasses, gas/dust protection masks, respirators, and ear muffs, PPE trainings and first aid boxes in the easy access areas.
- Necessary health and safety rules shall be enforced by the site foreman to ensure that all staff members adhere to the standards and are thus safe.

After mitigation measure, the impact on occupational health and safety will become less significant.

Table 6.22: After mitigation measures, impact significance on occupational health and safety during construction period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3 Operation phase (Construction for Phase 2: flaring system and Phase 3: LFG to electricity generation)

6.3.1 Environmental and social impacts during the operation phase

The proposed project is related to Clean Development Mechanism (CDM) which is designed to reduce emissions (methane) which can effect on the climate change.
Operation phase of proposed project will include two phases: **Phase 2:** ***Flaring system*** and **Phase 3:** ***LFG to electricity generation***.

However, the operation phase of the Landfill Gas to Energy project, **Phase 2** and **Phase 3**, will generate solid wastes, wastewater, and substances contributing to air pollution, a certain degree of noise, vibration, and hazardous wastes. Despite the project's optimum efforts to keep the pollutants at the lowest level by employing the best available technologies and management mechanisms, it continues to have lesser degree of footprint on the environment.

Regular maintenance of machine, equipment, vehicles and infrastructure including Emergency Response Plan, and careful selection of raw materials and less polluting chemicals, will be carried out as a part of the project's drive to further reduce the environmental footprint.

6.3.1.1 Impacts on air quality during operation phase

Clean Development Mechanism (CDM) project is intended to reduce greenhouse gases especially methane and other emissions which are currently produced at the open dumping site.

This project is intended to create positive impacts in terms of reducing air pollution as well as generating electricity for waste management purposes at Kyar Ni Kan landfill area.

During operation phase of the proposed project, the following activities will impact air quality;

- Phase (2) ***Flaring System*** – NOx and CO impact on the nearest community
- Phase (3) ***LFG to electricity generation*** – NOx and CO impact on the nearest community

Although Dioxins and furans can be reformed and emitted by the combustion process of Landfill gas, benefits of the project outweigh the emission of raw landfill gas from open area to the atmosphere.

(a) Fugitive particulate emissions

The particulates will be emitted from the following process:

- Handling and storage of chemicals and fuels
- Transportation of materials by trucks and other vehicles
- Storage, packing, bagging and delivery activities

(b)Gases emission

As proposed project is a CDM (Clean Development Mechanism) project, GHG emissions including methane emissions will be reduced as the gases from landfill sites will be collected through the pipeline system, processed and electricity will be generated.

GHG emissions would arise due to methane leakage from the collecting pipelines through certain points and valves, flaring system, generator operations and energy consumption for the transportation. Moreover, dioxins and furans can also be generated from combustion process of landfill gas.

The gases will be emitted from the following process that will further escalate air pollution issues:

a) Phase (2) Flaring System
b) Phase (3) LFG to electricity generation
c) Vehicle activities
d) The use of waste fuels such as solvents, waste oil, organic chemicals

To reduce air pollution impacts, the facility adopts and implements the highly efficient machine and equipment with optimum combustion process, manages well-coordinated traffic flows and monitors pipeline system and operating machines regularly. These will serve as the facility's drive to minimize air pollution issues.

6.3.1.2 Air impact assessment on emissions from the proposed landfill gas recovery project site (Kyar Ni Kan)

(i) Introduction

This study assesses the impact of proposed landfill gas (LFG) Recovery and Generation Project in the Kyar Ni Kan landfill site on the atmospheric environment. The Kyar Ni Kan (KNK) landfill site is located in the North of Mandalay as shown in Figure 6.1. This study simulated the impacts on air quality of the atmospheric emissions resulting from the proposed treatment options, flares and engine-generator, in 2 phases of the LFG project. The LFG treatment options in the 2 phases are detailed below.

1) Phase 2: one enclosed landfill gas flare,

2) Phase 3: one flare as phase 2 plus one engine-generator set in KNK.

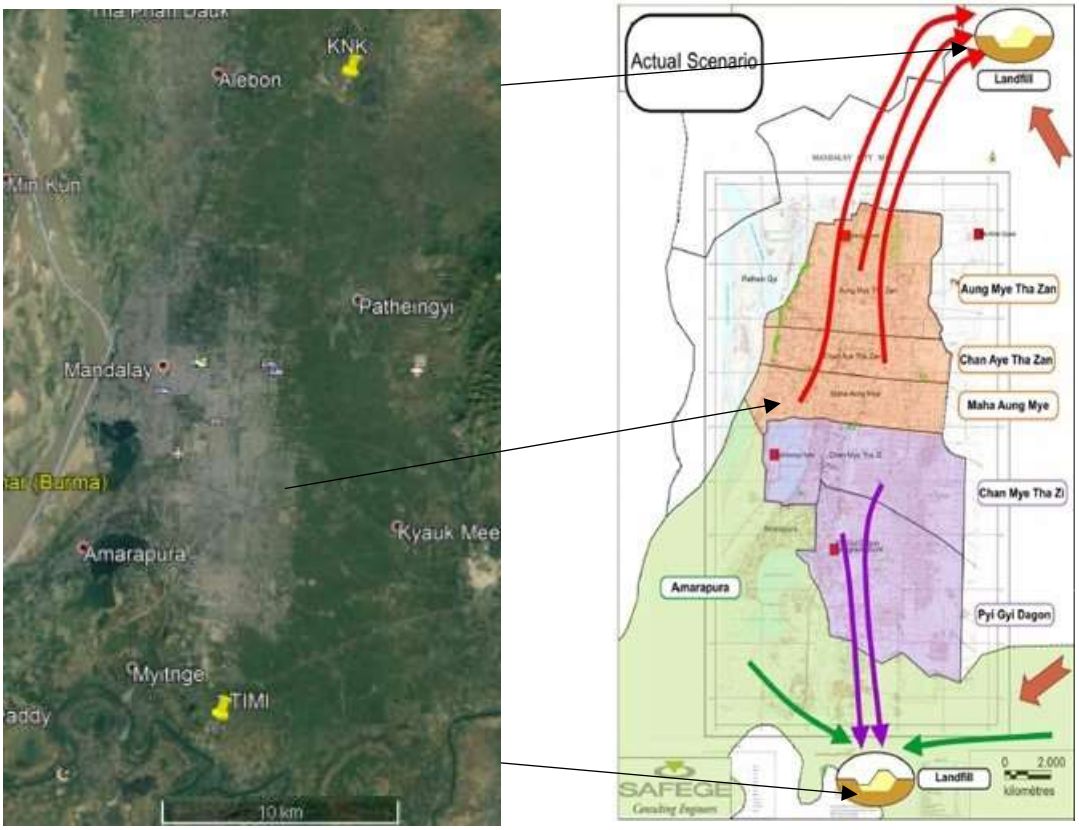


Figure 6.1: Landfill Gas Project locations (KNK)

This study applies the ***USEPA preferred AERMOD model*** to assess the dispersion and impacts of the emissions on the ambient air quality in the project area. AERMOD is a steady-state plume model that simulates atmospheric dispersion based on planetary boundary layer turbulence structure and scaling concepts.

The model needs two input files, the emission and the meteorology. The emission rates of the point sources of flares and generators proposed at the landfill site were calculated using the design data provided by the LFG project. The meteorological data were taken from the WRF (3D Weather Research and Forecasting mesoscale numerical weather prediction model) simulation for Myanmar with a nested domain containing Mandalay for one year of 2018. The input data preparation for AERMOD modeling and the modeling results are presented in this report.

6.3.1.3 Input data preparation

(i) Emission input data

The required inputs of the emission sources for AERMOD modeling were prepared from the designed parameters of the flares and generators. The emission rates were calculated as the product of flow rate (m^3/s) and concentration of pollutants in the flue gas (mg/m^3). The generator in KNK has 2 stacks (each: 0.2 m diameter and 3,011.5 m^3/h or 0.836 m^3/s) which are combined for modeling as one-point source with double diameter and flow rate.

Based on the designed information***, CO and NO_x*** are the major air pollutants from the flare and generator stacks. Therefore, the AERMOD simulation is conducted for these two pollutants using the inputs presented in Table 6.12.

Table 6.23: AERMOD input parameter for different emission sources

AERMOD input parameter	Emission sources in Phase 2	Emission sources in Phase 3	
	Flare in KNK	Generators in KNK	Flare in KNK
Elevation (m)	99	99	99
Stack height (m)	8.2	10	8.2
Diameter (m)	1.2	2 x 0.2*	1.2
Temperature (K)	823	823	823
Exit velocity (m/s)	2.57	-	2.57
Flow rate (m^3/s)	2.91	1.67*	2.91
Conc. (mg/m^3)			
CO	200	200	200
NO_x	150	100	150
Emission rate (g/s)			
CO	0.58	0.33	0.58
NO_x	0.44	0.17	0.44

Note: * values are combined from two stacks in the generator, each with a diameter of 0.2 m and flow rate of 3,011.5 m^3/h (0.836 m^3/s).

6.3.1.4 Preparation of meteorological input data

WRF modeling system was run and the outputs were used to prepare the meteorological input data for the AERMOD simulation. Two-way nesting domains (Figure 6.2) were configured for WRF version 4.2: 1) the coarse domain (WRF-D1) with resolution of 36 x 36km covering Myanmar and the surrounding areas; 2) the nested inner domain (WRF-D2) with resolution of 12 x 12 km covering the central part of Myanmar, including the Mandalay province. The MMIF model was used to extract and process the surface and profile meteorological files from WRF-outputs for a location with the coordinates of 22.086E - 96.162N which are input to AERMOD simulation for both landfill sites.

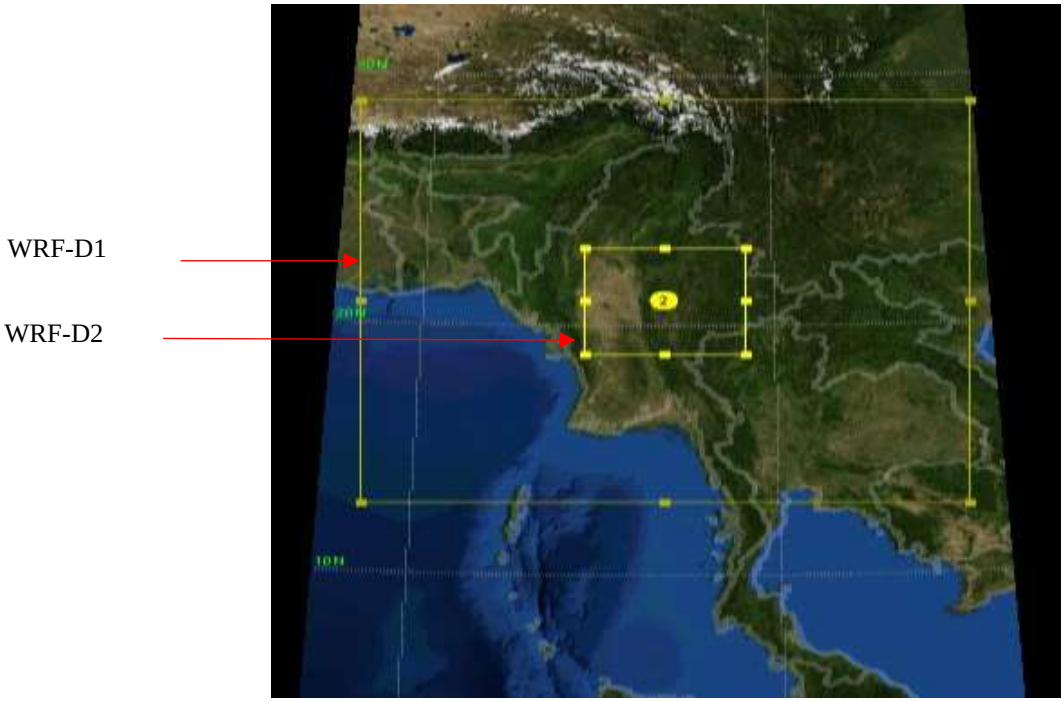


Figure 6.2: Two-way nesting domain configuration for WRF simulation covering Mandalay (inner domain 2)

Figure 6.3 presents the flow directions (wind directions + 180^{o}) of the hourly surface meteorological winds extracted from WRF-MMIF for the location in Mandalay. It is clearly seen that the southeasterly wind (blowing to the northwest) was the most prevailing, following by southwesterly and southerly. With the flow directions shown in Figure 1.3, KNK would normally be downwind of Mandalay city.

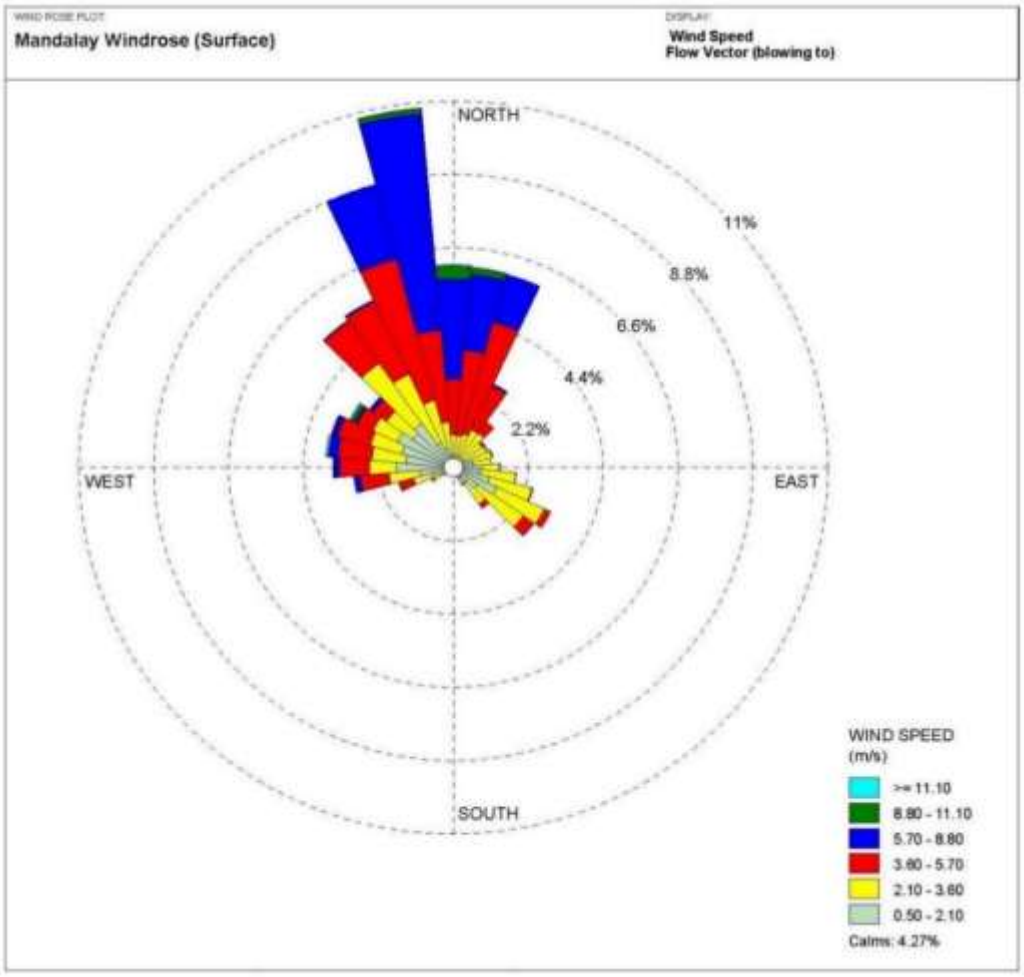


Figure 6.3: Surface wind speed and flow directions (blowing to) obtained from WRF-MMIF form Mandalay used in AERMOD simulation

6.3.1.5 Receptor grids

The AERMOD simulation was done simultaneously for all emissions sources for 3 receptor grid domains. The outter receptor grid (resolution of 500 x 500m) was set up to cover the Mandalay city and two land fill sites, with the domain area of 800 km^2. This domain aimed to assess the cummulative effects of two landfills on the air quality of the city. One inner receptor grid with area of 3 km^2 surrounding the landfill site having finer resolution (25 x 25m) were configured to better show the emission plumes around the landfill site (Table 6.13).

Table 6.24: Receptor domains configuration

Domain	Resolution	Area	Coverage
Mandalay	500 x 500 m	40 x 80 grids (Area = 800km^2)	Expanding over Mandalay city and surrounding area, including 2 landfill sites
KNK	25 x 25 m	60 x 60 grids (Area = 3km^2)	Covering KNK site

6.3.1.6 AERMOD modeling results

The AERMOD simulation was done for Phase 2 and Phase 3, separately, to assess the dispersion patterns and impacts of the emissions in each phase of the LFG project to the domain areas.

6.3.1.7 Air pollutants levels and dispersion pattern in Phase 2

The results show that in Phase 2 the levels of NO_2 and CO with different averaging times (1h, 8h, annual) are well below the respective Environmental Quality Emission Guideline (EQEG) stated by ECD, World Health Organization (WHO) guidelines and ambient air quality standards of United State Environmental Protection Agency (US EPA NAAQS). Table 6.14 presents the maximum (first highest) concentrations of these pollutants founded within 50-100 m from the point emission sources at KNK landfill site. Note that the output of the model is NO_x but assuming that all NO_x in the atmosphere will be eventually converted to NO_2 hence hereby the outputs are compared to the reference values available for NO_2.

Table 6.25: The maximum concentration of air pollutants dispersed from the point sources in Phase 2

Pollutants*	Max value ($\mu g/m^3$)	Locations of the max concentrations	Reference values** ($\mu g/m^3$)
	KNK		
NO_2 (1h)	64	- 75m north of KNK	200 (WHO)
NO_2 (annual)	4	- 100m north of KNK	40 (WHO)
CO (1h)	85	- 75m north of KNK	40,000 (EPA)
CO (8h)	80	- 75m north of KNK	10,000 (EPA)
CO (annual)	6	- 100m north of KNK	-

Note: *: short-term averaging (NO_2 1h, CO 1h and CO 8h) are the 1st highest values in the year; annual values (NO_2 and CO annual) is the annual average
**: WHO guideline values for NO_2, and USEPA NAAQS values for CO

The ***dispersion patterns of CO and NO_2*** show ***higher concentration plumes near the flare sites*** and dispersed following the prevailing wind direction, i.e. southeasterly wind (Figures 6.4, 6.5 & 6.6). Particularly, Figure 6.4 shows the pattern of the flare plumes of CO released from the KNK site and spreading to the northwest direction of the emission sources locations. Overall, the concentrations of 1h CO in the whole domain are well below US EPA NAAQS of 40,000 $\mu g/m^3$.

Due to its downwind location. KNK emission plume less significantly affected the Mandalay city comparing to the upwind- located TIMI.

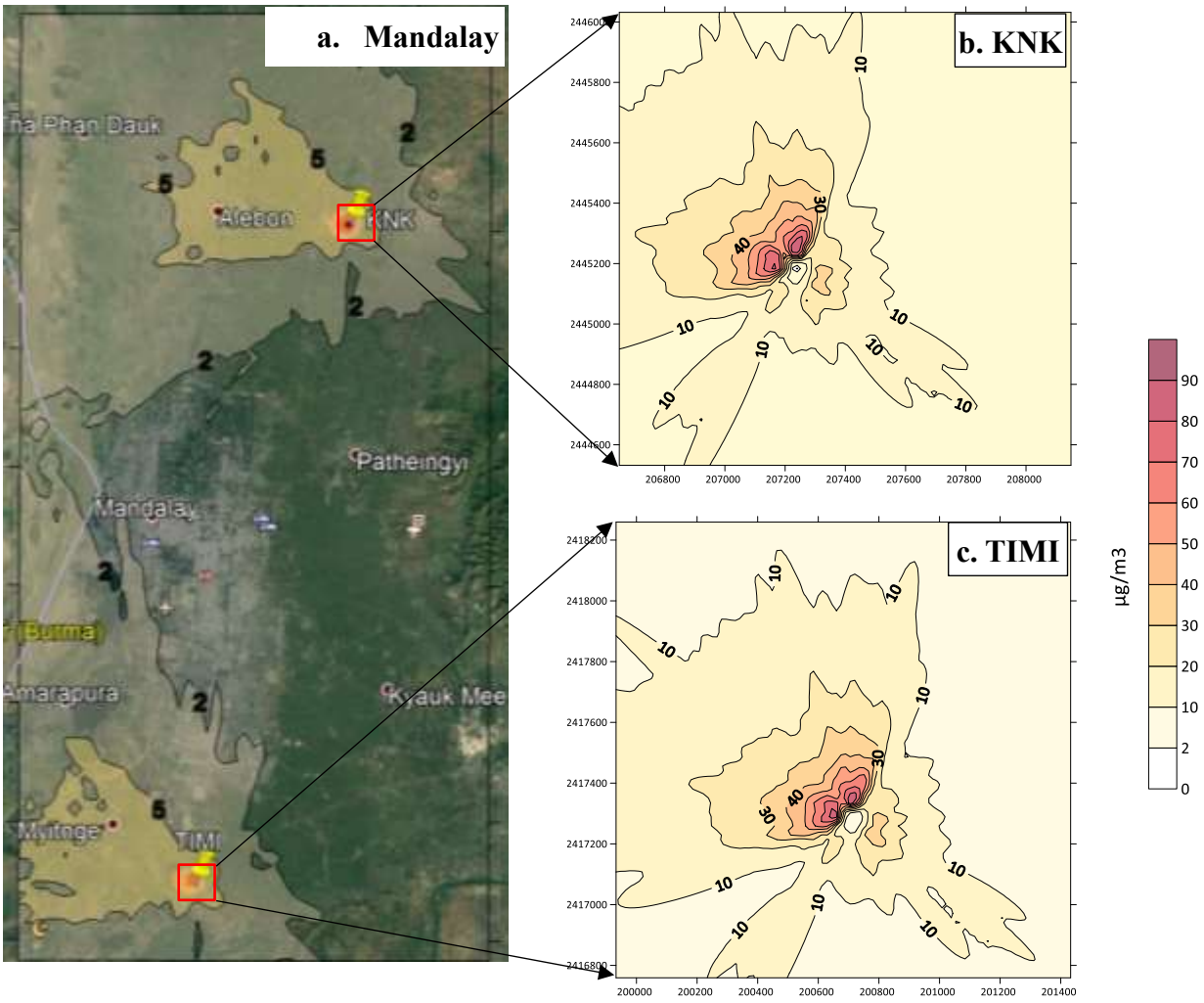


Figure 6.4: Dispersion patterns of the 1st highest values of 1h CO in Mandalay (Phase 2)

The plume dispersion patterns of 1h NO_x (Figure 6.5) is almost similar to those of 1h CO, e.g. dispersing to the northeast direction of the emission sources locations. The concentrations of 1h NO_x in the domains are well below WHO guideline value for NO_2 of 200 µg/m^3.

The plumes of annual average of NO_x spread over the area within 1.5 km from the emission sources to the northeast, with low concentrations (0.5-4 µg/m^3), as seen in Figure 6.6.

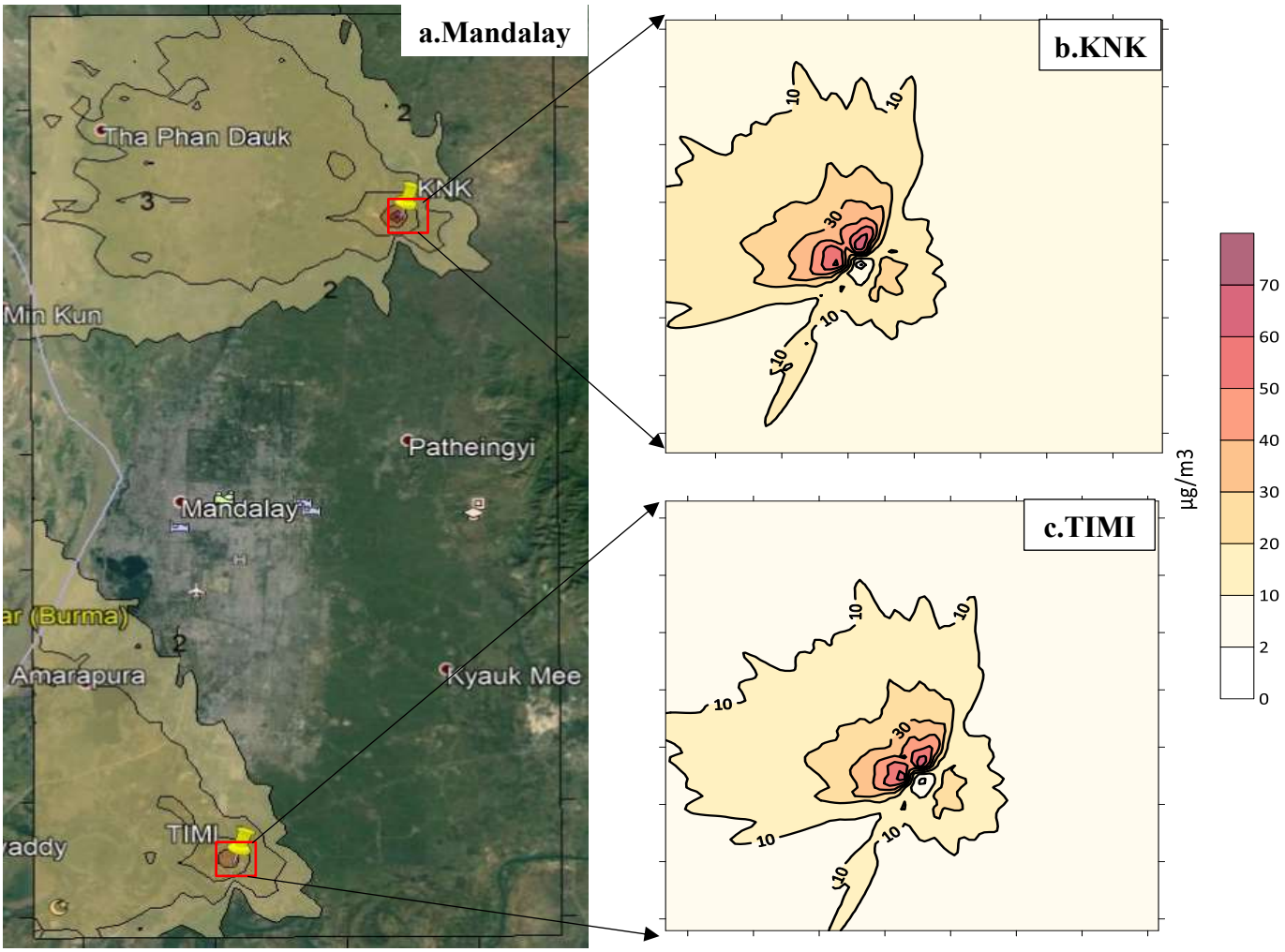


Figure 6.5: Dispersion patterns of the 1st highest values of 1h NO_x in Mandalay (Phase 2)

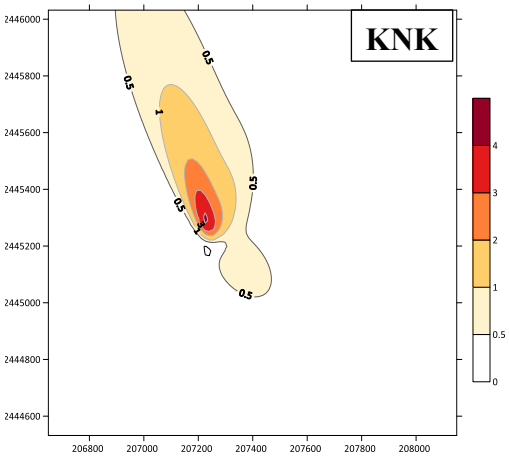


Figure 6.6: Dispersion patterns of the annual average NO_x around KNK (Phase 2)

6.3.1.8 Air pollutants levels and dispersion patterns in Phase 3

In this phase, a generator will be installed in KNK site which would increase the emissions at KNK. Table 6.15 presents the pollution levels in the KNK site in Phase 3 which show higher maximum concentrations of NO_2 and CO in different averaging time than those in Phase 2. None of the first highest concentrations of any pollutant exceeded the reference values. Note that, similar to Table 1.3 above, the model outputs of NO_x are compared to the reference values available for NO_2 which is the eventual form of NO_x in the atmosphere.

Table 6.26: The max concentration of air pollutants dispersed from KNK site in Phase 3

Pollutants*	Value ($\mu g/m^3$)	Locations found the max concentrations	Reference values** ($\mu g/m^3$)
NO_2 1h	83	- 100m north of KNK	200
NO_2 annual	7		40
CO 1h	124	- 100m north of KNK	40,000
CO 8h	107	- 80m north of KNK	10,000
CO annual	11	- 100m north of KNK	-

Note: *: short-term averaging (NO_2 1h, CO 1h and CO 8h) are the 1st highest values in the year; annual values (NO_2 and CO annual) is the annual average
**: WHO guideline values for NO_2, and USEPA NAAQS values for CO

Figure 6.7 and 6.8 show the plume dispersion patterns of 1h CO and 1h NO_2 in Phase 3 which also follow the main southeasterly wind direction, but the KNK plumes spread over larger area than that in Phase 2 due to the increase in the emission rate. The first highest concentrations of NO_2 and CO over the domains are well below the EQEG (ECD), WHO GV and US EPA NAAQS, respectively.

The changes for 1h NO_x was not significant when comparing Figure 6.5 (Phase 2) and Figure 6.8 (Phase 3).

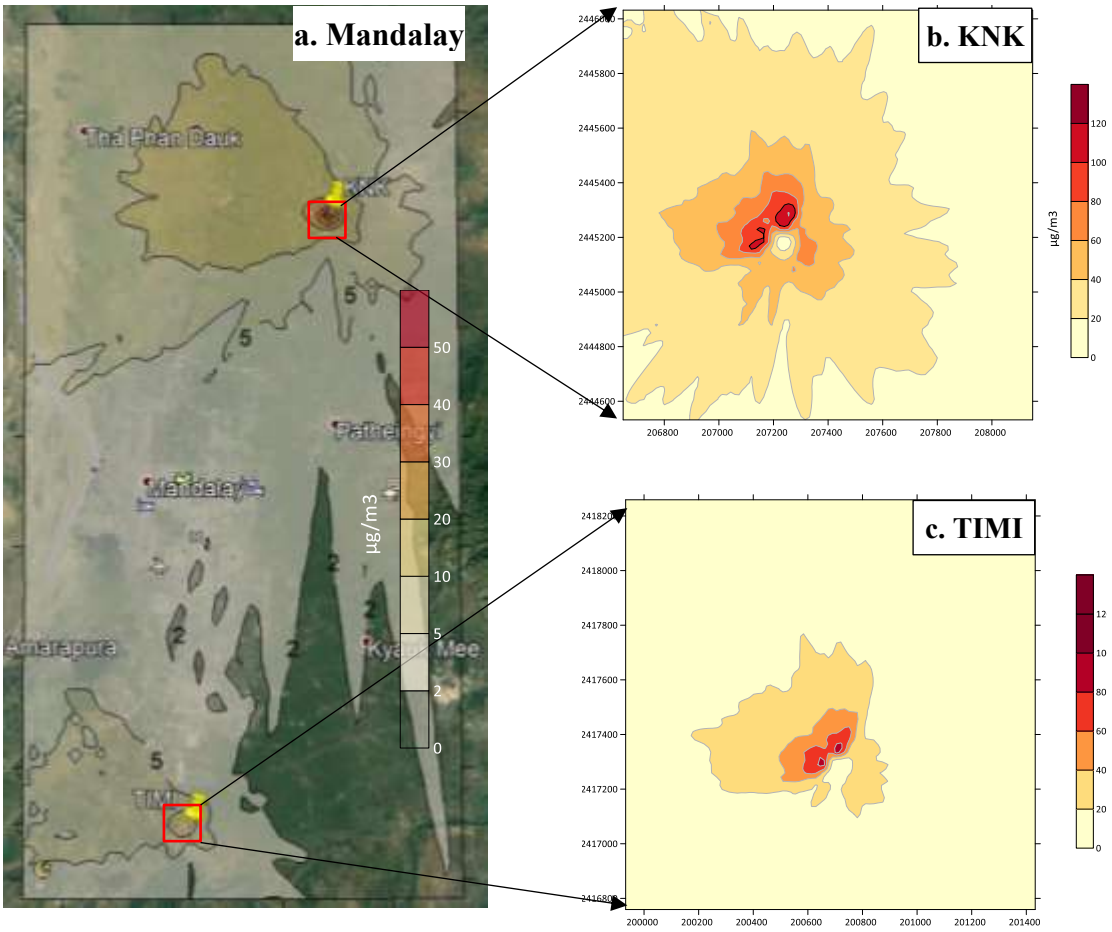


Figure 6.7: Dispersion patterns of the 1st highest values of 1h CO in Mandalay (Phase 3)

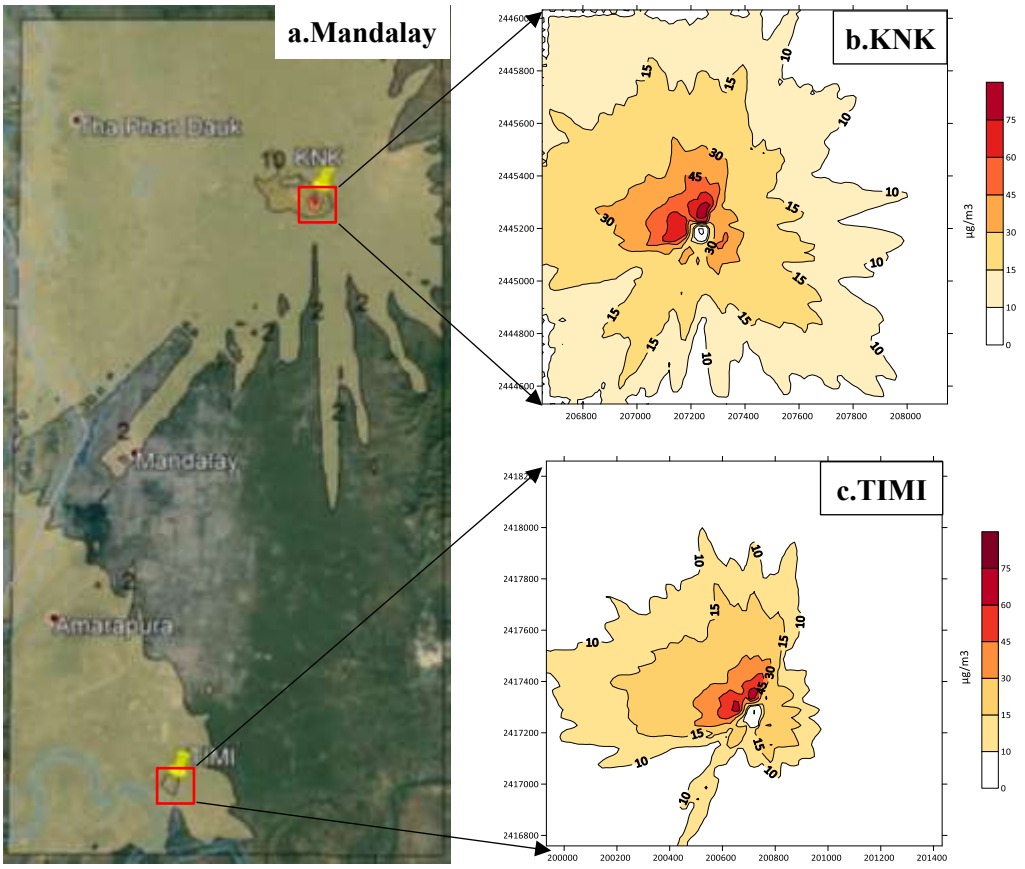


Figure 6.8: Dispersion pattern of the 1st highest values of 1h NO_x in Mandalay (Phase 3)

6.3.2 Impact assessment on air quality during operation phase

a) Impact significance on air quality by particulates

There will have a minor impact from particulate matter during the operation of the Landfill Gas to Energy project.

The magnitude of impact by particulate matter will be "***Medium***".

The area of impact will be not only within the project compound but also in the vicinity of project area. Therefore, the extent of the air quality impact from particulates is considered as "***Medium***".

The period of impact occurrence will be within the operation period and the duration of the impact for ten years by particulate matters is considered as "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact on air is considered as "***Medium***".

Therefore, the impact from particulate matters by the Landfill Gas to Energy project operation will be moderate and the significance of the impact will be "***Medium***".

Table 6.27: Impact significance on air quality during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+2+2= 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

a) Impacts significance on air quality by gas emission

In operation period of the project, methane gas from landfill site will be converted into energy and negative impacts of methane will be reduced. However, during Phase 2 and Phase 3 of the project, there will be gas emission such as CO and NOx.

Moreover, toxic gases such as dioxin and furans can be reformed due to combustion process.

The magnitude of impact on air quality by this gas emission will be "***Medium****"*.

The area of impact will be beyond project compound. Therefore, the extent of the impact on air quality will be "***Medium***".

The period of impact occurrence will be within the project period and these impacts will affect the project workers. The duration of the impact of gas emission will be "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***".

The importance of the impact on air will be considered as "***Medium***".
Therefore, the impact air quality by gas emission by the Landfill Gas to Energy projects operation will be less and the significance of the impact will be "***Medium***".

Table 6.28: Impact significance on gas emission during operation processes

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+2+2 = 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.3 Mitigation measures for air quality during operation phase

During proposed project operations, the following mitigation measures are recommended to minimize the impact on the ambient air quality.

- Adequate capping system with low-permeability covers to minimize LFG venting to the atmosphere.
- Install efficient LFG collection and control system to minimize methane migration with regular check-up and maintenance system of piping and pressure along with safe guard and gas detector.
- Enforce not to release LFG directly to the environment in a downtime or overhaul e.g. by drawing all LFG into combustion system.
- Proper engineering selection for LFG enclosed flares with high temperature and low calorific technology.
- Utilization of LFG generator set with low-emission engine.
- Use of international accepted flaring system with high capacity burning points.
- Operating with "3-T Rule" which are High Burning Temperature to boost waste pulverization, adequate Ignition Time to enhance waste annihilation and High Burning Turbulence to disperse warmth uniformly ensuring complete annihilation.
- Prevention of favorable condition that support formation of dioxins and furans immediately after post-combustion. Use specific design specifications such as cooling post combustion gases quickly from higher temperature to avoid extended exposure in temperature range that is known to favor dioxin and furan formation.
- Installing flaring plant away from ignition sources such as electric cables and dry trees.
- Enforce not to release LFG directly to the environment in a downtime or overhaul e.g. by drawing all LFG into combustion system.
- Reducing the presence of certain metals such as copper which are known to ease dioxin and furan formation.
- Proper management of contaminated materials.
- Comply with Gas Collection System (GCS) monitoring and regular schedule to check-up to detect operational problems early and minimize system downtime.
- Consider the use of low-emission generator engines.

- Careful use of energy efficient equipment and tools.
- Careful selection and use of environmentally friendly and low emission machines and vehicles.
- Maintain periodically operation machineries and vehicles in manufacture manuals to operate in good working condition.
- Schedule movement of vehicles and limit vehicular speed to minimize exhaust and dust emissions.
- Systematic arrangement of delivery operation schedules and times.
- Educating drivers and vehicle operators to stop engine idling.
- Education and training programs with competitions to encourage all employees to actively participate in energy saving.
- Storage of chemical and fuel in related covered or closed bays in areas protected from wind and other weather conditions.
- Spray water onto the ground to control dust.
- Minimize vehicle idling time by turning equipment off when not in use.
- Appropriate management of project traffic.
- Odor reduction measures to minimize odor disturbance from LFG plant if necessary.
- Use of enclosed belt conveyors for materials transportation and emission controls at transfer points.
- Plant long trees around the project area to control air pollution (a green belt).
- Placing a buffer zone with a garden or with a man-made forest between residential areas and project operation zones.

After mitigation measure, the impact on air quality will become less significant.

Table 6.29: After mitigation measures, impact significance on air quality during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.4 Impact assessment and mitigation measures on noise level

6.3.4.1 Potential impacts on noise quality

During the operational phase of the proposed project, noise will be generated from the project operations and transportation. The potential sources of noise pollution include:

- Material handling equipment and operations
- Vehicles and project operations
- Exposure of person to, or generation of, excessive ground-borne vibration or ground-borne noise levels
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

6.3.4.2 Impact significance on noise quality

Generally, noise at work can cause hearing damage that can lead to permanent and disabling. In operation phase of Landfill Gas to Energy project, some processing activities and machines such as generators can have noise impact on workers.

The magnitude of noise during the operation period will be "***Low***".

The area of impact will be only within the area of production. Therefore, the extent of the impact of noise and vibration will be "***Low***".

The period of impact occurrence will be within the production period. The duration of the impact of noise during operation is considered as "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, the impact of noise level by the Landfill Gas to Energy project will be moderate and the significance of the impact will be "***Medium***".

Table 6.30: Impact significance on noise level during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 1+1+2 = 4			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.4.3 Mitigation measures on noise level

Following precautionary measures should be adopted to control the noise level.

- Install sound insulation techniques with use of well-functioning silencers and dampers for LFG collection system, blower, moisture separator, generator and flares.
- Ensure anti-vibration control along with vibration damping seats to reduce earth-borne vibration level from the whole LFG plant.
- Orientate equipment with high-noise in one direction so that this noise is emitted away from receptors as far as feasibly.
- The workers and employees working at the project premises particularly nearby the operation emitting noise should use ear plugs and ear muffs for protection against the noise.
- Provide appropriate PPEs including ear muffs and make sure to wear these PPEs during working hours.
- Training to personnel will be imparted to generate awareness about effects of noise and importance of using PPEs.Ensure use of mufflers on diesel/gas driven machinery.
- Using enclosure for all generator sets.
- Use low noise equipment.
- Reduce the working hours of operating noisy machines.
- Schedule operation of noisy operation equipment at different times.
- Schedule noisy operation activities and transportation during day-time hours.
- Turn equipment off when not in use.
- Carryout regular maintenance of the equipment to minimize the noise level.
- Traffic control measures to be enforced strictly.
- Carry out periodic monitoring of noise levels, if values exceed the standard limits, suitable mitigation measures needed to be taken.
- Develop green belt to act as a noise barrier.
- Establish a grievance mechanism as part of a stakeholder engagement plan.

After mitigation measure, the impact on noise level will become less significant.

Table 6.31: After mitigation measure, impact significance on noise level during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.5 Impact assessment and mitigation measures on vibration level

6.3.5.1 Potential impacts on vibration

During the operational phase of the proposed project, vibration will be generated from the project operations including the generators and transportation. The potential sources of vibration pollution include:

- Machines and equipment used in the proposed project
- Project operating activities and vehicles

6.3.5.2 Impact significance on vibration

The magnitude of vibration during the operation period will be "***Low***".

The area of impact will be only within the area of production. Therefore, the extent of the impact of vibration will be "***Low***".

The period of impact occurrence will be within the production period. The duration of the impact of vibration during operation is considered as "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, the impact of vibration by the proposed project will be moderate and the significance of the impact will be "***Medium***".

Table 6.32: Impact significance on vibration during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 1+1+2 = 4			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.5.3 Mitigation measures on vibration

Following precautionary measures should be adopted to control vibration impacts by the proposed project.

- Ensure anti-vibration control along with vibration damping seats to reduce earth-borne vibration level from the whole LFG plant.
- Project activities must be carried out in such a way that vibrations arising will not cause damage to adjacent structures, residents and passers-by.
- Avoid combined of vibrating machines at the same time
- Apply vibration reducing technologies in operation activities of proposed project.
- Design project activities to reduce vibration.
- Maximizing the distance between the source and receiver.

- Mechanically isolate the vibrating source or surface to reduce exposure.
- Faulty tools should not be used and tools should be maintained properly because tools which are worn, blunt or out of alignment will vibrate more.
- Ensure that operating machines, equipment and vehicles are well maintained to avoid excessive vibration.
- Maintaining wheels of vehicles and rail smoothness for transportation.
- Specifying vehicles with low unsprung weight, soft primary suspension, minimum metal-to-metal contact between moving parts of the truck, and smooth wheels.
- Install vibration damping seats.
- Perform regular inspection and maintenance of preparation vehicles.
- Limit vehicles to an idling time and shut them off whenever possible. Schedule transportation during day-time hours.
- Preventing workers from the effects of vibration by selecting appropriate vehicles and tool, by using of appropriate vibration-absorbing materials (in gloves, for example) and by providing good work practices with education programs.
- Training to workers is necessary to control exposure eg, selection, use, maintenance of equipment and restriction of duration of exposure.
- Limit the time spent by workers on a vibrating surface.
- Provide appropriate PPE to workers for those working in vibrating areas.
- Schedule work to reduce adverse effects.
- Consider and employ vibration monitoring and measurements if appropriate.
- Notify nearby residents and property owners that vibration-generating activity is imminent.
- Monitor and record vibration from the project activity.
- Respond to and investigate complaints by nearby community.
- Establish a grievance mechanism as part of a stakeholder engagement plan.

After mitigation measure, the impact on vibration will become less significant.

Table 6.33: After mitigation measure, impact significance on vibration during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.6 Impact assessment and mitigation measures for water quality

6.3.6.1 Potential impacts on water quality

In the operation process of proposed Landfill Gas to Energy project, heat will also be used to evaporate leachates, so the existing negative impacts of leachate to surface water and ground water will be minimized to a certain extent.

There is no need to use a large amount of water in this project. Major water consumption is only for cleaning utensils, equipment and residential units including kitchen, toilets for workers. Thus, water consumption of the proposed project cannot affect the underground water level and the impact is likely to be low. The impact of water consumption could not affect the underground water pattern as the process does not use water as a major consumption.

6.3.6.2 Impact significance on water quality

In operation phase, the magnitude of the impact of physical, chemical and biological result of the ground water is considered as "***Low***".

The area of the potential impact will be within the immediate area of project activities and project community, and the extent of the impact will be "***Medium***".

The period of potential impact duration can be long term duration. The duration of the impact for water quality during operation is set as "***Medium****"*.

Therefore, the characteristic of water quality impact by the proposed project is rated as "***Medium"***.

The impact is expected to cause some disturbances potentially affecting communities locally and surrounding water bodies. The importance of the impact on water quality is set as "***Medium***".

The significant rating of impact is set as "***Medium***".

Table 6.34: Impact significance on water quality during operation phase

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 1+2+2 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.6.3 Mitigation measures for water resources

Specific measures that should be implemented include the followings:

- Well-management of leachate recirculation systems.
- Proper use of capping system to prevent erosion by runoff.
- Prefer environmental-friendly chemicals.
- Prevent washing away chemicals, solid waste, and hazardous waste into any drainage system, storing in a safe manner during rainstorms.
- Raw materials, chemicals and fuels should be properly and safely stored under the roof to prevent dumping into the water courses in the rainy season.
- Store, dispose and clean up all chemical, fuel and hazardous materials according to the procedures.
- Preventing leaks and spills. Proper management of storm water.
- Promptly detect and repair of water pipes and tank leaks.
- Quick fixing of leaking pipes.
- Install water conserving taps that turn-off automatically when water is not being used.
- Ensure taps are not running when not in use.
- Installing water efficient toilets and shower heads.
- Users to conserve water e.g. by avoiding unnecessary toilet flushing.
- Treat drainage system for sediment control.
- Promote recycling and reuse of water as much as possible.
- Proper recycling of water from other uses for sprinkling dusty pavements.
- Promote awareness to employees on water conservation and reducing water wastage limit water withdrawal to the amount that will not adversely affect the groundwater balance and the demand of the local community, by developing and conserving own source of water.
- Conducting regular training, monitoring, and inspection schemes together with keeping track of water uses minimizes waste and leaks from faulty connections and faucets.

After mitigation measure, the impact on water quality will become less significant.

Table 6.35: After mitigation measures, impact significance on water quality during operation phase

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.7 Impact assessment and mitigation measures for soil quality

6.3.7.1 Potential impacts on soil quality

As this CDM project reduces leachate by means of heating process, soil pollution by leachate will be minimized. However, following activities of operation phase may cause negative impact to soil system.

- Spills/ leaks of chemicals, solid waste, and hazardous waste from LFG plant site.
- Improper management of waste, wastewater, runoff and water usage
- Vehicular movement and potential leakage of oil/lubricants into the soil.

6.3.7.2 Impact significance on soil quality

The magnitude of impact on soil quality due to wastewater, spill/ leaks of hazardous wastes, chemical and fuel will be "***Medium***".

The area of impact will be only within the area of project compound. Therefore, the extent of the impact on soil quality and structure is "***Low***".

The period of impact occurrence will be remained after the project period and the duration of the impact on soil quality and structure is considered as "***Medium"***.

According to magnitude, extent and duration of the impact, the impact characteristic is considered as "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, the impact on soil quality and structure by the Landfill Gas to Energy project will be moderate and the significance of the impact will be "***Medium***".

Table 6.36: Impact significance on soil quality during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+1+2= 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.7.3 Mitigation measures for soil

Mitigation measures should be applied to minimize soil pollution and waste management impacts of a project depending upon site and project-specific conditions. Many impacts can be reduced

or avoided when considered during operation phase. The following mitigation measures should be used.

- Well-management of leachate recirculation systems.
- Proper use of capping system to prevent erosion by runoff.
- Prefer environmental-friendly chemicals.
- Store, dispose and clean up all diesel and hazardous materials according to the procedures.
- Collect and manage solid waste and hazardous waste along with using impermeable waste containers.
- Store, dispose and clean up all diesel and hazardous materials according to the procedures.
- All chemicals, paint, and fuel containers will be properly sealed and rigorous spill prevention
  mechanisms will be employed. Spills will be immediately treated to stop subsequent soil pollution.
- Construct proper drainage channels to handle storm water and sediment control that might affect soil quality.
- Reuse of treated grey water for dust control and plant watering.
- Implement adequate sanitary facilities along with septic tanks to handle sanitary waste.
- Arrange heavy machineries/vehicles movement and strict enforcement of on-site speed limit regulations.
- Ensure that operating machineries and vehicles have no leakage of oil or lubricants by maintaining regularly not to combine with surface runoff especially during the monsoon season.
- A waste management plan (WMP) starting from waste reduction, waste separation, proper waste collection and transportation for the project should be developed that sets out plans and actions for construction wastes.

After mitigation measure, the impact on soil quality will become less significant.

Table 6.37: After mitigation measures, impact significance on soil quality during operation phase

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.8 Impact assessment and mitigation measures for waste disposal

6.3.8.1 Potential impacts on waste disposal

Once the proposed project is complete and operational, it is expected to generate solid waste on a daily basis - both organic wastes and inorganic wastes such as plastics, used cables, damaged/expired devices, glasses, tins, bottles, packing materials, papers , stationeries, and other miscellaneous will be generated during the operational phase of the project.

Liquid waste of the project is low due to less amount of water consumption for processing. So, the impact of liquid waste to the environment will be low.

The proposed Landfill Gas to Energy project does not generate significant amount of wastewater that bring damage to the surface and ground water sources. The generation of sanitary wastewater discharges has no significant adverse impacts on the surrounding environment because the septic tank system is installed in the projected area. But, the lubricants, oil and grease used for vehicles and machines can cause contamination into the surrounding environment particularly air, water and soil.

6.3.8.2 Impact significance on waste disposal

In operation phase of Landfill Gas to Energy project, there are some kinds of solid wastes generated from raw materials, operation activities and domestic solid waste of workers.

There is also waste water from cleaning equipment, sanitary and domestic waste water of workers.

The magnitude of waste disposal during operation phase will be "***Medium***".

The area of impact will be only within the area of project compound. Therefore, the extent of the impact by waste during operation phase will be "***Low***".

The period of impact occurrence will be within the operation phase of Landfill Gas to Energy project and the duration of the impact by waste is considered as "***Medium"***.

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, waste impact by the Landfill Gas to Energy project during operation phase will be moderate and the significance of the impact will be "***Medium***".

Table 6.38: Impact significance on waste disposal during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+1+2 = 5			2 (Medium)	2 (Medium)	Significance

Significance = Characteristics x Importance	4 (Medium)

6.3.8.3 Mitigation measures for waste disposal

General mitigation practices and principles that could apply to the operation phase of proposed project include:

- Apply waste handling procedures for chemicals and their containers and emergency spill prevention/response to minimize waste emission from mishandling.
- Manage non-hazardous and hazardous waste in a separate way without mixing and use leak proof containers/areas for waste management.
- Develop waste management plan addressing separation, collection, storage, transportation and disposal for each item.
- Provide separate bins for food waste, metal and other wastes at the staff quarters and other facilities on site.
- Collect non-hazardous solid wastes for recycling.
- Setting up of separate waste collectors at different points.
- Regular cleaning and replacing of waste collectors.
- Encourage waste sorting by the facility users.
- Solid wastes that cannot be recycled must be treated appropriately before final disposal.
- Do not wash hazardous materials containers and not mix with other wastes.
- Maintain drains regularly and when required.
- Solid wastes should not be dumped into the drain.
- Blocked drains should be cleaned properly and debris disposed at approved sites.
- Conduct regular inspections for drainage pipe blockages or damages and fix appropriately.
- Ensure regular monitoring of the sewage discharged from the project.
- Avoid contamination of the surrounding environment by maintaining machines equipment and vehicles regularly and handling of fuel and lubricants with caution.
- Avoid leaks, spills or accidental releases into the soil, surface water and ground water resources by proper storage, handling and transport of hazardous materials.
- All employees will be encouraged to take part in education and training programs, and cleanup activities in turn not only in the facility but also with the adjacent communities.
- Develop a hazardous materials management plan addressing storage, use, transportation and disposal for each item.
- Train employees to promptly clean up any oil or hazardous material spill.

After mitigation measure, the impact on waste disposal will become less significant

Table 6.39: After mitigation measures, impact significance on waste disposal during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance

Significance = Characteristics x Importance	2 (Low)

6.3.9 Impact assessment and mitigation measures for ecological resources

6.3.9.1 Forest

Proposed landfill Gas to Energy project will be operated on the existing landfill site. As a result of negative impact to air, soil, water, noise during operation phase will affect biodiversity and forest to certain extent.

However, the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on these ecological resources will be considered as "less significant" in this operation phase complying with the mitigation and management measures elaborated above accordingly.

The forest nearby will be affected only to the certain extent but not significantly due to this project.

6.3.9.2 Impact significance on forest

During operation phase of proposed project, the magnitude of impact to forest will be "***Medium***".

The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the operation period so duration of impact will be "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to forest by the Landfill Gas to Energy project will be moderate during the operation phase and the significance of the impact will be "***Medium***".

Table 6.40: Impact significance on forest during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+2+2 = 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.9.3 Mitigation measures for forest

Complying with the mitigation and management measures for air, soil, water, noise and waste management which are elaborated above will reduce the negative impacts to forest by proposed project.

After mitigation measure, the impact on forest will become less significant.

Table 6.41: After mitigation measures, impact significance on forest during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.9.4 Wildlife

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. As a result of negative impact to air, soil, water, noise during operation phase will affect biodiversity, forest and wildlife to certain extent.

However, the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on wildlife will be considered as "less significant" in this **operation** phase complying with the mitigation and management measures elaborated above accordingly.

The wildlife nearby will be affected only to the certain extent but not significantly due to this project.

6.3.9.5 Impact significance on wildlife

During operation phase of proposed project, the magnitude of impact to wildlife will be "***Medium***". The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the operation period, so duration of impact will be "***Medium***.

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to wildlife by the Landfill Gas to Energy project will be moderate during the operation phase and the significance of the impact will be "***Medium***".

Table 6.42: Impact significance on wildlife during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+2+2 = 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.9.6 Mitigation measures for wildlife

Complying with the mitigation and management measures for air, soil, water, noise and waste management which are elaborated above will reduce the negative impacts to wildlife by proposed project.

After mitigation measure, the impact on wildlife will become less significant.

Table 6.43: After mitigation measures, impact significance on wildlife during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.9.7 Aquatic animal/ fish

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. The aquatic animals nearby will be affected only to the certain extent but not significantly due to this project.

Construction works of operation phase will lead negative impacts to environment (water, air and soil) and subsequent negative impacts on aquatic animals.

Impacts by this project on aquatic animal/fish will be considered as “less significant” in this operation phase if the mitigation and management measures elaborated above will be complied accordingly.

6.3.9.8 Impact significance on aquatic animals/fish

During operation phase of proposed project, the magnitude of impact to **aquatic animals** will be "***Medium***".
The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".
The period of impact occurrence will be within the operation period, so duration of impact will be "***Medium***".
According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to aquatic animals by the Landfill Gas to Energy project will be moderate during the operation phase and the significance of the impact will be "***Medium***".

Table 6.44: Impact significance on aquatic animals/fish during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+2+2 = 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.9.9 Mitigation measures for aquatic animals/ fish

Mitigation measures which are mentioned above for air, soil, water, noise and waste management will reduce the negative impacts to wildlife by proposed project.

After mitigation measure, the impact on aquatic animals/ fish will become less significant.

Table 6.45: After mitigation measures, impact significance on aquatic animals/ fish during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.3.10 Impact assessment and mitigation measures on human environment

6.3.10.1 Potential impact on human environment

a) **Potential impact on occupational health and safety**

The Landfill Gas to Energy project will collect methane gas to generate electricity and other remaining gases will be flared.

Employees' health hazard is high if the protective devices and Personal Protective Equipment are not provided to them. Inhalation of methane-contaminated air from leakage and workplace accidents can happen to workers.

Poorly maintained or improperly handled vehicles can lead to crushing injuries. A potential social impact during operation of the project will be both on the occupational health and safety of the staff. Mitigation measures are described in the next sections and on their working conditions.

b) **Potential impacts on social benefits**

In operation phase of the project, employment opportunities created by the project will have social benefit besides the expected economic benefit. Employment income from the project will have a substantial role for social livelihood improvement in the vicinity of project area.

These will involve other sources of employment such as direct service provision to the domestic sector e.g. office operators, engineers, security personnel etc. There will be positive gain for the revenue system arising from the tax being paid by the proponent to the government and other lead agencies. There is a community living at the landfill site who earn from collecting and selling recyclable wastes. They should get employment opportunities to compensate possible negative impacts on their income.

6.3.10.2 Impact significance on human environment

(a) Impact significance on occupational health and safety

There will be impact on occupational health and safety and the magnitude of impact during operation phase of the project will be "***Medium***".

The impact of the project can affect occupational health and safety of the workers. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the operation period and the duration of the impact on residential area is considered as "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium".***

Therefore, the impact on residential area by the Landfill Gas to Energy project will be less and the significance of the impact will be "***Medium***".

Table 6.46: Impact significance on occupational health and safety during operation period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+1+2 = 6			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

(b) Impact significance on Socio-economic

The Landfill Gas to Energy project is located in Kyar Ni Kan landfill area and has a close boundary with Kyar Ni Kan villge and the nearest residential areas with the project are In Gel and Aein Shay Min Htan Taw villages.

The local people can get job opportunities as project workers as well as skilled labour. Therefore, the impact by the proposed project on socio- economic may be positive impact.
As mentioned above, the social impact of this project is expected to be positive, as implementing this technology and committing with the CDM will allow not only improvements in landfill management in the short term but also to establish sustainable MSW management practices in the long. The project Landfill will also deliver local community benefits as it will create a new source of jobs during operation and maintenance of the LFG recovery plant; since there are no near settlements the reduction of odours and risk within the landfill is a benefit for people working inside the facility.

In KyarNiKan Landfill area, a small community, who earn from collecting and selling recyclable wastes, is living at the landfill site.

The impact on their income will be less as the proposed project collects landfill gas from the old dumping area and recyclable wastes are not used.

Moreover, those people should get employment opportunities from the project to compensate possible negative impacts on their income.

There will be impact on socio-economic status of surrounding people and the magnitude of impact during operation phase of the project will be "***Low***".

The impact of the project can affect socio-economic status of people living at the landfill site and nearby community. Therefore, the extent of the impact will be "***Medium*** ".

The period of impact occurrence will be within the operation period and the duration of the impact on residential area is considered as "***Medium***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium"***.
Therefore, the impact on residential area by the Landfill Gas to Energy project will be less and the significance of the impact will be "***Medium***".

Table 6.47: Impact significance on socio-economic during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	2 (Medium)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 1+2+2 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.3.10.3 Mitigation measures for human environment impact

Employees' health hazard will be high if protective devices are not provided to them.
Following measures should be adopted in the project area for three phases:

- All measures related to safety including safety appliances, training safety posters, Slogans, pictures should be posted readable clearly at the project.
- Warning not to smoke or place other sources of ignition within 25 feet of any source of LFG, including LFG components and portions of the leachate and condensate management systems.
- Using a personal combustible gas meter when working around any GCS components. Meters should have a minimum capability of monitoring for oxygen-deficient conditions, carbon monoxide concentrations and methane concentrations.
- Install fugitive extractors/filters with adequate ventilation system in LFG plant to extract dust and other fumes.
- Provide workers with PPEs and trainings to avoid exposure of fugitive, noise and vibration emission emitted by LFG plant operation activities and vehicle movement.
- Wearing appropriate personal protective equipment (PPE) for all tasks and be aware of the relative limitation of each level of PPE. Level D is the minimum requirement.
- Providing PPEs (Personal Protective Equipment), particularly gas masks to protect from leakage of methane.
- Making sure that all PPE is in good, working condition.
- Making sure that all monitoring equipment is fully charged and calibrated per manufacturer's requirements.
- Verifying that all pressures are relieved, and that any potential sources of pressurization are de-energized or locked out, before opening any vessels.

- Always comply with mechanical, electrical, pneumatic and hydraulic lock-out/tag-out procedures.
- Understanding the potential hazards of working in proximity to LFG and LFG condensate.

- Identify and develop measures to control occupational hazards _ confined space hazards, lack of oxygen, potential methane travel, fire, extreme temperatures, chemical hazards, and uncontrolled energy.
- Limit occupation in confined space and strict to use gas monitoring devices/personal gas detectors.
- Having personnel trained to identify and work in permit-required confined spaces.
- Having personnel trained to identify trenching and excavation activities compliant with OSHA requirements.
- Awareness for the hazards of working in proximity to flares and associated combustion systems.
- Awareness for the hazards of working in proximity to rotating equipment, including blowers, compressors and pumps.
- Install fugitive extractors/filters with adequate ventilation system in LFG plant to extract dust and other fumes.
- The workers exposed to noisy sources should be provided with ear muffs/plugs.
- Adequate facilities for drinking water and toilets should be provided to the employees.
- The health of the workers should be regularly checked by a well-qualified doctor and proper records will be kept for each worker.
- Rinse eyes with water if they come into contact with dust or chemical, and consult a physician.
- Use soap and water to wash off dust to avoid skin damage.
- Be sure that trucks and other vehicles are in good working order.
- Regular inspection and maintenance of machine, equipment and vehicles.
- The fire and safety equipment should be properly utilized and maintained regularly.
- Well stocked first aid box which is easily available and accessible should be provided within the building.
- Well-designed waste management system and storm water drainage systems have to be put in place so as to ensure that breeding grounds of disease carrying vectors such as rats, flies, mosquitoes, cockroaches etc. are effectively controlled in work area.
- Providing proper job opportunities to community living at the landfill site.

After mitigation measure, the impact on human environment will become less significant.

Table 6.48: After mitigation measures, impact significance on human environment during operation period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4 Environmental and social impacts during the decommissioning phase

The activity of **Decommissioning/Closure Phase** is related to the use of decommissioning equipment. **Decommissioning/Closure Phase** includes site clearing and some earth work activities.

6.4.1 Impacts assessment and mitigation measures on air quality during decommissioning phase

6.4.1.1 Potential impact on air quality during decommissioning phase

During this phase, decommissioning activities and the operation of vehicles for facilities can also release dust particles and gaseous emissions which can affect the ambient air quality for the short periods. There may also be gaseous emissions from various activities including combustion of fuel for vehicle movements. Generally, this will adversely affect localized air quality for a short period.

Criteria air pollutant and air emissions that would arise from the demolition of the proposed project are quantified and summarized below.

- Heavy machinery /vehicles such as diesel-powered bulldozers and loaders would be used throughout the entire decommissioning phase
- Vehicle traffic on paved and unpaved roads
- Demolition activities, earth work
- Worker accommodation

Adjacent to the demolition site and along the transportation route, natural habitat, residents, and construction crew will be potentially affected by the air pollution.

6.4.1.2 Impact significance on air quality during decommissioning phase

In demolition phase, there may have temporary impacts on air quality. The breaking down of the building can emit large amount of dusts but can vary depending on activities. There may also have gaseous emissions from diesel generators and fuel combustion. The magnitude of impact on air quality will be "***Medium***".

The area of impact will be not only within the area but also in the vicinity area according to wind direction. Therefore, the extent of the air quality impact from particulates is "***Medium***".

The period of impact occurrence will be within the demolition phase and the duration of the impact by demolition activities is considered as "***Low***".
According to magnitude, extent and duration of the impact, he impacts characteristics will be "***Medium***". The importance of the impact on air is considered as "***Medium***".

Therefore, the impact from particulate matters and gaseous emission by the Landfill Gas to Energy project demolition will be moderate and the significance of the impact will be "***Medium***".

Table 6.49: Impact significance on air quality during decommissioning phase

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.1.3 Mitigation measures for air quality during decommissioning phase

The following mitigation measures should be practiced to reduce potential dust and gaseous emissions into the environment.

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system.
- Conduct dust and pollutant control measures near emission activities.
- Avoid demolitions works in extremely dry weathers.
- Sprinkle water on graded access routes when necessary to reduce dust generation by machines.
- Demolished materials on site to be covered to prevent to be blown off by wind.
- Decommissioning waste on site to be covered to prevent to be blown off by wind.
- Minimization of exhaust emissions.
- Minimizing dust from material handling sources by using covers.
- Air pollution from vehicles will be minimized by using low emission equipment and vehicles.
- Ensure strict enforcement of on-site speed limit regulations.
- Vehicle idling time shall be minimized.
- Truck drivers should avoid unnecessary running of vehicle engines at loading/ offloading points and parking areas, and to switch off or keep vehicle engines at these points.
- Optimize vehicle movements to eliminate unnecessary vehicle movements.

- Spraying water to minimize dust from vehicle movements.
- Alternatively, fueled construction equipment shall be used where feasible equipment shall be properly maintained.
- Prohibit burning of domestic waste on site.

After mitigation measure, the impact on air quality will become less significant.

Table 6.50: After mitigation measures, impact significance on air quality during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.2 Impact assessment and mitigation measures for noise

6.4.2.1 Potential impacts on noise level

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas. It will involve less noise generation due to the absence of operational equipment. But there will be some noise generated from heavy machineries running for dismantling activities. The decommissioning noise impact is the short-term pollution to local ambient noise quality. Noise and vibration affect natural vegetation, animals, workforce, and communities from the areas. This will be as a result of the noise and vibration that will be experienced as a result of demolishing the proposed project.

6.4.2.2 Impact significance on noise

In decommissioning phase, noise will be experienced as a result of demolishing the proposed project. The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding area.

The magnitude of impact from noise will be "***Medium***".

The area of impact will be not only within the project but also in the vicinity area. Therefore, the extent of the impact noise will be "***Medium***".

The period of impact occurrence will be within the demolition period. The construction workers and people in the vicinity area will have impact from noise of the demolition processes and so the duration of the impact from noise and vibration is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***".

The importance of the impact is considered as "***Medium***".

Therefore, the impact noise and vibration by demolition of the Landfill Gas to Energy project will be moderate and the significance of the impact will be "***Medium***".

Table 6.51: Impact significance on noise during decommissioning phase

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.2.3 Mitigation measures on noise

The following mitigation measures should be used to reduce noise pollution.

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety.
- Use of well-functioning demolition equipment, machineries and vehicles with noise-control techniques as well as silencer.
- Machinery drivers and machinery operators should switch off engines of vehicles or machinery not being used.
- Schedule noisy decommission activities and transportation during day-time hours.
- Combine noisy operations at the same time
- Used good condition and insulated demolition machineries and other equipment should be used in good condition and insulated.
- Turn equipment off when not in use.
- Provide PPE, particularly hearing protection devices for those working in noisy areas.

After mitigation measure, the impact on noise will become less significant.

Table 6.52: After mitigation measure, impact significance on noise during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	Low (1)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.3 Impact assessment and mitigation measures for vibration level

6.4.3.1 Potential impacts on vibration

The decommissioning works on site will result in vibration impacts due to mobilization of machines (mixers, tippers, cranes and backhoe), increased traffic and incoming heavy vehicles to transport materials. Some equipment used in decommissioning phase of project can create high vibration levels. Severity of a vibration impact is related to the type and location of the vibration source(s).

Hand Arm Vibration can be a significant health risk when workers use powered hand tools for significant lengths of time. Moreover, driving off road or operating a ride-on vehicle under extreme conditions can give rise to Whole Body Vibration (WBV) to drivers.

6.4.3.2 Impact significance on vibration levels

Vibration activities during decommissioning phase of project include decommissioning activities and use of heavy trucks on rough terrain. The magnitude of impact from vibration is "***Medium***".

The area of impact will be within the project area. Therefore, the extent of the impact on vibration is "***Low***".

The period of impact occurrence will be within the decommissioning period. The workers and people in the vicinity area will have impact from and vibration by the proposed project and the duration of the impact from vibration is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact of vibration by the proposed project will be moderate during decommissioning phase and the significance of the impact will be "***Medium***".

Table 6.53: Impact significance on vibration level during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+1+1 = 4			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.3.3 Mitigation measures for vibration impacts

During decommissioning phase of proposed project, the following mitigation measures are recommended to minimize vibration impact on individuals, sensitive areas and livestock.

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety.
- Use of well-functioning demolition equipment, machineries and vehicles.
- Machinery drivers and machinery operators should switch off engines of vehicles or machinery not being used.
- Decommissioning activities must be carried out in such a way that vibrations arising will not cause damage to adjacent structures, residents and passers-by.
- Apply vibration control technologies during decommissioning period.
- Design decommissioning activities to reduce vibration.
- Maximizing the distance between the source and receiver.
- Mechanically isolate the vibrating source or surface to reduce exposure.
- Faulty tools should not be used and tools should be maintained properly. Tools which are worn, blunt or out of alignment will vibrate more.
- Ensure that decommissioning machines, equipment and vehicles are well maintained to avoid excessive vibration.
- Maintaining wheels of vehicles and rail smoothness for transportation.
- Specifying vehicles with low unsprung weight, soft primary suspension, minimum metal-to-metal contact between moving parts of the truck, and smooth wheels.
- Install vibration damping seats.
- Perform regular inspection and maintenance of preparation vehicles.
- Limit vehicles to an idling time and shut them off whenever possible. Schedule transportation during day-time hours.
- Preventing workers from the effects of vibration by selecting appropriate vehicles and tool, by using of appropriate vibration-absorbing materials (in gloves, for example) and by providing good work practices with education programs.
- Training to workers is necessary to control exposure eg, selection, use, maintenance of equipment and restriction of duration of exposure.

- Limit the time spent by workers on a vibrating surface.
- Provide appropriate PPE to workers for those working in vibrating areas.
- Schedule work to reduce adverse effects.
- Avoid combined of vibrating machines at the same time.
- Consider and employ vibration monitoring and measurements if appropriate.
- Notify nearby residents and property owners that vibration-generating activity is imminent.
- Monitor and record vibration from the project activity.
- Respond to and investigate complaints by nearby community.

After mitigation measure, the impact on vibration will become less significant.

Table 6.54: After mitigation measures, impact significance on vibration during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.4 Impact assessment and mitigation measures on water quality

6.4.4.1 Potential impacts on water quality

In the decommissioning phase, the materials generated by the decommissioning activities such as clay, plaster, limestone, concrete, mercury containing light bulbs, old batteries can be accumulated in nearby water courses due to runoff of these materials during the rainy season. It may lead to degradation of groundwater quality.

6.4.4.2 Impact significance on water quality

In decommissioning phase, the magnitude of the impact on water is considered as "***Medium***".

The area of the potential impact will be within the immediate area of decommissioning activities, and the extent of the impact is considered "***Low***".

The period of potential impact duration can be short term duration. The duration of the impact for water quality during decommissioning will be set as "***Low***".
Therefore, the characteristic of water quality impact by the proposed project decommissioning phase is rated as "***Medium***".

The impact is expected to cause some minor disturbances potentially affecting communities locally and surrounding water bodies. The importance of the impact on water quality is set as "***Medium***".

The significant rating of impact is set as "***Medium***".

Table 6.55: Impact significance on water quality during decommissioning phase

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+1+1 = 4			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.4.3 Mitigation measures for water resources

The following mitigation measures should be practiced and used to reduce potential impacts for water resources.

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety.
- Prevent washing away open stacks of demolition waste or debris into any drainage system along with covering with waterproof materials during rainstorms.
- Store non-hazardous and hazardous waste in a safe manner using impermeable waste containers in order to prevent from passing through by run-off.
- Implement regular maintenance of water storage and piping systems.
- Enforce to reuse water as much as possible e.g. spraying used-water over dusty areas.
- Water should be used efficiently at the site by the workers carrying out decommissioning activities in order to avoid irresponsible water use.
- Soil erosion and sediment control mechanisms will add positive effects on mitigation matters for water pollution
- Ensure that construction machineries and vehicles have no leakage of oil or lubricants by maintaining regularly not to combine with surface runoff especially during the monsoon season.
- Use leak proof containers for storage and transportation of oil and grease.
- Collect and manage solid waste and hazardous waste along with using impermeable waste containers.
- Collect solid wastes in containers and disposed of properly.

After mitigation measure, the impact on water quality will become less significant.

Table 6.56: After mitigation measure, impact significance on water quality during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	Low (1)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.5 Impact assessment and mitigation measures for soil quality

6.4.5.1 Potential impacts on soil quality

In decommissioning phase of proposed project, it may cause impact to soil system and its quality due to improper management for solid waste, waste water, hazardous waste, spills/ leaks of oil and lubricants from fuel equipment and vehicles in demolition site, and soil erosion.
Clearing, earth moving and excavation activities will affect the natural surface flow regime of water.

Accidental spillage of materials/chemicals during handling and leakage from decommissioning process may lead to soil contamination.

6.4.5.2 Impact significance on soil quality

In decommissioning phase of proposed project, it may cause impact to soil system because buildings, flare stack and infrastructures will be removed.
Thus, the magnitude of impact on soil quality will be "***Medium***"

The area of impact will be only within the area of project compound. Therefore, the extent of the impact on soil quality and structure is "***Low***".

The period of impact occurrence will be remained after the project period and the duration of the impact on soil quality and structure is considered as "***Medium"***.

According to magnitude, extent and duration of the impact, the impact characteristic was considered as "***Medium***". The importance of the impact was considered as "***Medium***".

Therefore, the impact on soil quality and structure by the Landfill Gas to Energy project was less and the significance of the impact would be "***Medium***".

Table 6.57: Impact significance on soil quality during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	2 (Medium)	Equivalent Characteristics	Importance	
Characteristics = 2+1+2= 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.5.3 Mitigation measures for soil

Mitigation measures should be applied to minimize soil pollution and waste management impacts of a project depending upon site and project-specific conditions. Many impacts can be reduced or avoided when considered during the design and construction phase. The following mitigation measures should be used.

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system.
- When required, topsoil will be carefully removed and saved for reuse.
- Recycle of excavated earth materials if possible.
- Reuse of treated grey water for dust control and plant watering.
- Frequent water sprinkling and appropriate scheduling for truck and heavy equipment movements will also be arranged throughout the construction period.
- A waste management plan (WMP) starting from waste reduction, waste separation, proper waste collection and transportation for the project should be developed that sets out plans and actions for wastes by decommissioning phase. Hazardous-materials handling procedures to reduce the potential for a spill during construction, and will include an emergency response program to ensure quick and safe cleanup of accidental spills.
- Ensure that any waste is disposing correctly way without open-dumping.
- Manage non-hazardous and hazardous waste from demolition site in a safe manner using impermeable waste containers.
- Ensure that chemicals, oil and lubricants are stored in leak-proof storage tanks with proper handling.
- All chemicals, paint, and fuel containers will be properly sealed and rigorous spill prevention mechanisms will be employed. Spills will be immediately treated to stop subsequent soil pollution.
- Ensure only well-maintained equipment and vehicles used for the demolition phase.
- Arrange heavy machineries/vehicles movement and strict enforcement of on-site speed limit regulations.
- Ensure that construction machineries and vehicles have no leakage of oil or lubricants into soil by maintaining regularly.

After mitigation measure, the impact on soil quality will become less significant.

Table 6.58: After mitigation measures, impact significance on soil quality during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1=3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.6 Impact assessment and mitigation measures on waste disposal

6.4.6.1 Impacts on waste disposal

Demolition of the proposed project and related infrastructure will result in large quantities of solid waste. The waste will contain the various materials including concrete, drywall, wood, glass, paints, pipe and metals, garbage, containers, fluorescent light, furniture, tires, drums, and any containers with residues remaining on the bottom and fuel tanks.

In addition to solid waste, lubricants and fuel from vehicles and machines and liquid wastes can cause contamination into the surrounding environment particularly air, water and soil. The generation of sanitary wastewater discharges has no significant adverse impacts on surrounding environment.

6.4.6.2 Impact significance on waste disposal

Solid Wastes from demolition include concrete, brick and clay tile, steel, drywall and wood products.

But, some of these wastes have the potential to recycle in other construction. However, solid waste from demolition waste may still remain as large amount than other phases, construction and operation phase.

The magnitude of impact from solid waste during demolition phase will be "***High***".

The area of impact will be only within the area of project compound. Therefore, the extent of the impact by solid waste during demolition will be "***Low***".

The period of impact occurrence will be within the Landfill Gas to Energy project demolition period and the duration of the impact by solid waste is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, solid waste impact by the Landfill Gas to Energy project demolition will be moderate and the significance of the impact will be "***Medium***".

Table 6.59: Impact significance on waste disposal during decommissioning phase

Characteristics					
Magnitude	Extent	Duration			
3 (High)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 3+1+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.6.3 Mitigation measures on waste disposal

The following mitigation measures should be used to reduce potential impacts for waste disposal:

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety.
- Develop a hazardous materials management plan addressing storage, use, transportation and disposal for each item.
- Manage non-hazardous and hazardous waste in a separate way without mixing and use leak proof containers/areas for waste management covering waste classification, separation, collection, storage, transfer and disposal.
- Do not wash hazardous materials containers and not mix with other wastes.
- The hazardous wastes should be disposed with proper disposal method and caution.
- Train employees to promptly clean up any oil or hazardous material spill.
- Ensure that chemicals, oil and lubricants are stored in leak-proof storage tanks with proper handling.
- Check regularly waste containers to avoid overspill of waste containers.
- Fuel storage facilities should be removed immediately upon completion of the decommissioning phase.
- Perform waste segregation applying 3Rs method (Reduce, Reuse and Recycle).
- Provide separate bins for food waste, metal and other waste at the temporary camp and other facilities on site.
- Collect recyclable wastes such as paper, metal, and plastic to support partly recycle mechanism.
- Wastes can be recycled or disposed at the landfill.
- Prohibit open-dumping or direct discharge of any waste to the drainage system on/off site. Solid wastes should not be dumped into the drain.

After mitigation measure, the impact on waste disposal will become less significant.

Table 6.60: After mitigation measure, impact significance on waste disposal during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.7 Impact assessment and mitigation measures for ecological resources

6.4.7.1 Forest

As a result of negative impact to air, soil, water, noise during decommissioning phase will affect biodiversity and forest to certain extent.

However, the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on these ecological resources will be considered as "less significant" in this decommissioning phase complying with the mitigation and management measures elaborated above accordingly.

The forest nearby will be affected only to the certain extent but not significantly due to this project.

6.4.7.2 Impact significance on forest

During decommissioning phase of proposed project, the magnitude of impact to forest will be "***Medium***".

The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the decommissioning period so duration of impact will be "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to forest by the Landfill Gas to Energy project will be moderate during the operation phase and the significance of the impact will be "***Medium***".

Table 6.61: Impact significance on forest during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.7.3 Mitigation measures for forest

Complying with the mitigation and management measures for air, soil, water, noise and waste management which are elaborated above will reduce the negative impacts to forest by proposed project.

After mitigation measure, the impact on forest will become less significant.

Table 6.62: After mitigation measures, impact significance on forest during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.7.4 Wildlife

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. As a result of negative impact to air, soil, water, noise during decommissioning phase will affect biodiversity, forest and wildlife to certain extent.

However, the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on wildlife will be considered as "less significant" in this decommissioning phase complying with the mitigation and management measures elaborated above accordingly.

The wildlife nearby will be affected only to the certain extent but not significantly due to this project.

6.4.7.5 Impact significance on wildlife

During decommissioning phase of proposed project, the magnitude of impact to wildlife will be "***Medium***".
The area of impact will be not only within the project area but also in the vicinity area.

Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the decommissioning period, so duration of impact will be "***Low***.

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to wildlife by the Landfill Gas to Energy project will be moderate during decommissioning phase and the significance of the impact will be "***Medium***".

Table 6.63: Impact significance on wildlife during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.7.6 Mitigation measures for wildlife

Complying with the mitigation and management measures for air, soil, water, noise and waste management which are elaborated above will reduce the negative impacts to wildlife by proposed project.

After mitigation measure, the impact on wildlife will become less significant.

Table 6.64: After mitigation measures, impact significance on wildlife during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.7.7 Aquatic animal/ fish

Proposed landfill Gas to Energy project will be constructed on the existing landfill site. The aquatic animals nearby will be affected only to the certain extent but not significantly due to this project. Construction works of decommissioning phase will lead negative impacts to environment (water, air and soil) and subsequent negative impacts on aquatic animals.

Impacts by this project on aquatic animal/fish will be considered as "less significant" in this decommissioning phase if the mitigation and management measures elaborated above will be complied accordingly.

6.4.7.8 Impact significance on aquatic animals/fish

During decommissioning phase of proposed project, the magnitude of impact to **aquatic animals** will be "***Medium***".

The area of impact will be not only within the project area but also in the vicinity area. Therefore, the extent of the impact will be "***Medium***".

The period of impact occurrence will be within the decommissioning period, so duration of impact will be "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is "***Medium***".

Therefore, the impact to aquatic animals by the Landfill Gas to Energy project will be moderate during the decommissioning phase and the significance of the impact will be "***Medium***".

Table 6.65: Impact significance on aquatic animals/fish during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	2 (Medium)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+2+1 = 5			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.7.9 Mitigation measures for aquatic animals/ fish

Mitigation measures which are mentioned above for air, soil, water, noise and waste management will reduce the negative impacts to wildlife by proposed project.

After mitigation measure, the impact on aquatic animals/ fish will become less significant.

Table 6.66: After mitigation measures, impact significance on aquatic animals/ fish during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

6.4.8 Impact assessment and mitigation measures on human environment

6.4.8.1 Potential impacts on human environment

a) Potential impacts on occupational health and safety

Significant hazards can be occurred due to potential fall of materials or tools as well as temporary hazards such as physical hazards, dust emission and noise pollution. Moreover, accidents and injuries to workers can be caused by heavy vehicle movement for transport of materials and equipment in the demolition phase.

The proposed project will appoint some workers in decommissioning phase. A potential social impact during the decommissioning phase of the project will be on the occupational health and Safety of the staff. Mitigation measures are described in the next sections and on their working conditions.

b) Potential impacts on social benefits

For demolition to take place properly and in good time, several people will be involved. As a result, several employment opportunities will be created for the workers who will work for demolition during the demolition phase of the proposed project.

6.4.8.2 Impact significance on human environment

a) Impact significance on occupational health and safety

During decommissioning phase, there may have impact on occupational health and safety for breaking down the infrastructure or some other decommissioning activities. The magnitude of the impact will be "***Medium***".

The area of impact will be only within the decommissioning area and therefore, the extent of the impact on occupational health and safety will be "***Low***".

The period of impact occurrence will be within the demolition process and the duration of the impact is considered as "***Low***".

According to magnitude, extent and duration of the impact, the impact characteristics will be "***Medium***". The importance of the impact is considered as "***Medium***".

Therefore, the impact on occupational health and safety by the Landfill Gas to Energy project demolition will be "***Medium***".

Table 6.67: Impact significance on occupational health and safety during decommissioning phase

Characteristics					
Magnitude	Extent	Duration			
2 (Medium)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 2+1+1 = 4			2 (Medium)	2 (Medium)	Significance
			Significance = Characteristics x Importance		4 (Medium)

6.4.8.3 Mitigation measures for human environment

The project will implement the following mitigation measures for Occupational Health and Safety.

- Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system.
- Provide workers with PPEs and trainings to avoid LFG and fugitive emission during decommissioning LFG plant including severe winds or weather in landfill site.
- All workers will be provided with personal protection equipment (PPE) and will be obliged to wear them in work zones
- Minimize threats by bacteria, insects, germs and chemicals by providing workers with PPE and hygiene facilities as well as mask, glove, footwear, hand sanitizer and anti-bacterial solvent.
- Apply adequate waste handling and disposal on site in compliance with the relevant regulations.
- Strictly enforce that workers adhere to the HSE manuals including safety net system and specific PPE use to avoid slips, falls, hits and confined space threat.
- Prohibit smoking and other ignition sources in areas with potential LFG emissions using warning signs.
- Designate restricted areas for danger zones with caution signs if necessary.
- Promote safe and healthy working environment, health, and well-being of all employees.
- Rinse eyes with water if they come into contact with dust and consult a physician.

- Use soap and water to wash off dust to avoid skin damage.
- The fire and safety equipment should be properly utilized and maintained regularly.
- Well stocked first aid box which is easily available and accessible should be provided.
- Initial job trainings relevant to the assignments should be offered for the relevant staff.
- Particular works shall strictly follow work permit scheme.
- Providing proper job opportunities to community living at the landfill site.

After mitigation measure, the impact on human environment will become less significant.

Table 6.68: After mitigation measure, impact significance on human environment during decommissioning period

Characteristics					
Magnitude	Extent	Duration			
1 (Low)	1 (Low)	1 (Low)	Equivalent Characteristics	Importance	
Characteristics = 1+1+1 = 3			1 (Low)	2 (Medium)	Significance
			Significance = Characteristics x Importance		2 (Low)

Chapter 7

Cumulative Impacts

7. Cumulative Impact assessment

Cumulative impacts typically refer to those effects on local communities and ecosystems which result from incremental direct and indirect effects from the proposed project as well as added contributed effects from other projects or actions at and around the same projected site area.

Thus, the cumulative effects in relation to existing activities at the local environment were reviewed and assessed for significance.

The proposed Kyar Ni Kan landfill gas recovery project site is situated approximately 10 km north part of Mandalay. According to the onsite surveys, the existing landfill site which is receiving wastes from the townships of Aung Mye Thar Zan, Chan Ayethar Zan, Maha Aung Myea, nearby villages and most of the cemeteries including the Kyar Ni Kan (Aye Yeink Nyein) cemetery and Islam cemetery are located within (2) km of the proposed project site.

The following figure 7.1 shows the nearby villages, existing landfill sites and cemeteries.

Figure 7.1: Kyar Ni Kan Landfill gas recovery project with nearby surroundings

7.1 Cumulative impact on air quality

Cumulative impacts refer to the incremental effect of several projects/activities that may have an individually minor, but collectively significant, impact on air quality.

There will be cumulative negative impact on air quality as other air pollution sources such as cemeteries and local daily human activities (transportation, open burning and farming etc.) located in the surrounding area of the proposed project.

In addition, as the two landfill gas recovery projects (Kyar Ni Kan and the Thanung Inn Myauk Inn) which are about 30 km apart respectively locate in the North and the South of the

Mandalay city will operate simultaneously, the cumulative contributions of the emissions from both KNK and TIMI to the pollution in the city

Accordingly, as compared to Figure 7.2 for Phase 2 below, the area between contour 2 and 5 µg/m3 in Figure 7.3 over the city was larger which was due to the increase in the emission rates at KNK.

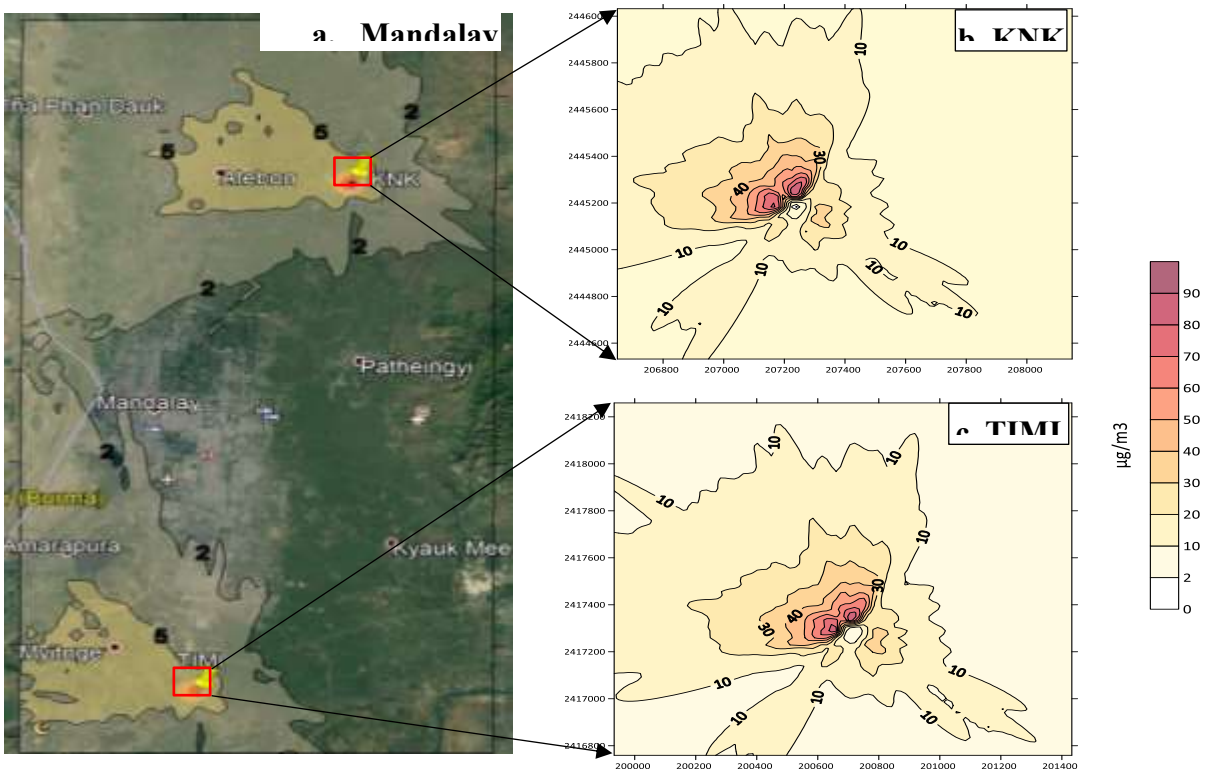


Figure 7.2: Dispersion patterns of the 1st highest values of 1h CO in Mandalay (Phase 2)

There are some increases in the cumulative effects of KNK and TIMI over the Mandalay city for 1h CO in Phase 3. Furthermore, in Phase 3, there will be one more generator in KNK which would contribute additional emissions at this site. Therefore, higher concentrations and larger plumes of CO and NOx from KNK were seen in the domains. The cumulative effects of the emissions on the air pollution in Mandalay city also increased as shown from the larger area between contour 2 µg/m3 and 5 µg/m3 of 1h CO in Phase 3 as compared to Phase 2. However, the magnitude of the effects was similar to Phase 2: 2-5 µg/m3 of 1h CO and <2 µg/m3 of 1h NOx.

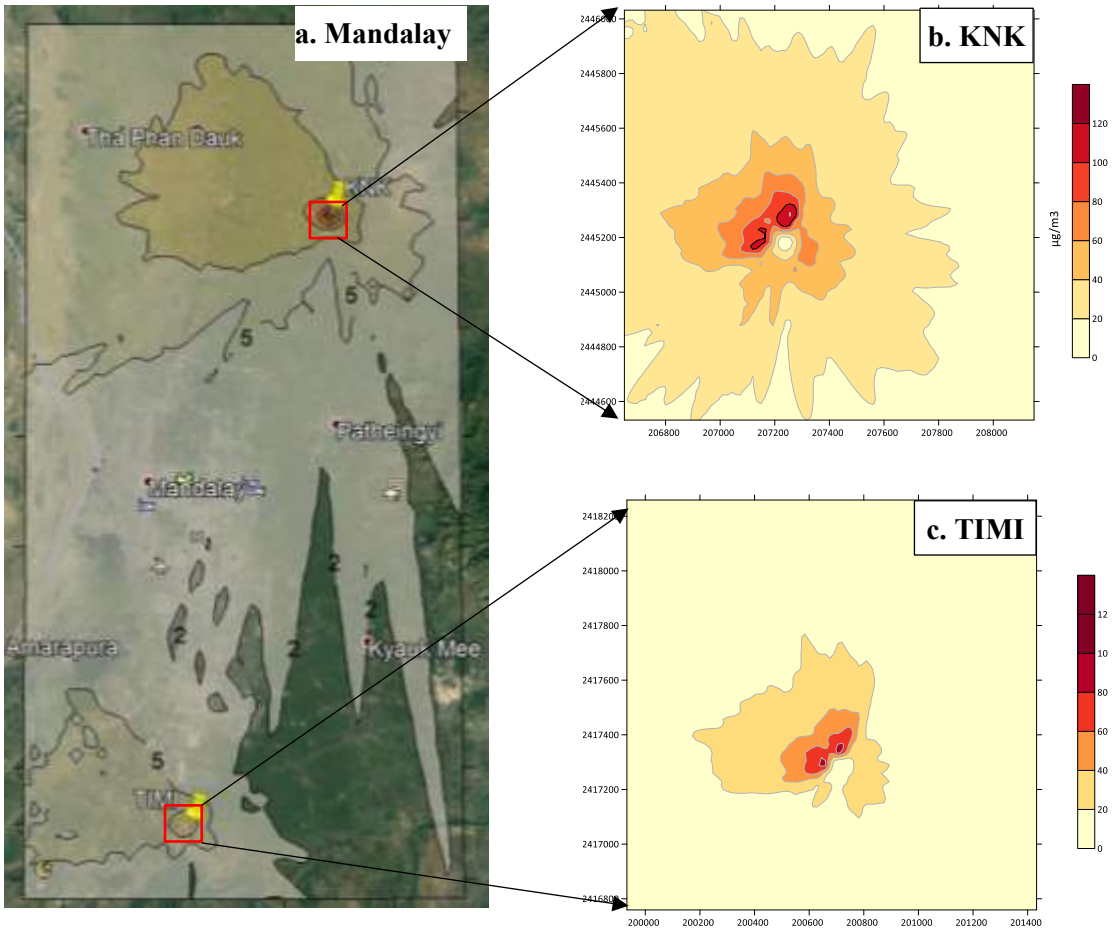


Figure 7.3: Dispersion patterns of the 1st highest values of 1h CO in Mandalay (Phase 3)

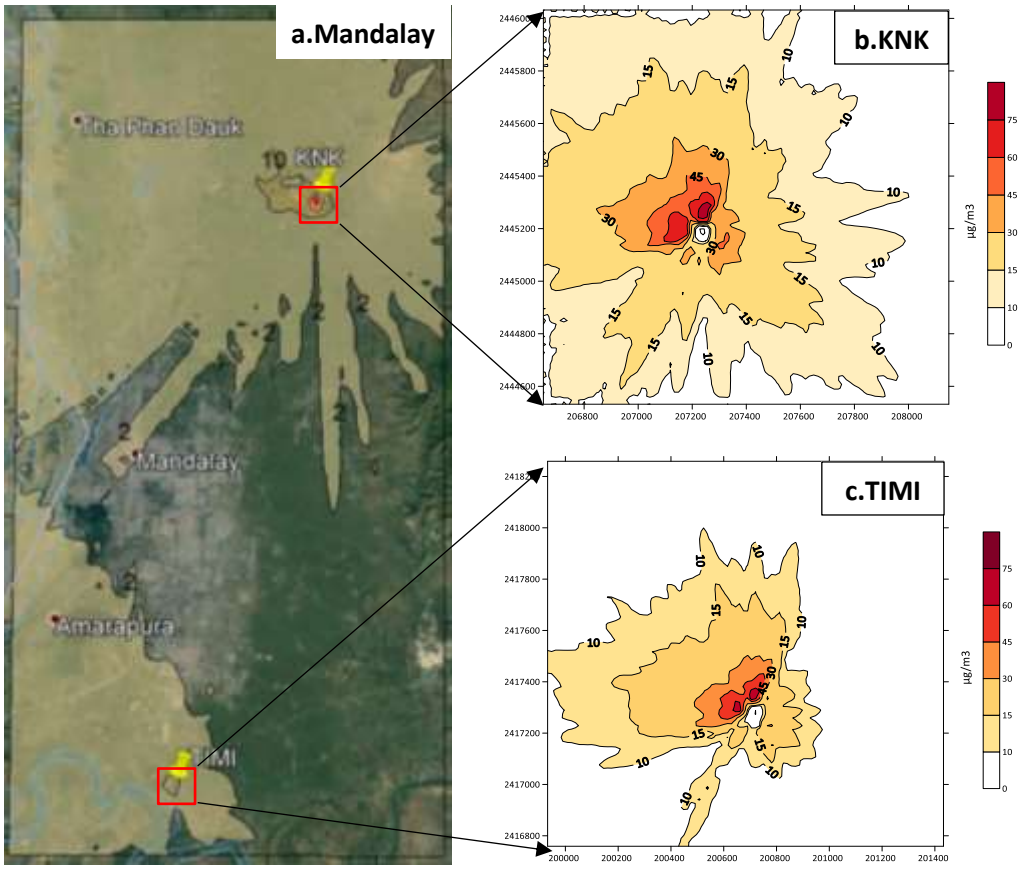


Figure 7.4: Dispersion pattern of the 1st highest values of 1h NOx in Mandalay (Phase 3)

7.2 Cumulative impact on noise quality

The cumulative noise impact at a residence is the noise received at that residence when two or more of the projects or factories are operating simultaneously. Cumulative noise impacts are considered for the proposed KNK landfill gas recovery project and other existing sources in the vicinity. The noise generated from the proposed project during the construction, operation and decommissioning phases and the process of other activities including transportations would increase noise level.

7.3 Cumulative impact on water quality

The KNK landfill gas recovery project is currently assumed to use the water from both tube wells and public supply. Total water usage is approximately 30 m3/day (7,925 gallons/day) for the construction phase. Nevertheless, the operation phase will be using the amount lesser than the construction phase is. Thus, there will be a cumulative increase in water usage would be only in the construction phase.

7.4 Cumulative impact on traffic

There will be a cumulative increase in automobile and truck traffic in the vicinity nearby the project site particularly in the construction phase. It will be expected there will be an increase number of vehicles during the hours of 8:00 a.m. to 5:00 p.m. However, based on the existing infrastructure, it is more than adequate to handle the increased number of vehicles. Therefore, the cumulative impact in terms of “congestion” is negligible.

7.5 Cumulative impact on solid waste and waste water

The impact of waste disposal from the proposed project would likely to be moderately contribute the incremental effects of various activities nearby.

The cumulative effect of wastewater disposal is less significant comparing to that of operation phase of the project than the construction phase.

Chapter 8

Environmental Management Plan

8 Environmental management plan (EMP)

8.1 Introduction

Proper implementation of a comprehensive Environmental Management Plan (EMP) will ensure that the proposed Korea East-West Power Company and HANATEC Company meets regulatory and operational performance (technical) criteria.

This section describes the modalities provided in the project for the implementation of the proposed mitigation measures to its potential negative impacts. It proposes the institutional responsibilities for the implementation of the mitigation measures, the implementation indicators, and the time frame for monitoring and follow-up for the implementation activities.

Environmental Management Plan for each phase (Construction phase, Operation phase and Demolition phase) provides specific environmental guidance for each activity of a project. The intention of the Environmental Management Plan is to ensure that activities borne from the construction, operation and demolition phase of the project are managed and mitigated in order to ensure that the impacts will be within applicable national standards.

8.2 Objectives of the environmental management plan

Environmental Management Plan (EMP) for all the identified environmental impacts during construction and operational stages of the proposed project is prepared to ensure that sufficient procedural measures are in place to reduce and minimize associated adverse impacts to acceptable or manageable levels.

This environmental management plan aims at recommending improvements to management structures and procedures to ensure that future management recognizes the impacts assessed in this**.** The strict implementation of the EMP and project management's strict enforcement of the adequate construction practices and standards will greatly reduce the negative impacts of the project.

Environmental and social consultants if necessary, will be engaged to support EMP implementation including monitoring. The mitigation measures presented in the following tables [**Table 8.1** for construction phase, **Table 8.2** for operational phase, **Table 8.3** for decommissioning phase] for all three phases are recommended for the impacts specified for the project.

8.3 Environmental and social management plan

This LFG Recovery project is an environmentally beneficial project with low-significance impacts on the environment preventing odorous LFG emissions to the atmosphere and potential LFG fire/explosion. In the meantime, there is still the probability that it can contribute negative impacts on the environment. To ensure the minimum impact on the environment, Environmental and Social Management Plan Measures are prepared by the following three tables:
Table 8.1 for construction phase, **Table 8.2** for operational phase, **Table 8.3** for decommissioning phase.

8.3.1 Environmental and Social Management Plan for Construction Phase

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the construction phase are presented below:

Table 8.1: Environmental and Social Management Plan for the Construction Phase

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
Impact on Air Quality	Pollutant emission from constructing LFG collection system along with drilling LFG collection wells Fugitive emissions from waste compaction, capping operations, earth works. LFG plant construction activities/machineries emitting particulate and toxic gas, including earth works excavation, site levelling, cutting and welding activities, and vehicular movement.	• Apply dust and pollutant controls near emission activities such as LFG well construction and drilling, waste compaction, capping and earth works e.g. water sprinkling. • Soil erosion and dust control management measures also assist in the management of air pollution from construction operations. • Minimize earth works in extremely dry weathers. • Minimize stockpiling of construction materials, e.g. bricks, cement, sand and soils and locate as possibly far away from receptors. • Use of vegetation of stockpiles where a stockpile is not to be used for a month to stabilize the surface and prevent dust generation. • Prevent blowing off by the wind by constructing wind breaks around potentially dusty construction activities and covering construction materials. • Select low-emission construction equipment, machineries and vehicles and maintain them in accordance with manufactures manual. • Schedule operating times of construction machineries and vehicles to minimize air pollution as possibly. • Minimize vehicle idling time by turning equipment off when not in use. • Strict enforcement of on-site speed limit regulations.	• Implement dust and pollutant control activities on LFG project site on a regular basis. • Minimize earth works as possibly. • Use low-emission machineries and equipment. • Report the incidents.	Construction team and/or HSE team	Monitoring Report

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		• Ensure open burning of any waste is banned strictly at construction site.			
Impact on Noise Quality	Constructing LFG collection system as well as drilling LFG collection wells LFG plant construction activities including earth works, cutting, welding, collision and dropping materials (man-made noise) Operation of typical construction equipment, machineries and vehicles.	• Apply noise and vibration control technologies along with silencers or mufflers in waste compactor, LFG well drilling rig and construction machineries. • Orientate equipment with high-noise in one direction so that this noise is emitted away from receptors as far as feasibly. • Schedule noisy construction and transportation activities during day-time hours by combining noisy operations at the same time and avoiding combination of vibration and man-made noise. • Maintain periodically construction machineries and vehicles to operate in good working condition. • Limit vehicles and machineries to an idling time and shut them off whenever possible. • Handle carefully loading and unloading construction materials. • Avoid sensitive institutions/receptors such as educational, health and residential buildings nearby the project site.	• Ensure to apply anti-noise and vibration technologies. • Orientate machineries with high noise in one direction. • Schedule noisy operations and vehicular movement during day-time hours. • Avoid sensitive receptors to noise.	Construction team and/or HSE team	Monitoring Report
Impact on Water Quality	Potential sedimentation due to removal of vegetation,	• Implement soil erosion and sediment control mechanisms for minimizing water pollution. • Prevent washing away open stacks of construction	• Prevent construction materials, chemicals and waste from	Construction team and/or HSE team	Monitoring Report

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
	top soil level and ground surface for infrastructures including flare stack Surface runoff from construction materials, chemicals, solid waste, and hazardous waste from LFG plant construction site. Improper management of water usage, waste, wastewater and storm water/rainwater from construction site. Potential leakage of oil and/or lubricants to runoff	materials, sand, waste or debris into any drainage system along with covering with waterproof materials and storing in a safe manner during rainstorms. • Prefer environmental-friendly or water-based chemicals. • Store chemical, paint, and fuel containers in a safe manner and apply emergency spill prevention/response to ensure quick and safe cleanup of accidental spills in order to prevent from passing through by run-off. • Collect and manage solid waste and hazardous waste along with using impermeable waste containers. • Avoid water extraction from underground as possible and/or Limit usage amount without negative contribution to groundwater balance and local community's demand. • Implement regular maintenance of water storage and piping systems. • Enforce to reuse water as much as possible e.g. spraying used-water over dusty areas. • Implement wastewater drainage system efficiently. • Ensure that construction machineries and vehicles have no leakage of oil or lubricants by maintaining regularly not to combine with surface runoff especially during the monsoon season.	washing away by surface runoff. • Selection of environmental-friendly or water-based chemicals. • Ensure quick and safe cleanup for accidental spills/leakage of chemicals, oil and lubricants. • Implement systematic wastewater drainage system.		

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
Impact on Soil Quality	Earth works for LFG plant construction such as excavation, site levelling, vegetation clearance and topsoil removal Improper management of construction materials, chemicals, solid waste, hazardous waste and wastewater from LFG plant construction site Construction machineries/vehicles movement and Potential leakage of oil/lubricants into the soil.	• Implement proper earth-work management for minimizing soil disturbance and soil degradation by specifying work zones, defining construction phases, and managing actively daily activities. • Reduce earth works for LFG plant construction as possible, especially in extremely dry weathers. • Increase waste compaction to reduce cover soil required. • If required, remove topsoil carefully and save to reuse. • Prefer environmental-friendly chemicals. • Apply hazardous-materials handling procedures for chemical, paint, and fuel containers and emergency spill prevention/response to ensure quick and safe cleanup of accidental spills in order to avoid subsequent soil pollution. • Collect, separate and manage solid waste and hazardous waste as well as using leak proof containers/areas. • Implement efficient wastewater drainage system for storm-water and sediment control. • Arrange heavy machineries/vehicles movement and strict enforcement of on-site speed limit regulations. • Ensure that construction machineries and vehicles have no leakage of oil or lubricants into soil by maintaining regularly. • Designate strategically site boundaries to minimize surface runoffs especially during monsoon season.	• Utilization of environmental-friendly or water-based chemicals. • Minimize earth works so far as possible. • Apply hazardous-materials handling and spill prevention procedures. • Ensure chemicals/waste handling areas with spill/leak proof. • Incident report if any spill/leak occurs.	Construction team and/or HSE team	Monitoring Report

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
Waste Pollution	Biodegradable waste generation from soil excavation and clearance Waste/debris emission from LFG plant construction activities Chemicals/Oil waste emission Packaging waste emission Waste emissions from construction workers	• Manage construction wastes by separating into reusable items and biodegradable items to be reused, recycled or disposed of whenever possible. • Prefer environmental-friendly construction materials without over-ordering and manage them in a way to keep safe storage, regular check-up and proper handling. • Prefer less-hazardous chemicals and order the required amount exactly as possible. • Choose less-packaging materials to reduce packaging waste generation as much as possible. • Apply waste handling procedures for chemical, paint, and fuel containers and emergency spill prevention/response to minimize waste emission from mishandling. • Manage non-hazardous and hazardous waste in a separate way without mixing and use leak proof containers/areas for waste management covering waste classification, separation, collection, storage, transfer and disposal. • Do not wash hazardous materials containers and not mix with other wastes. • Perform waste segregation applying 3Rs method (Reduce, Reuse and Recycle). • Collect recyclable wastes such as paper, metal, and plastic to support partly recycle mechanism. • Check regularly waste containers to avoid overspill of	• Use environmental-friendly materials and avoid over-ordering and mishandling. • Apply adequate waste handling and disposal in compliance with the relevant regulations. • Prohibit open-dumping or direct discharge of any waste to the drainage system on/off site	Construction team and/or HSE team	Monitoring Report

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		waste containers. • Prohibit open-dumping or direct discharge of any waste to the drainage system on/off site. • Encourage not to use plastic bags so far as possible by providing awareness to workforce.			
Impact on Ecological Resources	Forest, Wildlife and Aquatic animal/ fish As the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on these ecological resources will be considered as "less significant" in this construction phase complying with the mitigation and management measures elaborated above accordingly.				
Impact on occupational Health and Safety	Safety threat by constructing LFG collection system along with drilling LFG collection wells through wastes. Fugitive and noise emissions from LFG plant construction activities, waste compaction, capping operations, earth works. Potential health threats by bacteria, germs and	• Ensure that boreholes drilled for vertical LFG wells are not left open to prevent workers from falling into boreholes. • Provide workers with PPEs and trainings to avoid exposure of LFG and fugitive emission during drilling wells and constructing plant including severe winds or weather in landfill site. • Minimize threats by bacteria, insects, germs and chemicals by providing workers with PPE and hygiene facilities as well as mask, glove, footwear, hand sanitizer and anti-bacterial solvent. • Strictly enforce that workers adhere to the HSE manuals including safety net system and specific PPE use to avoid slips, falls, hits, fire, explosion and confined space threat. • Prohibit smoking and other ignition sources in areas with potential LFG emissions using warning signs.	• Provision of safe and healthy working conditions for all employees. • Provision of PPEs and HSE trainings for the particular work.	Construction team and/or HSE team	Incident Record

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
	fungi from landfill, chemicals and wastes. Potential construction hazards including slips, falls, hits, LFG fire, explosion, confined space hazards and road accidents.	• Designate restricted areas for danger zones with caution signs if necessary. • Specific preparation of PPE as well as fall protection equipment, safety suits, helmets, glasses, gas/dust protection masks, respirators, and ear muffs, PPE trainings and first aid boxes in the easy access areas. • Employ drivers with license and strict accident prevention measures along with vehicular checks and speed-limits. • Apply adequate waste handling and disposal on site.			

8.3.2 Environmental and Social Management Plan for Operational Phase

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the operational phase.

Table 8.2: Environmental and Social Management Plan for the Operational Phase

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
Impact on Air Quality	Potential LFG emission/leak from LFG collection and control system such as pipelines, surface capping, and blower. Pollutant emissions from LFG flaring and generator plant Emission from vehicular movement Intermittent emissions from new-well drilling for future well-field expansions	• Adequate capping system with low-permeability covers to minimize LFG venting to the atmosphere. • Install efficient LFG collection and control system to minimize methane migration with regular check-up and maintenance system of piping and pressure along with safe guard and gas detector. • Verifying that all pressures are relieved, and that any potential sources of pressurization are de-energized or locked out, before opening any vessels. • Always comply with mechanical, electrical, pneumatic and hydraulic lock-out/tag-out procedures. • Proper engineering selection for LFG enclosed flares with high temperature and low calorific technology. • Utilization of LFG generator set with low-emission engine. • Use of international accepted machines and equipment with high capacity burning points. • Implement dioxin and furan pollutant control measures by preventing favorable condition that support formation of dioxins and furans immediately after post-combustion.	• Precautionary measures for capping to control LFG venture and migration to the environment. • Authentic pipeline quality (HDPE) to prevent gas leakage • Monitoring any potential sources of pressurization • International practice and maintenance techniques for LFG collection, flaring and utilization to minimize pollutant level. • Maintenance of operation machineries and	Project Management Team, Workers and/or HSE Team	Monitoring report within every six months or periodically as prescribed by the Ministry

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		• Installing flaring plant away from ignition sources such as electric cables and dry trees. Enforce not to release LFG directly to the environment in a downtime or overhaul e.g. by drawing all LFG into combustion system. • Maintain periodically operation machineries and vehicles in manufacture manuals to operate in good working condition. • Odor reduction measures to minimize odor disturbance from LFG plant if necessary. • Use environmentally friendly and low emission machines and vehicles. • Schedule movement of vehicles and limit vehicular speed to minimize exhaust and dust emissions. • Minimize vehicle idling time by turning equipment off when not in use. • Ensure open burning of any waste is banned strictly at construction site. • Plant long trees around the project area to control air pollution (a green belt). • Placing a buffer zone with a garden or with a man-made forest between residential areas and project operation zones.	vehicles in manufacture manuals. • For future well-field expansions, adapt the mitigation measures described for the construction phase. • Keep records of all the incidents and maintenance history of the equipment.		
Impact on Noise Quality	Operation activities of LFG collection and control system, flaring and generator plant.	• Install sound insulation techniques with use of well-functioning silencers and dampers for LFG collection system, blower, moisture separator, generator and flares.	• Apply anti-noise and vibration techniques in noise-generating machineries of LFG	Project Management Team, Workers	Monitoring report within every six

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
	Emission from vehicular movement New-well drilling activities for future well-field expansions.	• Ensure anti-vibration control along with vibration damping seats to reduce earth-borne vibration level from the whole LFG plant • Orientate equipment with high-noise in one direction so that this noise is emitted away from receptors as far as feasibly. • Schedule noisy operation activities during day-time hours by combining noisy operations at the same time and avoiding vibration combination and man-made noise. • Maintain periodically operation machineries and vehicles in manufacture manuals to operate in good working condition. • Schedule vehicular operation during day-time hours to limit noise affected to the receptors. • Limit vehicles and machineries to an idling time and turn them off whenever possible. • For future well-field expansions, adapt the mitigation measures described for the construction phase.	plant, especially generator, blower and condensation. • Schedule noisy operations and vehicular movement during day-time hours. • For future well-field expansions, adapt the mitigation measures described in the construction phase. • Comply with the national noise quality standards.	and/or HSE Team	months or periodically as prescribed by the Ministry
Impact on Water Quality	Surface runoff and spills/ leaks of chemicals, solid waste, and hazardous waste from LFG plant site.	• Well-management of leachate recirculation systems. • Proper use of capping system to prevent erosion by runoff. • Prefer environmental-friendly chemicals. • Prevent washing away chemicals, solid waste, and hazardous waste into any drainage system, storing in a safe manner during rainstorms.	• Utilization of environmental-friendly or water-based chemicals. • Ensure quick and safe cleanup for accidental	Project Management Team, Workers and/or HSE Team	Monitoring report within every six months or periodically as

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
	Improper management of waste, wastewater, runoff and water usage Potential leakage of oil/lubricants to runoff New-well drilling activities for future well-field expansions.	• Store chemicals and their containers in a safe manner and apply emergency spill prevention/response to ensure quick and safe cleanup of accidental spills in order to prevent from passing through by run-off. • Collect and manage solid waste and hazardous waste along with using impermeable waste containers. • Avoid water extraction from underground as possible and/or Limit usage amount without negative contribution to groundwater balance and local community's demand. • Implement regular maintenance of water storage and piping systems to minimize wastewater generation and leaks from faulty connections and faucets. • Enforce to reuse water as much as possible e.g. spraying used-water over dusty areas. • Implement wastewater drainage system efficiently to control storm-water and sediment control. • Ensure that operating machineries and vehicles have no leakage of oil or lubricants by maintaining regularly not to combine with surface runoff especially during the monsoon season. • Implement adequate sanitary facilities along with septic tanks to handle sanitary waste. • For future well-field expansions, adapt the mitigation measures described for the construction phase.	spills/leakage of chemicals, oil and lubricants. • Implement systematic waste and wastewater management system. • Limit and monitor ground-water usage. • For future well-field expansions, adapt the mitigation measures described for the construction phase. • Comply with the national effluent quality standards.		prescribed by the Ministry

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
Impact on Soil Quality	Spills/ leaks of chemicals, solid waste, and hazardous waste from LFG plant site. Improper management of waste, wastewater, runoff and water usage Vehicular movement and potential leakage of oil/lubricants into the soil. New-well drilling activities for future well-field expansions.	• Well-management of leachate recirculation systems. • Proper use of capping system to prevent erosion by runoff. • Prefer environmental-friendly chemicals. • Store chemicals and their containers in a safe manner and apply emergency spill prevention/ response to ensure quick and safe cleanup of accidental spills in order to prevent from passing through by run-off. • Collect and manage solid waste and hazardous waste along with using impermeable waste containers. • Store, dispose and clean up all diesel and hazardous materials according to the procedures. • Construct proper drainage channels to handle storm water and sediment control that might affect soil quality. • Reuse of treated grey water for dust control and plant watering. • Implement adequate sanitary facilities along with septic tanks to handle sanitary waste. • Arrange heavy machineries/vehicles movement and strict enforcement of on-site speed limit regulations. • Ensure that operating machineries and vehicles have no leakage of oil or lubricants by maintaining regularly not to combine with surface runoff especially during the monsoon season.	• Utilization of environmental-friendly or water-based chemicals. • Regular inspection of storage areas of hazardous materials for assurance of the spill/leak proof. • Enhance chemicals/waste handling areas with leak proof and spill prevention/response procedures. • Handle properly hazardous waste by waste management company or deal directly with City Development Committee (CDC) without improper disposal.	Project Management Team, Workers and/or HSE Team	Monitoring report within every six months or periodically as prescribed by the Ministry

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		• For future well-field expansions, adapt the mitigation measures described for the construction phase.	• For future well-field expansions, adapt the mitigation measures described for the construction phase.		
Waste Pollution	Waste generation and disposal of LFG plant including hazardous and non-hazardous waste. Domestic waste from staff quarters Improper waste management from the operation activities. New-well drilling activities for future well-field expansions.	• Apply waste handling procedures for chemicals and their containers and emergency spill prevention/response to minimize waste emission from mishandling. • Manage non-hazardous and hazardous waste in a separate way without mixing and use leak proof containers/areas for waste management. • Develop waste management plan addressing separation, collection, storage, transportation and disposal for each item. • Do not wash hazardous materials containers and not mix with other wastes. • Perform waste segregation applying 3Rs method (Reduce, Reuse and Recycle). • Collect recyclable wastes such as paper, metal, and plastic to support partly recycle mechanism. • Check regularly waste containers to avoid overspill of waste containers. • Prohibit open-dumping or direct discharge of any waste to the drainage system on/off site.	• Utilization of waste segregation system. • Apply adequate waste handling and disposal in compliance with the relevant regulations. • Handle properly hazardous waste by waste management company or deal directly with City Development Committee (CDC) without improper disposal. • Prohibit open-dumping or direct discharge of any waste to the drainage system on/off site	Project Management Team, Workers and/or HSE Team	Waste Record

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		• Encourage not to use plastic bags so far as possible by providing awareness to workforce. • Ensure that all trash containers in the plant are properly sealed at all times to prevent waste being blown and scattered. • Ensure timely collection and disposal of all solid waste generated or Deal directly with City Development Committee (CDC) to routinely handle non-hazardous or hazardous waste. • For future well-field expansions, adapt the mitigation measures described for the construction phase.	• For future well-field expansions, adapt the mitigation measures described for the construction phase.		
Impact on Ecological Resources	Forest, Wildlife and Aquatic animal/ fish As the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on these ecological resources will be considered as "less significant negligible" in this operation phase complying with the .mitigation and management measures elaborated above accordingly.				
Impact on occupational Health and Safety	Fugitive, noise and vibration emissions from LFG plant operation activities and vehicle movement. Potential safety threat by LFG emission, confined space	• Install fugitive extractors/filters with adequate ventilation system in LFG plant to extract dust and other fumes. • For gas pipelines, provide warning sign of danger by stamping, embossing, painting, printing or any other means at the ostensible place in salient words or signs near the receptacle.	• Implement adequate ventilation system with dust/fume extractors. • Take precautions to prevent potential hazards and threats. • Provision of safe and healthy working	Project Management Team, Workers and/or HSE Team	Training Report Incident Report

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
	occupancy, electrical, chemical, and fire/explosion threat _high voltage room and generators. Potential safety threat by slips, falls, hits, and road accidents. Potential health threats by bacteria, fungi virus and germs Exposure to hazardous and non-hazardous materials. New-well drilling activities for future well-field expansions.	• Verifying that all pressures are relieved, and that any potential sources of pressurization are de-energized or locked out, before opening any vessels. • Always comply with mechanical, electrical, pneumatic and hydraulic lock-out/tag-out procedures. • Provide workers with PPEs and trainings to avoid exposure of fugitive, noise and vibration emission emitted by LFG plant operation activities and vehicle movement. • Identify and develop measures to control occupational hazards _ confined space hazards, lack of oxygen, potential methane travel, fire, extreme temperatures, chemical hazards, and uncontrolled energy. • Limit occupation in confined space and strict to use gas monitoring devices/personal gas detectors a minimum capability of monitoring for oxygen-deficient conditions, carbon monoxide concentrations and methane concentrations. • Prohibit smoking and other ignition sources within 25 feet of such areas with potential LFG emissions, LFG components and portions of the leachate and condensate management systems using warning signs. • Designate restricted areas for danger zones with caution signs if necessary. • Install fire/gas/shock automatic detection and firefighting system, prepare potable dry-type fire –	conditions for all employees. • Provision of PPEs and HSE trainings for the particular work. • For future well-field expansions, adapt the mitigation measures described for the construction phase. • Report the incidents if any.		

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		extinguishers and enforce emergency response drill, especially evacuation plan. • Training on knowledge of site security, hazard types, equipment training, and equipment-specific emergency procedures to avoid different risks/accidents such as electric shock, explosiveness, high noise, and health issues caused by insects, animals and/or poisonous plants at site. • Specific preparation of PPE as well as fall protection equipment, safety suits, helmets, glasses, gas/dust protection masks, respirators, and ear muffs, PPE trainings and first aid boxes in the easy access areas. • Employ drivers with license and strict accident prevention measures along with vehicular checks and speed-limits. • Provide HSE manuals and post safety appliances, training safety posters, slogans, pictures clearly. • Minimize threats by bacteria, insects, germs, chemicals and waste by providing workers with PPE and hygiene facilities as well as mask, glove, footwear, hand sanitizer and anti-bacterial solvent. • Keep in a clean and safe state, including floor, walls, work rooms, and ceilings. • Provide first aid kits and adequate medical care to the employees in case on an accident. • Adequate facilities for drinking water and toilets should be provided to the employees.			

Potential Impact	Environmental Aspects/Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
		• For future well-field expansions, adapt the mitigation measures described for the construction phase.			

8.3.3 Environmental and Social Management Plan for Decommissioning Phase

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the decommissioning phase.

Table 8.3: Environmental and Social Management and Monitoring Measures for the Decommissioning Phase

Potential Impact	Environmental Aspects/ Activities	Mitigation and Management Measures	Specific Measures	Responsibility	Report
Impact on Air Quality	Pollutant emission from demolition of LFG plant such as LFG collection wells and flare Emissions from decommissioning vehicles and equipment usage.	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system. • Conduct dust and pollutant control measures near emission activities. • Avoid demolitions works in extremely dry weathers as possible. • Sprinkle water on graded access routes when necessary to reduce dust generation by machines. • Demolished materials on site to be covered to prevent to be blown off by wind. • Select low-emission demolition equipment, machineries and vehicles and maintain them in accordance with manufactures manual. • Minimize vehicle idling time so far as possible. • Optimize vehicle movements to eliminate unnecessary vehicle movements. • Schedule operating times of demolition machineries and vehicles to minimize air pollution as possibly. • Ensure strict enforcement of on-site speed limit regulations.	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system. • Implement dust and pollutant control measures for demolition site. • Cover demolished materials on site to prevent to be blown off by wind. • Perform dust suppression activities	Demolition Team and/or Designated HSE Team	Incident Record

		• Ensure open burning of any waste is banned strictly at demolition site.	performed on a regular basis. • Minimize air pollution from vehicles using low emission equipment and vehicles. • Prohibit burning of domestic waste on site. • Report the incidents to the Site Manager if any.		
Impact on Noise Quality	Operation of typical demolition equipment, machineries and vehicles. Potential collision and dropping materials, shouting (man-made noise)	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety. • Use of well-functioning demolition equipment, machineries and vehicles with noise-control techniques as well as silencer. • Schedule noisy decommission activities and transportation during day-time hours by combining noisy operations at the same time and avoiding combining vibration • Maintain periodically construction machineries and vehicles to operate in good working condition. • Limit vehicles and machineries to an idling time and shut them off whenever possible. • Handle carefully loading and unloading demolition materials. • Minimize man-made noise so far as possible.	• Perform adequate demolition plan of LFG project to enhance environmental and human safety. • Use of demolition equipment, machineries and vehicles with noise-insulation techniques. • Ensure No noisy activity to be carried out during night-time. • Ensure that noise levels meet	Demolition Team and/or Designated HSE Team	Incident Record

			guidelines and if necessary, put in place noise control measures.		
Impact on Water Quality/ Resource	Surface runoff from demolished materials, non-hazardous and hazardous waste from LFG plant demolition site. Improper management of demolition waste and wastewater. Potential leakage of oil and/or lubricants from fuel equipment and vehicles to runoff	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety. • Prevent washing away open stacks of demolition waste or debris into any drainage system along with covering with waterproof materials during rainstorms. • Store non-hazardous and hazardous waste in a safe manner using impermeable waste containers in order to prevent from passing through by run-off. • Collect and manage solid waste and hazardous waste along with using impermeable waste containers. • Implement regular maintenance of water storage and piping systems. • Enforce to reuse water as much as possible e.g. spraying used-water over dusty areas. • Ensure that construction machineries and vehicles have no leakage of oil or lubricants by maintaining regularly not to combine with surface runoff especially during the monsoon season.	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety • Prevent demolished materials, chemicals and waste from washing away by surface runoff. • Ensure quick and safe cleanup for accidental spills/leakage of chemicals, oil and lubricants. • Keep tall storm drains clear of demolition debris to ensure free water flow. • Reuse all grey water where practicable.	Demolition Team and/or Designated HSE Team	Incident Record
Impact on Soil Quality	Improper management for solid waste, waste	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system.	• Conduct adequate demolition plan of LFG project to	Demolition Team and/or	Incident Record

	water and hazardous waste from demolition site. Spills/ leaks of oil and lubricants from fuel equipment and vehicles in demolition site.	• Manage non-hazardous and hazardous waste from demolition site in a safe manner using impermeable waste containers. • Ensure that chemicals, oil and lubricants are stored in leak-proof storage tanks with proper handling. • Ensure that any waste is disposing correctly way without open-dumping. • Reuse of treated grey water for dust control and plant watering. • Ensure only well-maintained equipment and vehicles used for the demolition phase. • Arrange heavy machineries/vehicles movement and strict enforcement of on-site speed limit regulations. • Ensure that construction machineries and vehicles have no leakage of oil or lubricants into soil by maintaining regularly. • Recycle of excavated earth materials if possible.	enhance environmental and human safety emphasizing on demolition of LFG collection and control system. • Apply adequate waste handling and disposal in compliance with the relevant regulations • Monitor chemical and waste storage areas for the assurance of the spill/leak proof system. • Ensure that any waste is disposing correctly way without open-dumping.	Designated HSE Team	
Waste Pollution	Non-hazardous and hazardous waste/debris from LFG plant demolition activities.	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety. • Manage non-hazardous and hazardous waste in a separate way without mixing and use leak proof containers/areas for waste management covering waste classification, separation, collection, storage, transfer and disposal. • Ensure that chemicals, oil and lubricants are stored in	• Implement adequate demolition plan of LFG project to enhance environmental and human safety. • Apply adequate waste handling and disposal	Demolition Team and/or Designated HSE Team	Incident Record

	Chemicals/oil waste emission Waste emissions from construction workers	leak-proof storage tanks with proper handling. • Do not wash hazardous materials containers and not mix with other wastes. • Perform waste segregation applying 3Rs method (Reduce, Reuse and Recycle). • Collect recyclable wastes such as paper, metal, and plastic to support partly recycle mechanism. • Check regularly waste containers to avoid overspill of waste containers. • Prohibit open-dumping or direct discharge of any waste to the drainage system on/off site. • Ensure that any waste is disposing correctly way without open-dumping.	in compliance with the relevant regulations • Monitor chemical and waste storage areas for the assurance of the spill/leak proof system. • Ensure that any waste is disposing correctly way without open-dumping.		
Impact on Ecological Resources	Forest, Wildlife and Aquatic animal/ fish As the proposed project is a Clean Development Mechanism (CDM) project located in the existing municipal landfill site, the impacts by this project on these ecological resources will be considered as "negligible" in this decommissioning phase.				
Impact on Occupational Health and Safety	Emissions from LFG plant decommissioning activities. Potential health threats by bacteria, germs, fungi, chemicals and wastes.	• Prepare adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system. • Provide workers with PPEs and trainings to avoid LFG and fugitive emission during decommissioning LFG plant including severe winds or weather in landfill site. • Minimize threats by bacteria, insects, germs and chemicals by providing workers with PPE and hygiene facilities as well as mask, glove, footwear, hand sanitizer and anti-bacterial solvent.	• Implement adequate demolition plan of LFG project to enhance environmental and human safety emphasizing on demolition of LFG collection and control system.	Demolition Team and/or Designated HSE Team	Incident Record

	Potential demolition hazards including slips, falls, hits, LFG fire, confined space and road accidents.	• Apply adequate waste handling and disposal on site in compliance with the relevant regulations. • Strictly enforce that workers adhere to the HSE manuals including safety net system and specific PPE use to avoid slips, falls, hits and confined space threat. • Prohibit smoking and other ignition sources in areas with potential LFG emissions using warning signs. • Designate restricted areas for danger zones with caution signs if necessary. • Specific preparation of PPE as well as fall protection equipment, safety suits, helmets, glasses, gas/dust protection masks, respirators, and ear muffs, PPE trainings and first aid boxes in the easy access areas. • Employ drivers with license and strict accident prevention measures along with vehicular checks and speed-limits.	• Take precautions to prevent potential hazards and threats. • Provision of safe and healthy working conditions for all employees. • Ensure the PPEs are provided appropriately for the particular work.		

8.4 Environmental monitoring Plan

Table 8.4 Monitoring plan for environmental, social and health impact

Factors	Parameter & Guideline	Procedure	Proposed Duration	Frequency of Monitoring	Location
Air Quality	**National Environmental Quality (Emission) Guideline (EQEG)** For both Generator and Flare, • PM (PM10, PM2.5) • NOx • SO2 • CO • VOC • O3 • Methane • H2S • CO2	Method Myanmar National Environmental Quality (Emission) Guidelines	**Duration:** 24hr continuously **Frequency:** • Every six months during operation and once during decommissioning phase • In case of any complaint regarding air quality, an additional air quality measurement may be conducted in response to specific complaints (if necessary)	Will submit monitoring reports to the Ministry not less frequently than every six (6) months or periodically as prescribed by the Ministry.	Nearest sensitive receptor or downwind of the project (complaint area) (if necessary)
Noise	• LA_{eq} 1 hr ≤ 70dBA	Method • Myanmar National Environmental Quality (Emission) Guidelines, Effective since 2015 in accordance with The Environmental Conservation Law, 2012	**Duration:** 24hr continuously **Frequency:** • Every six months during operation and once during decommissioning phase • In case of a complaint regarding noise from project site, an additional noise measurement may be conducted (if necessary)		Within 1km of a community

Factors	Parameter & Guideline	Procedure	Proposed Duration	Frequency of Monitoring	Location
Effluent from the LFG recovery flaring plant	**National Environmental Quality (Emission) Guideline (EQEG)** For Daily Maximum Concentration, • BOD5 • COD • Oil and Grease • PH • Temperature • Total Coliform • Total Phosphorus • Total Nitrogen • TSS	Method • Analytical Methods followed to Standard Methods for effluent levels for municipal landfills, recommended by National Environmental Quality (Emission) Guideline (NEQG)	• Every six months during operation and once during decommissioning phase	Will submit monitoring reports to the Ministry not less frequently than every six (6) months or periodically as prescribed by the Ministry.	Near effluent source
Hazardous and Non-hazardous waste	• Manifest Disposal and Tracking Report	• Track waste volume by type and disposal location daily	• Throughout all phases	Regular Check-up If any , Incident Report	At all project locations
Social	• Environmental watch committee collaborated by the Municipality • Complaint • Monitoring and solving	• Record complaint • Monitor, investigate and implement suitable solutions			Project area, community around project area, and transportation route
Public and Occupatio	• Accidental statistics • Cause of accidents • Mitigation measures	• Conduct summary report for accident investigation			Project area, community around project

Factors	Parameter & Guideline	Procedure	Proposed Duration	Frequency of Monitoring	Location
nal health and safety					area, and transportation route

8.4.1 Budgets and responsibilities for environmental monitoring

Table 8.5: Budgets and responsibilities for environmental monitoring

Environmental Factors	Index/ Parameters	Responsibility	Estimated Budget
Operation phase			
Air Quality	**National Environmental Quality (Emission) Guideline (EQEG)** For both Generator and Flare, • PM (PM10, PM2.5) • NOx • SO2 • CO • VOC • O3 • Methane • H2S • CO2	Environmental Team (Third Party)	USD 500
Noise	• LA_{eq} 1 hr, 24 hr	Environmental Team (Third Party)	USD 200
Effluent (site runoff and wastewater discharges) (both construction phase and operation phase)	**National Environmental Quality (Emission) Guideline (EQEG)** For Daily Maximum Concentration, • BOD5 •COD •Oil and Grease •PH •Temperature •Total Coliform •Total Phosphorus •Total Nitrogen •TSS	Environmental Team (Third Party)	USD 300
Hazardous and Non-hazardous waste	• Manifest Disposal and Tracking Report	Environmental Team (Third Party)	
Social	• Environmental watch committee collaborated by the Municipality • Complaint	Environmental Team (Third Party)	

	• Monitoring and solving		
Public and Occupational health and safety	• Accidental statistics • Cause of accidents • Mitigation measures	Environmental Team (Third Party)	

8.5 EMP Budget

The estimated costs for the initial implementation of EMP will be defined on an initial set up basis. The EMP cost is planned as the following amount:

The Korea East-West Power Company and HANATEC Company will use 2% of the investment amount for the EMP cost.
The company will revise these costs and develop annual operating costs for the EMP. These include the following costs:

a) Supervision on environment (includes sampling for environmental quality)
b) Engineering supervision cost
c) Institutional Strengthening, Training and Capacity Building
d) Development of Manual of functions and procedures including HSE procedures
e) Equipment and logistics
f) The social welfare programs for the employees and the nearby community who needs

8.6 Corporate Social Responsibility

The Korea East-West Power Company and HANATEC Company implements Corporate Social Responsibility (CSR) plan together with EMP during the operation period. The objective of CSR plan is to conduct the business in a way that is ethical, society friendly and beneficial to community in terms of development.

The project proponent should contribute 2% of the net profit for Corporate Social Responsibility (CSR) for the development of local communities including living standards, their health, religious organizations and local's education. Among the 2% of the net profit of the project, 0.5% amount should be used for the community development such as transportation, 1% should be intended for the local's health and education and the remaining 0.5% should be for the donation of pagodas and monasteries.

Chapter 9

Emergency Response Plan

9. Emergency Response Plan

9.1 Introduction

This chapter describes the strategy how to manage all possible emergencies, operational emergencies, natural, man-made disasters and epidemics, along with actions required and written procedures to be carried out in order to respond the major hazards. Thus, an Emergency Response Plan (ERP) will be established for emergency situations that may arise during the construction, operation and decommissioning /closure phase of Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project.

Moreover, it will give guidance on actions and lines of communication in the event of an emergency and outline the respective responsibilities of the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project and Health and Safety (HSE) contractor/Manager.

The objective is to prepare the resources (personnel and equipment) available to respond accidents all which can be resulted by the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project's activities, emergency situations (chemical and fuel spill, fire, security incident, medical evacuation) and major disasters including erosions as well. This will lead to identification of potential accidents along with limitation of its consequences as well as high level of prevention of the potential negative consequences on humans and environment.

In the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project, in general, there should be either Emergency response in charge or HSE manager and Response Team for the emergencies. The team should be prepared as follows:

- Training of the team members along with their responsibility and equipped with the emergency materials
- Establishment and provision of the written emergency procedures
- Description and Availability of the Emergency Response Plan (ERP) in all employees and project workers and there should be documented and posted
- Identification of the locations of the emergency evacuation Muster points
- Provision of alarm system and firefighting equipment
- Supporting of first aid equipment
- Minimizing that should be reasonably practicable the risk to human life, the environment, assets and business in the event of an accident or emergency situation by ensuring effective and efficient intervention
- Ensuring the availability of adequate information on the emergency situations through a good communication system
- Ensuring efficient management of the emergency through the effective and efficient response of all dedicated resources
- Identification of the governmental authorities, media and other relevant stakeholders to be notified and production of a description of the procedures for communicating with them

The potential emergencies that likely occur at the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project:

- Gas leak
- Fire/ Explosion
- Chemical exposure
- Workplace accidents/ Injury
- Natural Disasters (erosions)
- Epidemics/ Pandemic

9.2 Emergency policy

- The Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project needs to establish policies and oversee all matters of operation of these project's activities. If as an emergency may occur at any time and, in all likelihood, without warning, it is essential to have policies and procedures in place to assure the orderly operation and recovery of the project.
- The established policies and procedures will be set up together with roles and responsibility for making decisions and taking actions.
- Thus, emergency management plans described in the above sections should lie with either an emergency service in charge or the project's designee and the onsite response team.

9.3 Organization of emergency team

Phase I Emergency team shall be formed with senior persons available in shift and/or trained or experienced with environmental management issues. This team shall be constituted with Project Shift- In charge (for project emergencies) as Emergency response in charge/Site Incident Controller and pilot on duty. The numbers of the in charge will depend on the project's decision and its capacity. The Workplace Health and Safety representative shall be designated.

Phase II Emergency team lead by emergency service in charge shall be formed with the response team occupying action group.

Phase III Emergency team shall be organized immediately in order to be well prepared to respond the emergency events that can happen either unexpectedly or accidently.

9.3.1 Key Activities and Processes of Emergency Management Team (EMT)

The EMT is responsible for providing support and assistance to EMT Leader & on-site Emergency Response Team (ERT) and ensuring that all tasks assigned are tracked, followed up & completed in a safety & efficient manner.
The following table shall be utilized by EMT during planning process.

Phase	Activity
Evaluate the situation and progress of the response	• Gather, record, analyses and display situation and resource information • Obtain a clear picture of the scale and complexity of the incident, and assess the incident potential • Assess worst-case potential • Determine resources required to implement the Incident Action Plan
Establish and refresh incident objectives and strategy	• Formulate and prioritize response objectives. • Identify analyses and evaluate reasonable response strategies to • Accomplish the overall objectives of the response.
Develop the Incident Action Plan	• Determine the tactical direction (i.e. what, why, who, when, where and how) and the resources, logistics and strategies for the next operational period. • Define operational periods. • Identify resource status and availability. • Configure organizational structure to implement tactics, and determine work assignments and specific resource requirements. • As needed, develop and prioritize Incident Action Plan.
Prepare and disseminate the Incident Action Plan	• Format the Incident Action Plan in accordance with the level of complexity of the incident, and produce a well-prepared outline for an oral briefing or written plan. • Obtain Incident Action Plan attachments and review for completeness and approval. • Ensure the Incident Action Plan is up-to-date and complete in relation to the incident situation. • Reproduce the Incident Action Plan and distribute before the start of the next operational period.
Evaluate and revise the Incident Action Plan	• Compare planned progress with actual progress on a regular basis, and identify deviations or changes in resource availability, mission failure or unexpected success, and new safety and environmental considerations. • Input new information and changes in the situation into the

	first step of the planning process as necessary to modify the Incident • Action Plan for the current or subsequent operational period.

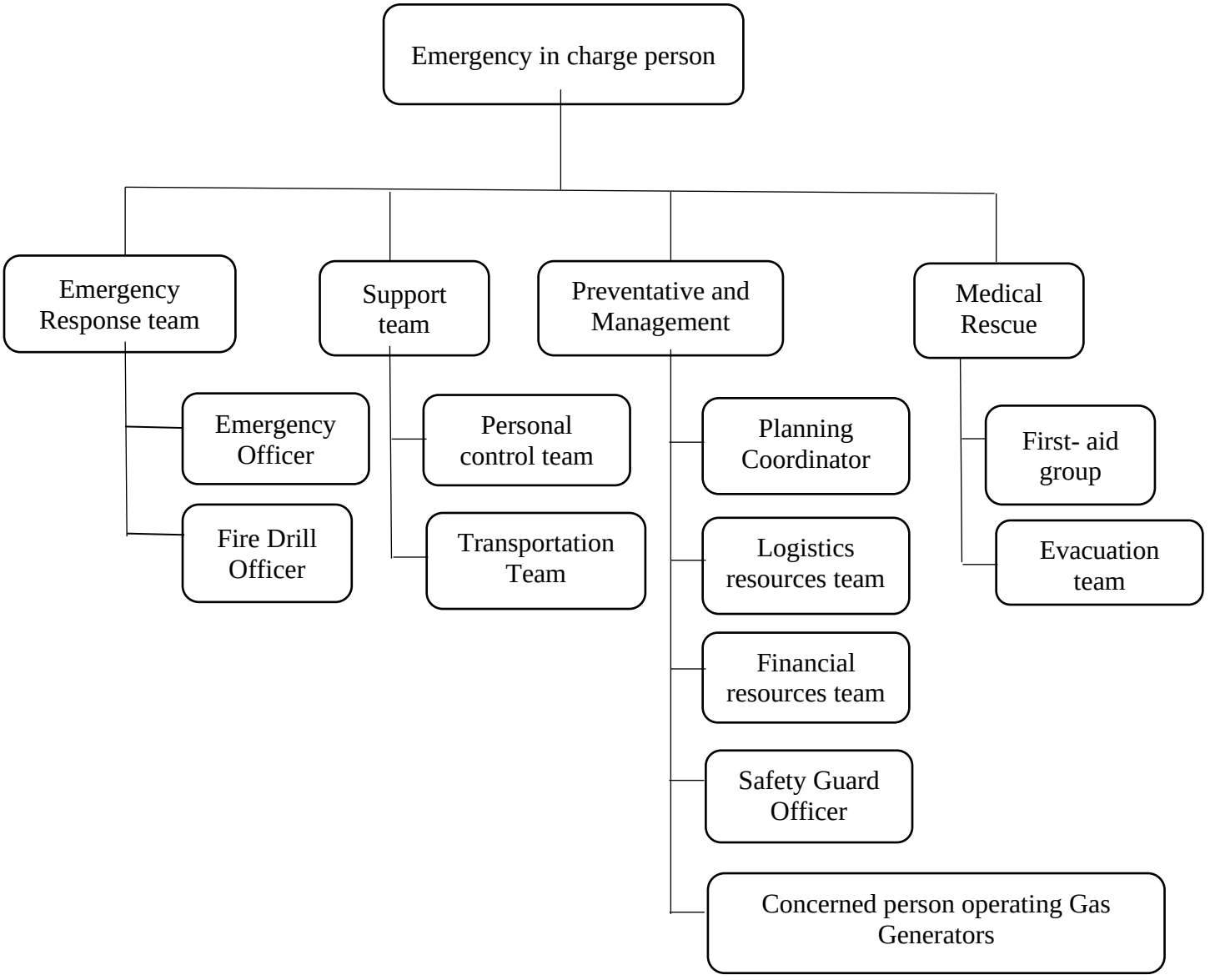


Figure 9.1: Organization chart for emergency team

9.4 Emergency response procedure

Before preparing a procedure, a risk assessment will be carried out for estimating how likely it is for an emergency event to occur and if it does, how serious or damaging the consequences would be. The emergency procedure should provide an appropriate and proportionate response to this situation. The emergency response flow is described in the following Figure

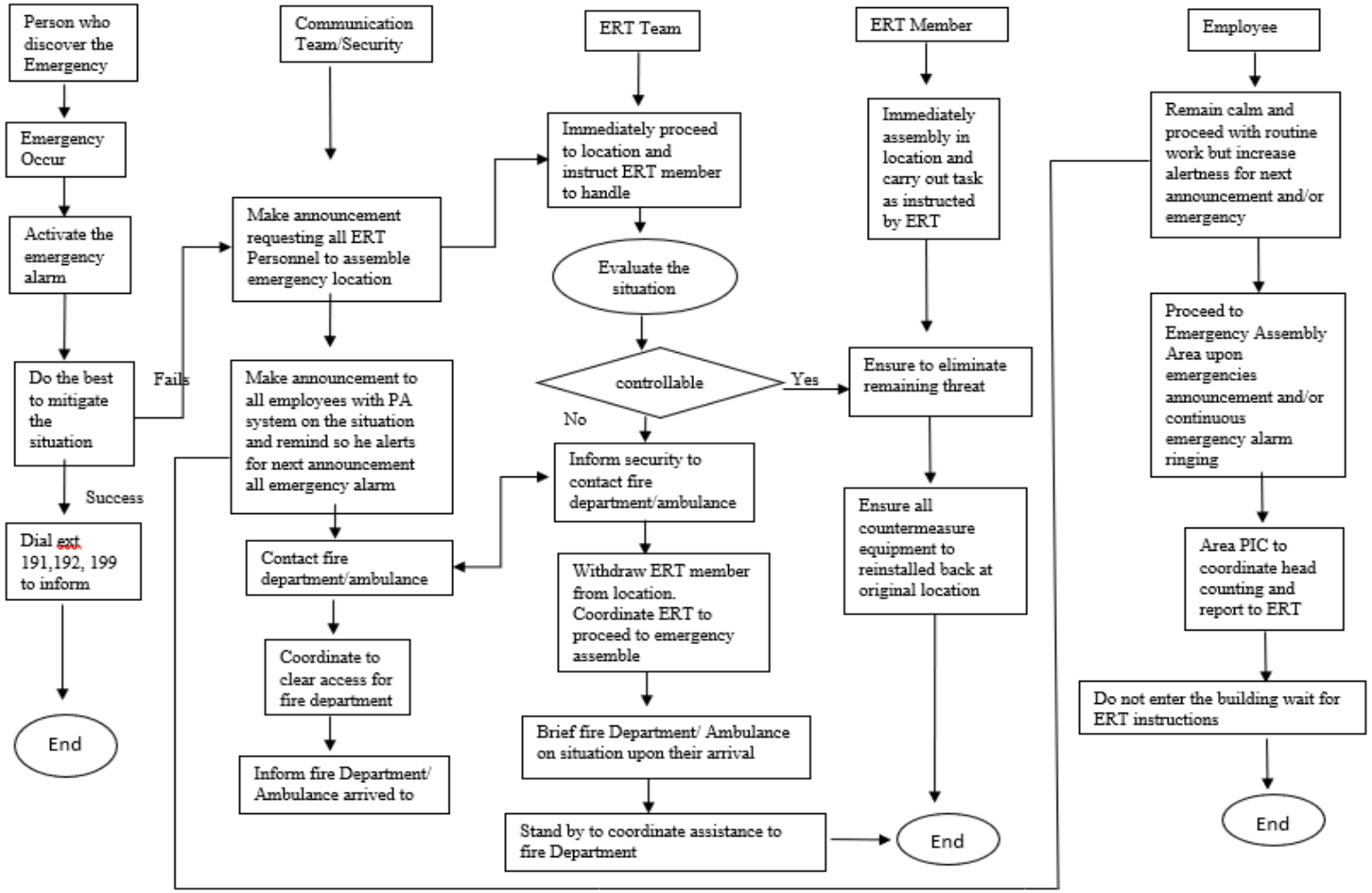


Figure 9.2: Emergency Response Flow Chart

9.4.1 Reporting an emergency

The person who discovered an emergency case shall immediately inform the Project Manager. Whenever there is an imminent or emergency situation, the operating building must immediately:

1. Activate facility alarms or communications systems to notify personnel to evacuate the affected site.
2. Notify the relevant department using the following outline:
   a. Your name and name of company
   b. Location of project, i.e. Kyar Ni Kan Landfill site, Amarapura Township, Mandalay.
   c. Describe nature of the case, i.e. fire, chemical spill, Gas leak or workplace accident.
   d. Any other requested information
3. Go to the parking lot or send someone to the parking lot to direct the relevant department to the emergency area.
4. Contact Mandalay Electricity Supply Corporation (MESC) to secure electrical service to the affected area.
   Mandalay Electricity Supply Corporation
   Phone Numbers – 02 – 407 5614, 09 205 2910
   Email: mandalaydis@mescmm.com
5. Assist in assessing the extent of damage caused.
6. Assess the adequacy of the Emergency Plan and the response by personnel to determine if the Plan is adequate and if additional training is needed.

Careful and complete details of all emergencies should be recorded in the appropriate log book, with each entry giving at least the following information:

- Date of incident
- Item of equipment
- Details of emergency
- Details of immediately previous maintenance work carried out to the equipment
- Previous evidence or warnings of trouble
- Any special circumstances or other relevant details
- Action taken to affect both temporary and permanent repairs.

9.5 Emergency response plan for Methane Gas Generation

Methane will be used as a heat source in the production of electricity for Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project. Methane is an odorless and colorless gas which is flammable and combustible with oxygen.

The possibility of gas leak is mostly associated with "negligible" because HANATEC, is going to conduct gas leakage tests of piping and storage facilities and tests on fire extinguishing systems in accordance with the national high pressure gas safety laws of korea/Myanmar. Moreover, gas pipeline operation shall be run under a strict monitoring and prevention solution in place including strict engineering design standards, totally enclosed delivery technology, strict engineering quality control, effective environmental protection measures, and high-standard engineering measures for various potential emergency issue restraints and multiple protections for fire safety, as well as standardized and normalized work procedures, professional equipment service and maintenance, and effective emergency treatment and harm reduction measures.

However, the probability of gas leak cannot be ruled out completely. Fire and explosion may be resulted from the leakage of Methane gas and therefore methane gas detection with methane sensors and infrared cameras monitoring along with dry chemical powder or water spray, and carbon dioxide (CO2) that can be extinguished the fire from a gas explosion with fire monitors, lifesaving equipment and medical equipment should be kept in good condition.

9.5.1 Action plan for gas leak

Responsible Person	Action Item
Anyone who can detect methane and other gas leak	Immediately Inform project manager or Emergency response in charge.
Emergency in charge person	On receiving the information, the project Manager shall immediately proceed to find out the source of the gas leak. When the source of gas leak can be determined, Alert all of the workers and any passers- by to stay clear of the affected area. When the source of gas leak cannot be found out Announce to vacate the room/ space, and initiate an evacuation by manually engaging the nearest fire alarm pull station. Depending on the seriousness of the gas leak, nearest fire station will be needed to contact.

Onsite emergency response team & Fire Station	• On receiving an emergency response request, members of the Emergency Response Team are to proceed to the scene of the incident ensuring that they have all their emergency personal protective equipment (PPE). • Carry out the required emergency actions as directed by the Emergency Response Team leader/ in charge person. • Extinguish all flames, etc • Dry chemical powder or water spray, and carbon dioxide (CO2), that can be extinguished the fire from a gas explosion, with fire monitors, lifesaving equipment and medical equipment shall be available. • Use proper personal protection and extinguishing media • Assess the situation from time to time and use appropriate strategy • Medical rescue team must be stand by for personal injury in case. ***Important*** • Do not return to an evacuated building until and unless told to do so by Emergency Team Leader.   Gas Analyzer Gas Flow Meter

9.5.2 Emergency shutdown

The Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project shall install emergency shutdown system to stop the outlet pumps in case of low level, and high- level transmitters providing high level alarm. The following modifications have been planned by the ERT for emergency shutdown of operation_

Installation of a new shutdown valve at the inlet of each pipeline to be closed in case of high level and in case of emergency shutdown.

Installation of sprinkler and it will spray water automatically over the tank when the outside temperature becomes near limited.

Installation of gas leaking detector to catch leaking and it will alert automatically sound alarm and then the gas will be stop.

9.6 Emergency fire/ explosion response plan

The possibility of fire occurrence is mostly associated with "high" because of the flammable gases around the project site. Thus, the firefighting equipment should be available at all work area and warehouses of the project and should be kept in good working state. The use of this fire-fighting equipment should be one of the key points during the training of the ERP team, workers and staff. The personnel technician in charge of the maintenance and plant management should regularly check this equipment and ensure that they are always ready to be used.

Moreover, the fire alarm system should be installed both at the project and admin office. Floor plan along with the emergency exits should be allocated.

Figure 9.3 Fire alarm and firefighting equipment

9.6.1 Action plan for fire/ explosion

Responsible Person	Action Item
Anyone who notices fire	Immediately Inform project manager available in shift and/or trained or experienced with environmental management issues along with the details of the information: fire source, the nature of fire etc. OR Inform directly to relevant department, such as Police Station or Fire Force near Yangon Industrial Zone. **Nearest Police Station** **1. Kyar Ni Kan Police Station** Address: Kyar Ni Kan Group, Beside Mandaly-Madaya Road. Phone: 09 423408525

	2. Patheingyi Myoma Police Station Address: Patheingyi Road, Patheingyi Township Phone: 02 57749
	Nearest Fire Station **1. Aung Chan Thar Fire Station** Address: Aung Chan Thar village, Myo Taw Se Pin Road, Beside Mandalay-Madaya Railway Phone: 09 777786862 **2.Patheingyi Fire Station** Address: Patheingyi Road, Patheingyi Township Phone: 024058056
Emergency in charge person	On receiving the information of an emergency, the Project Manager shall immediately proceed to the scene of the incident to assess the seriousness of the emergency. If an emergency is confirmed, he shall: ➢ Immediately raise the alarm and inform all employees as follows: • Location of fire • Type of fire • Seriousness of fire ➢ Immediately inform emergency service in charge

Onsite emergency response team **&** **Nearest township fire station**	• Start the actions and activate Emergency Action Plan in consultation with Emergency response in charge and use proper personnel protective equipment • Carry out the required firefighting emergency action as directed by Emergency Response Team leader/ in charge person. • Water borne firefighting equipment such as firefighting tugs with fire monitors, lifesaving equipment and medical equipment shall be available • Based on the type of project area involved initiate relevant response • Use proper personal protection and extinguishing media • Assess the situation from time to time and use appropriate strategy • Remove unaffected containers/goods from the area if possible • Medical rescue team must be stand by for personal injury in case. ***Important*** **For substances, which becomes dangerous when wet/ violently react with water** • Use dry chemical for small fire. • use smother with dry inert material and dispose them

9.6.2 Fire extinguishers and fire drills

Fire extinguishers: In the event fire, extinguishers are used to fight a fire only when it is safe for the employee to do so and the employee has been trained on how to properly use a fire extinguisher, the project manager should contact the service supplier to have the extinguisher(s) serviced and recharged.

***Fire drills*:** Fire drills will be held at least once per year to determine effectiveness of this emergency procedure. A written record of the drill will be kept on file at the facility by human resources.

9.6.3 Possible Types of Fire and Management

Fuel Storage Fires	• Fuel storage fires have the ability to escalate rapidly. • The fire authorities should be notified as soon as possible to allow for mobilization of fire equipment. • Always treat fuel storage fires with dry powder, foam or CO2 extinguishers. Water will tend to spread the fire. • If safe to do so endeavor to turn off the valve or stop leak in order to stop the supply of fuel to the fire. • If all efforts are unable to control the fire, water sprays should be directed to surrounding areas, storage drums and equipment to prevent the spread of the fire and limit heat damage. • After the fire has been extinguished, monitor the area to ensure it does not reignite.
Equipment Fire	• The two main causes of a landfill equipment fire are electrical faults or litter (caught on exhaust or manifold). These types of fires are minimized by regular inspections, servicing, maintenance, and cleaning. • When an equipment fire occurs. • Activate the fire suppression system (where fitted). • Extinguish using a dry powder or CO2 extinguisher. • Isolate batteries at the earliest convenience. • Prevention of secondary fires, including landfill fires, is extremely important. If safe to do so the equipment should be moved to a safe location away from the active tipping face. • After the fire has been extinguished, monitor the area to ensure it does not reignite.
Landfill Fire	• Can cause significant impacts on local air quality through odor and smoke. Air monitoring should be conducted for any subterranean fires or large fires that burn for a long period of time. • Extreme care must be taken when fighting a landfill fire as smoke and fumes may be toxic. • Use a dry powder or CO2 extinguishers in the first instance.

	• Apply and compact (if possible) thick layer of cover to prevent oxygen from reaching the burning area. • Seek advice from the Landfill Operations Manager before using water (some materials are not compatible with water). • If the above is not sufficient to extinguish the fire. • Systematically dig out the affected area. • Extinguish the fire in the excavated material using one of the methods above. • Subterranean landfill fires are difficult to extinguish. It is important to prevent subterranean fires by removing any ignition sources (e.g. • Lead acid batteries) and using daily cover. Extinguishing landfill fires quickly and monitoring the area for flare-ups minimizes the risk of a subterranean fire. • If a subterranean fire is detected the area must be isolated in case of a surface collapse resulting from the fire burning out a subsurface cavity. • Subterranean fires can be extinguished by systematically digging out the affected area and extinguishing the fire in the excavated material. • Capping the area to minimize oxygen ingress. • Displacing oxygen by injecting an inert gas, such as nitrogen, into the • fire.

9.7 Workplace accident

All of the workers for the operation of Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project are well trained through the capacity building and training program provided by the project. However, workplace accident is inestimable and can be happen accidently. The Project provides first aid training for the workers, and medicines and materials needed in case of emergency.

The project shall establish a workplace policy, where all unplanned or undesired occurrence which may or may not result in injury to person and or damage to property, must be reported immediately

9.7.1 Action plan for workplace accidents

Responsible Person	Action Item
Nearby person (or) Colleague	• Immediately inform the emergency service in charge • In serious case, call doctor at once or transport to doctor or hospital. Hospitals near the project are as follows (**Open 24 hours**) **Nearest Hospital** 1. **Patheingyi Hospital** Address: Patheingyi Road, Patheingyi Township Phone: 02 57570 2. **Mandalay General Hospital** Address: 30th Street, Between 74x77 Street, Chan Aye Tharsan Township, Mandalay Phone: 02 21041 Take actions in consultation with Emergency service in charge/ Shift In Charge and activate Emergency Action Plan
The Emergency response in charge	• Clearing employees from the area. • Cut off electrical supply if necessary • Controlling or eliminating sources of imminent danger • Ensuring that there is minimal scene disturbance, aside from anything required to be disturbed to deliver first aid and/ or control or eliminate an imminent danger. • Cure the injured person with provided first aid kit by a first aider trained in Emergency First Aid before the ambulance arrives.

9.8 Medical emergency response plan

The Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project shall provide First Aid, Emergency Treatment, and Administration of medication for the workers during the working activities.

9.8.1 General provisions

1) The provisions of this policy are intended to meet workers health which needs during minor and major injuries or medical emergencies.

2) To ensure workers safety, the project shall adopt the position that workers shall administer medications at home whenever possible.

3) The project shall recognize that accidents and medical emergencies can happen during working hours; therefore, project shall adopt guidelines to prepare staff members to provide first aid and emergency care during these unexpected events.

9.8.2 First aid emergency treatment

1. First aid shall be provided to project admin staff, and workers.
    - Either any project staff member or licensed medical professional designated by the project to render care that should complete training in CPR and First Aid provided by the nationally recognized training organization.
    - First aid supplies shall be kept in central locations in the project where they will remain clean, dry, and available to all personnel.
2. When an emergency exists, staff members will implement appropriate emergency procedures, “activating the project’s Emergency Response Plan (ERP).”
    - Any worker can contact the Emergency medical treatment place
    - Either project member or licensed medical professional at the project should be trained to administer emergency procedures needed in life-threatening situations.

9.8.3 Work field trips

For field trips that are considered an extension of the work activities, first aid supplies shall be available on all vehicles during work trips.

Figure 9.4: First aid kit

9.9 Emergency response plan for chemical exposure

Regarding the chemical exposure issue, if the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project uses some kinds of soft chemicals, a **Material Safety Data Sheet** (**MSDS**), which is able to represent the chemicals that are being used in the project, shall be kept. It will include information of the chemicals on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. Emergency eye wash station should be kept at the project for emergency cases.

Figure 9.5: Emergency eye wash station

9.9.1 Special Equipment for Emergency

Project employees may need personal protective equipment to evacuate during an emergency. Personal protective equipment must be based on the potential hazards in the workplace and the appropriate controls and protective equipment for those hazards. Personal protective equipment may include items such as the following:

- PPE Suits to cover skin
- Safety glasses, goggles, or face shields for eye protection
- Hearing protection
- Related Hard helmets and safety shoes for head and foot protection;
- Proper respirators
- Any other special equipment or warning devices necessary for Methane emergency cases.

Table 9.1 Personal protective equipment (PPE) and their functions

Function of PPE	Feature and Characteristics
Protective goggles	
Goggles with direct vents are not suitable for protection from chemical splattering or smoke.	
Hearing Protection	
Cotton earplugs: disposable earplugs for short- term use – not suitable for high noise levels	
Elastic earplugs: washable, reusable earplugs	
Earmuffs: They offer a high level of sound reduction and are suitable for high noise levels. They can be used in combination with safety helmet.	 
Respiratory Protection	

Dust mask: lightweight mask that is fitted over the nose and mouth and secured behind the head with elastic Gas Mask Respirator: Gas masks are also known as "air-purifying respirators" because they filter or **clean chemical gases and possibly particles** out of the air as you breathe. This respirator includes a face piece or mask, and a filter/cartridge (if the filter is in a metal shell it is called a "canister"). Straps secure the face piece to the head.	 
Head Protection	
Use head gear which conforms to recognized safety standards	
Hand and Arm Protection	
Gloves for common tasks (cotton/ leather)	
Heat- resistant gloves	
Foot Protection	
Select footwear that fits the purpose and conforms to recognized safety standards.	 
Body Protection	
Reflective clothing: For working in busy traffic: brightly- colored reflective clothing can increase the visibility of employees and reduce their chances of being struck by vehicles or machinery	

9.10 Natural Disaster

9.10.1 Earthquake

The following are the main activities to be undertaken should any part of the Project be affected by earthquake:

- Cease operations in the area.
- Assessment of damage.
- Prevent any further damage by following specific contingency plans i.e Pipe system failure, Generator and/or Flare stack failure.
- Relocate fuel or any hazardous materials, if required.
- Repair damage, as appropriate.
- Assess and treatment of surface or ground water.
- Monitoring to determine effectiveness of remedial actions.
- Engage appropriate consultants.

9.11 Emergency evacuation plan

Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project prepare the emergency evacuation outlines basic procedures to follow in the event of an emergency such as fire or explosion, chemical spill, incident, or natural disaster that may require evacuation of the building.

9.11.1 Evacuation procedures

There is air horn method for notifying occupants and they may indicate an emergency or a test of the emergency systems.

When an alarm sounds, all personnel must immediately evacuate the building in accordance to the emergency evacuation procedure.

All departments will adhere to the following instructions in an emergency:

1. In the event of an evacuation, everyone should use the nearest exit if safe to do so. If an emergency situation prevents the use of the emergency exit nearest to your work station, proceed to the nearest alternate exit.
2. If safe to do so, zone marshals will walk through their zones to make sure all staff have left and to close all doors.
3. The receptionist will take the visitor log book and the staff itinerary for a roll call.

4. All personnel should stay calm and proceed in an orderly fashion to prevent any injuries to themselves or other employees.
5. Once outside the building, assemble in the parking lot, keeping a safe distance away from the building. Immediately report to the project manager or designate who will be taking headcount to ensure everyone is out of the building.
6. All personnel must await further instructions.

9.12 Reporting Procedures

Reports shall be produced through the course of implementation of monitoring programs and collecting incident/emergency response forms as well and then submitted to the industrial zone representative.

The either Emergency response in charge or HSE manager will be responsible for ensuring that reporting and management procedures are being followed and documented accordingly.

Incident details to be reported include:

- How the incident occurred.
- Monitoring (current and additional).
- Photographs (where possible).
- Remedial actions.
- Triggers for ceasing remedial actions.
- Any findings of experts consulted.
- Preventative actions.

9.12.1 Air quality

The onsite response team is needed to report any excessive emissions from the site to the Emergency response in charge. A community complaints register will be maintained in order to identify areas where dust management is a significant problem.

Moreover, the data of 24 hour continuous ambient air monitoring (Preferable period (dry weather) quarterly monitoring a year) will be reported to the relevant regulatory agencies.

9.12.2 Noise quality

All operational phase complaints are to be reported to the Emergency response in charge and a record of any noise complaints along with the corrective action will be placed in a log book.

Moreover, the data of 24 hour continuous noise monitoring (quarterly monitoring a year) will be reported to the
relevant regulatory agencies.

9.12.3 Water Quality

a) Ground water and surface water quality nearby

Although water is a necessity during the construction phase, there will be no direct significant impact on water body due to the landfill gas impact.
Annual report based on (once a year) along with the corrective actions will be reported through the emergency service in charge to the relevant regulatory agencies.

b) Wastewater

Annual report based on (once a year) along with the corrective actions of point sources of negative impact will be reported through the emergency service in charge to the relevant regulatory agencies.

9.12.4 Emergency response plan

Immediately notify the emergency response in charge in the event of an unexpected gas leakage.

Weekly reports (as appropriate) will be completed on-site and reviewed by the emergency service in charge.

In the event of a leak, the emergency response in charge is responsible for the preparation of an Environmental Incident Report, Corrective Action Report and for provision to the concerned industrial zone authority.

The Workplace Health and Safety representative will be responsible for enforcing all occupational and public health directives and keeping all related records and communications regarding this.

9.13 Documentation/Logbooks/ Environmental management file

The following documentation must be kept on site in order to record compliance with the EMP.
An Environmental File which includes:

- Copy of the EMP,
- Copy of the Environmental Approval,
- Copy of the health and safety regulations and measures
- Copy of all other licences/permits;
- Copy of the respective Emergency response Plans;
- Copy of relevant legislation;
- Environmental Method statements compiled by the Contractor;
- Non-conformance Reports;
- Environmental register which shall include:
- Communications Register–including records of Complaints, and, minutes and attendance registers of all environmental meetings.

- Monitoring Results including environmental monitoring reports, register of audits,
- Incident book including copies of notification of Emergencies and Incidents, this must be accompanied by a photographic record.
- Waste manifests
- Waste Documentation such as waste generation, waste audit, waste water disposal and Sewerage Disposal Receipts;
- Material Safety Data Sheets for all hazardous substances;
- Air, Noise and Water Quality Monitoring reports;
- Written Corrective Action Instructions; and
- Notification of Emergencies and Incidents

Furthermore, the following information shall be posted at the office and working environment:

9.13.1 Important Phone Numbers

FIRE station:
MEDICAL emergency:
AMBULANCE
SECURITY – Township Police, Industrial zone security
- Project Control room
- Arrangement of assembly points

9.14 Actuating of Siren

***Siren for declaring Emergency*:** Siren to be sounded continuously for 30 Seconds with an interval of 5 Seconds to be repeated 10 times.
***Siren declaring Evacuation from the project area*:** Siren to be sounded for 5 seconds till the area is evacuated by people or for ½ hour whichever is less.
Siren declaring All Clear and returning to the work: Siren to be sounded continuous for 5 minutes

9.15 Review of the EMP

The project environmental personnel shall review the EMP to assess its effectiveness and relevance as follows:

- The full EMP shall be reviewed at least annually

Relevant parts of the EMP shall be reviewed periodically following a reportable incident, an addition, up-date or change or a sub-plan, reporting; non-compliances; and corrective actions implemented

9.16 Capacity building and training program

Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project will educate the project employees about the types of emergencies that may occur and train them in the proper course of action; such as awareness disaster training, firefighting training and first aid training. The size of the workplace and workforce, processes used, materials handled, and the availability of onsite or outside resources will determine the training requirements. Project employees will be sure to understand the function and elements of the emergency action plan, including types of potential emergencies, reporting procedures, alarm systems and evacuation plans.

Training may include practicing evacuations, identifying assembly points, location of emergency equipment, first aid arrangements and how to safely shut down machinery.

In determining training requirements, the following should be considered:

- inclusion of emergency procedure training in induction courses for new workers
- provision of refresher training for existing workers
- provision of training for short-term contractors or visitors at the workplace (this may not need to be as extensive as may be required for workers), and
- Provision of specific training for individuals who have a formal role in an emergency for example fire wardens, floor wardens, first aid officers.

General training for project employees should address the following:

- Individual roles and responsibilities;
- Threats, hazards, and protective actions;
- Notification, warning, and communications procedures;
- Means for locating employee/ workers in an emergency;
- Emergency response procedures;
- Evacuation, shelter, and accountability procedures;
- Location and use of common emergency equipment; and

The employee will be trained in first-aid procedures, including protection against blood borne pathogens; respiratory protection, including use of an escape-only respirator; and methods for preventing unauthorized access to the site. A good idea is to hold practice drills as often as necessary to keep employees prepared. After each drill, gather management and employees to evaluate the effectiveness of the drill. Identify the strengths and weaknesses of the plan and work to improve it.

9.17 Preliminary EMP Costs

Estimated costs for the initial implementation of the EMP will be defined on an initial set up basis. The project will revise these costs and develop annual operating costs for the EMP. These include the following costs:

1. Supervision on environment (includes sampling for environmental quality)
1. Engineering supervision cost
2. Institutional Strengthening, Training and Capacity Building
3. Costs of salaries, administration and function of the environmental unit of project
4. Technical assistance to project environmental unit
5. Development of Manual of functions and procedures including HSE procedure
6. Equipment and logistics

Chapter 10

Public Consultation and Disclosure

10. Public consultation and disclosure

10.1 Introduction

The survey conducted at the In Gel village which is the immediate vicinity to the proposed project, Kyar Ni Kan Landfill Gas to Energy project in order to identify the perception of community likely affected by the project activities as well as their social impacts.
Firstly, a meeting with the village head, MCDC officials and some respective household members was held and the scope of the project along with the aim of the CDM approach was briefly explained.

There are two sets of surveys for the households from the nearest village and the people who are living closely as well as relying on the waste disposal site for their incomes. The survey was carried out using the preformed questionnaire comprising a mixture of quantitative and qualitative question types.

The survey was carried out starting from 9 to 18 of September, 2020 by the EQM socio-economic survey Team. The set of questionnaire form used in the survey is attached in Appendix (D).

10.2 Objectives of the study

The main objectives of the socio-economic survey are as follows:

1. To collect the data on current socio-economic status including livelihoods and existing environmental conditions in the project area.
2. To reveal community perception on the proposed project and how it can effect on their lifestyles
3. To assess the condition of the positive and negative impact on the socio-economic status along with better suggestions to minimize the negative effects.

10.3 Social Survey Instruments

In the household surveys conducted in the In Gel village, which is home for 252 households, questionnaires were delivered to each household by the Village Tract Administrator /Head of the respective wards and then collected after one week. During that time, interviewers were contacting the selected participants whether they can understand the questions in order to obtain the reliable responses.

Generally, the household questionnaire consists of sections on household member characteristics, household economics, health condition, education, transportation system, cultural aspect, usage of internet, electricity utilization as well. Among the sections, one section focused solely on respondents' experiences with and awareness of climate and ecosystem changes. The data entry, data analysis as well as interpretation were conducted by using SPSS 21.

Total 40 households (***30 households*** from ***In Gel village*** and ***10 households nearby landfill site***), who are representative about the information of village and attitude towards the proposed project were randomly selected in order to conduct socio-economic surveys for the proposed project in Kyar Ni Kan.

In order to have a sufficient information about the people who are closest to the landfill site, 10 households who are relying on the waste disposal site for their incomes, are conducted in the survey.
It is the best way to consider typical and representative of the community which may potentially affected by project activities.

10.4 Socio-Economic Surveys on Key Informants and local community (Nearest Village)

10.4.1 Socio-Economic Surveys on Key Informants and local community

The (40) households including household leaders, religious leaders and community surveys were conducted using the socio-economic and attitude questionnaire.

10.4.1.1 Current situation of infrastructure, resources and services

From the key informant survey, firstly it focused on infrastructure, resources and services including health, education, water sanitation, hygiene and transportation. According to the findings, majority can access healthcare and education. In the usage of electricity, public electricity is mainly for lighting; however, but, not only electricity but also, charcoal and firewood are still being used for cooking.
For water supply, the main source of drinking water is from deep well. Most households, they disinfected water before use either boiling or sedimentation. But from the past to until now, water quality has not changed.

10.4.1.2 Analysis of climate condition and environmental aspects

(a) Air, water and soil quality analysis

As the results of socio-eco surveys, climate becomes warmer and air quality is not negatively changed. All the conditions of the natural environment are normal situation.

10.4.1.3 Analyzing result for the information related to project

Regarding awareness and attitude on the project, most of the respondents know a little information about the proposed project.

Socio-Demographic of the community

(i) Distribution of population responding questionnaires

In the respective village, 40 respondents were randomly selected and questionnaires were given. Among the survey respondents, 60% is female and remaining 40% is male. Most respondents comprise of heads of households and housewives; however, but a few are family members including sons and daughters. According to the results, all household members are "***Buddhist***". The ethic occupied by the population lived around the proposed project is "***Burmese***".

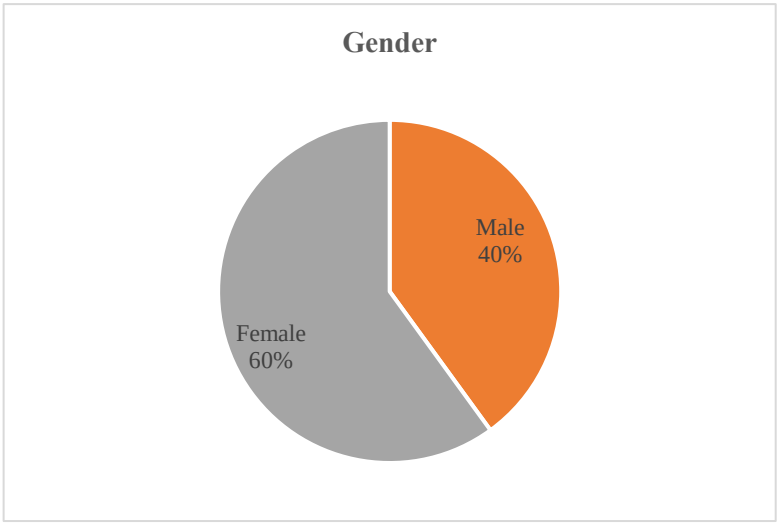


Figure 10.1: Distribution of population responding to the questionnaire

(ii) Age distribution

The survey identified that majority (32%) is 40-50 and then followed by 30-40 is (18%), 20-30 and 50-60 are (14%) each and the least is 70 above which is (3%).

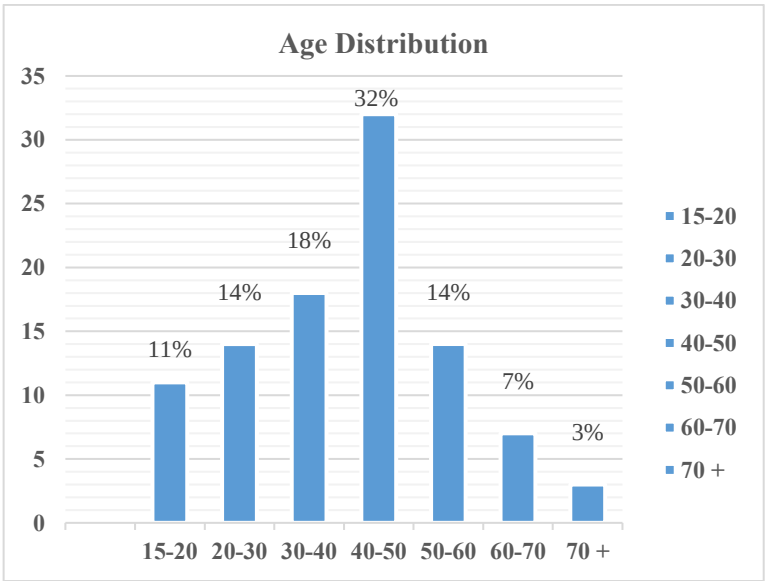


Figure 10.2: Age distribution

(iii) Occupation status

The following pie chart summarizes the information on the pattern of occupation status of the households in the village. According to the result, 63% of the respondents are "***Farmers***", 15% each for "***Casual workers***", "***Livestock workers***", and 3% is "***Skilled workers***".

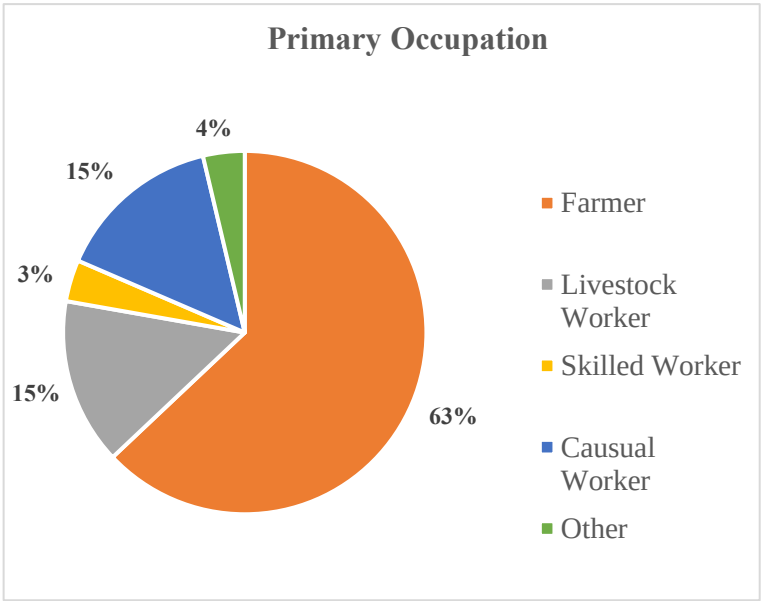


Figure 10.3: Different types of occupation

(iv) Income level

The annual income of households was assessed through the survey of household's characteristics.

In the figure below shows the percentage of annual income level in the community.

The majority (32%) is less than 500,000 kyats followed by (28%) which is between 500,001 to 1,000,000 per year.

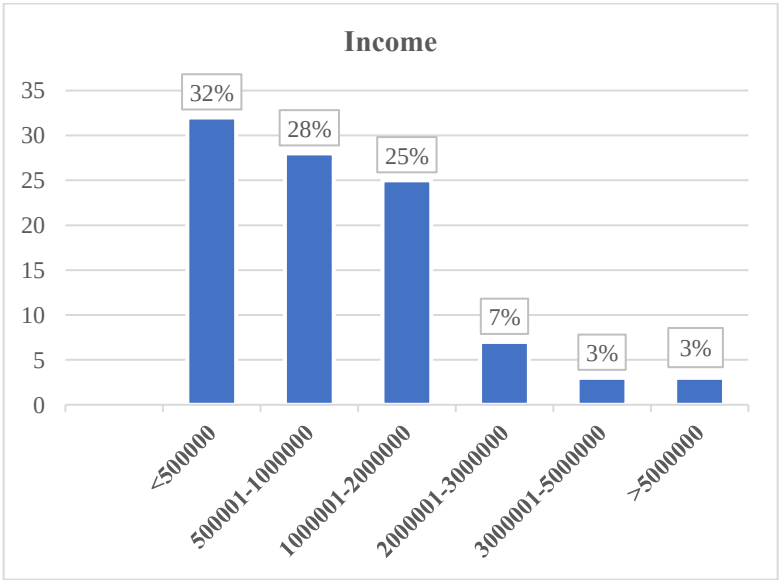


Figure 10.4: Percentage of income level at community

(v) Education

It is observed that 44% of respondents are "Primary school" education level and 37% have "Middle school" level. About 13% have "High education" level and only 3% has the "Monastic education" level and "Graduate" level.

For Highest education level in family, most households (41%) have “Middle school” education level followed by” High school” level (24%).

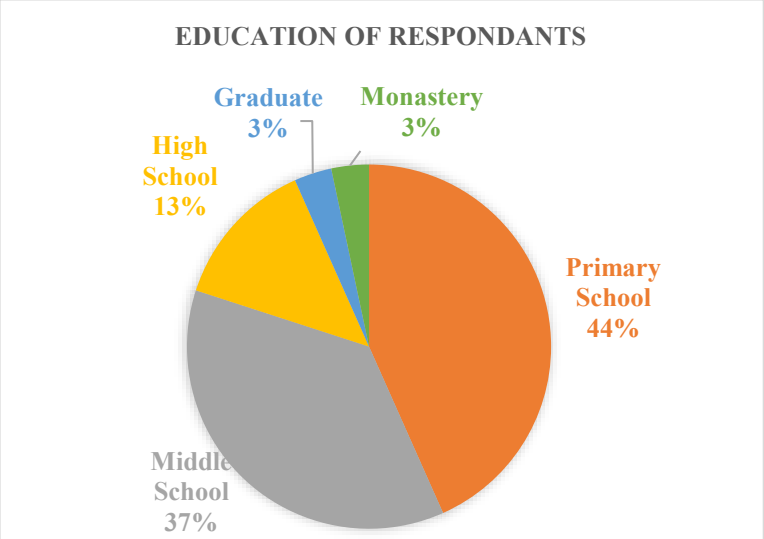


Figure10.5: Education level of respondents

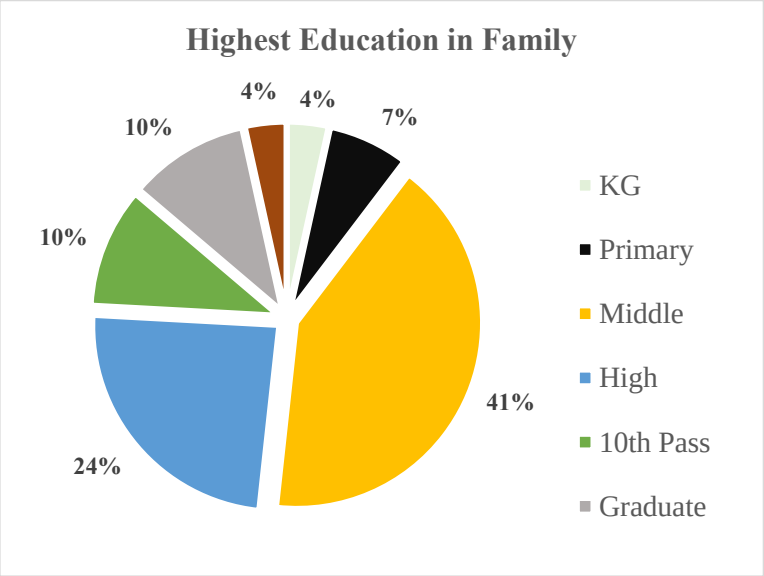


Figure 10.6: Highest Education level in Family

(vi) Household Expenditures

The household expenditure of local people per month including cooking fuel,

1) Education,
2) Usage of fuel (diesel/petrol)
3) Transportation,
4) Communication (telephone/mobile),
5) Entertainment,
6) Healthcare/medical expenditure,
7) Input investment,
8) Annual maintenance of house,

9) Loan repayment,
10) Cultural/religious expenses and
11) Food expenditures were analyze.

For all these different categories, the following figure shows the outcomes of the respondents.

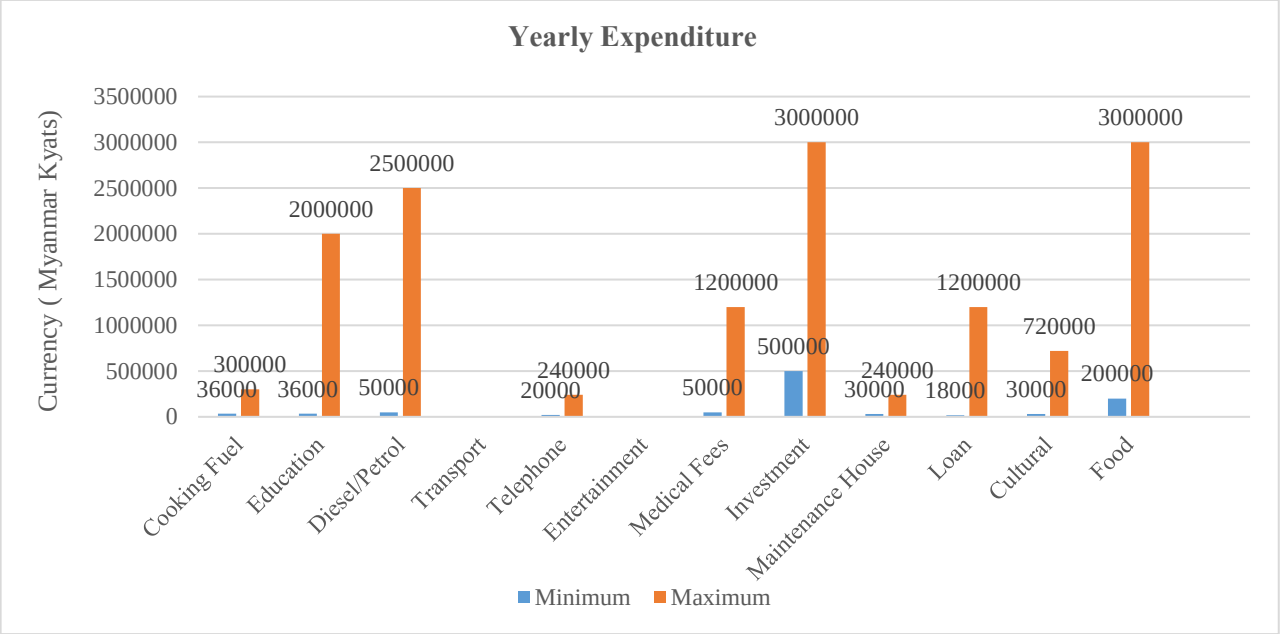


Figure 10.7: Percentage of household expenditures

(vii) Total Expenditure

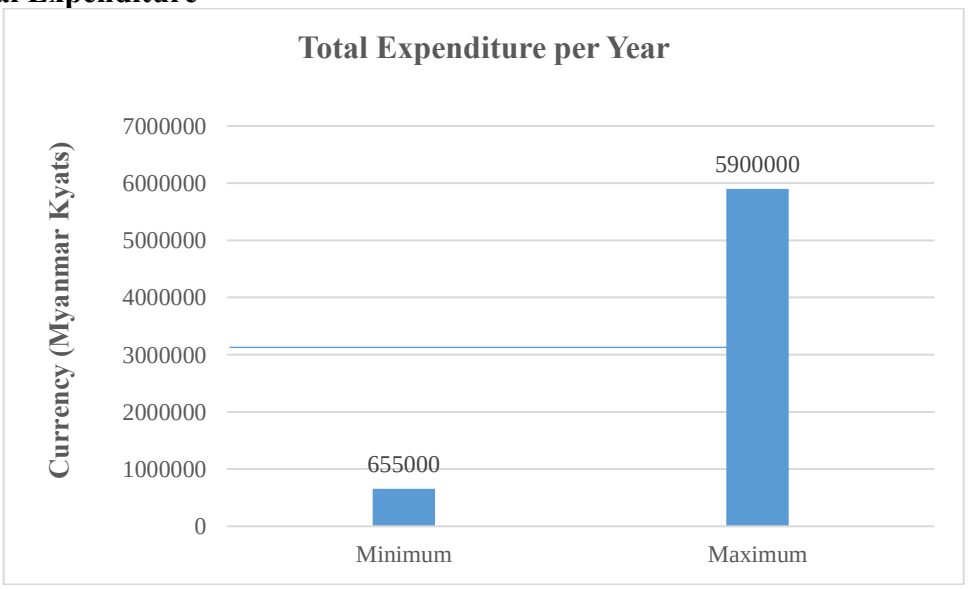


Figure 10.8: Percentage of total household expenditures

(viii) Household health condition

According to the survey, the common sickness of household members are Flu and catching a cold (22%) and (20%) respectively followed by hypertension (10%) and malaria, muscle pain and ear, eye, tooth diseases for (7%) each.

Five percent of surveyed household suffers skin diseases and 3% for cancer and 2% for digestive system disorders. Irritations, blurred vision and fatigue are also mentioned by the small percentage
(more or less 1%) of surveyed respondents.

For incidence of diarrhea within three months, majority (93%) did not experience that disease.
For incidence of any sickness within three months, majority (83 %) did not experience any sickness.

The majority (57%) among the surveyed households get treatment from "***Private clinic with doctor***", 13% for "***Health Assistant***" and 10% for "***Doctor from other village***" followed by 7% each for "***General Hospital***" and "***Self-medication***".

Moreover, 3% percent of respondents get treatment from "***Midwife***" and another 3% gets treatment from both "***General hospital and Midwife***".

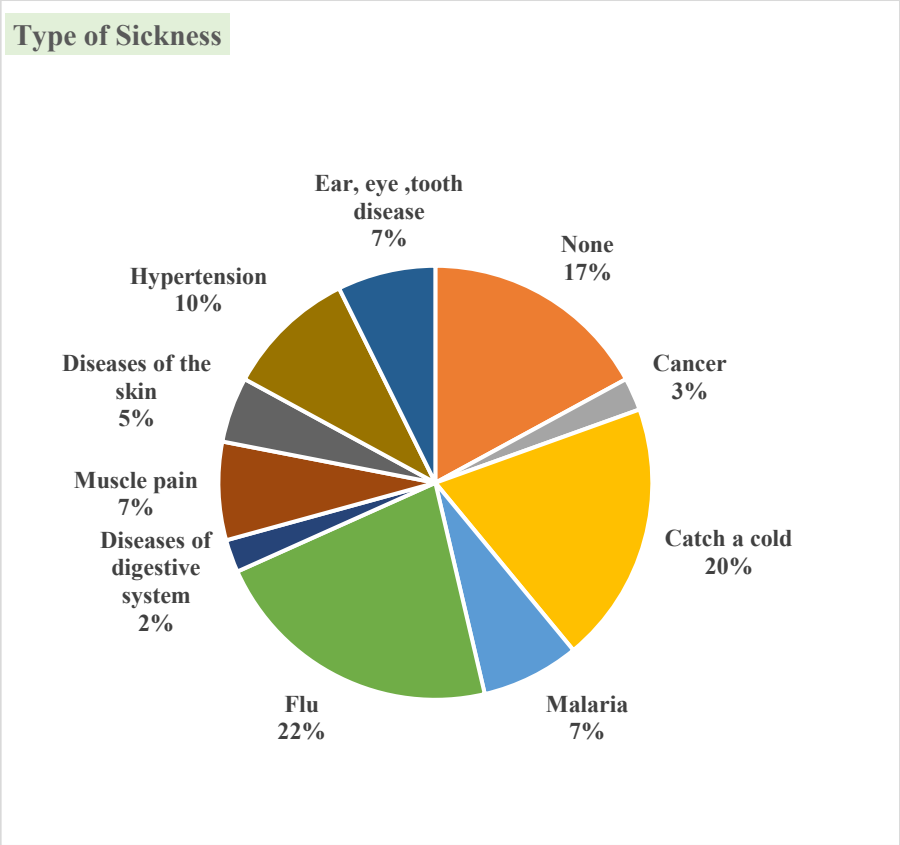


Figure 10.9: Health condition

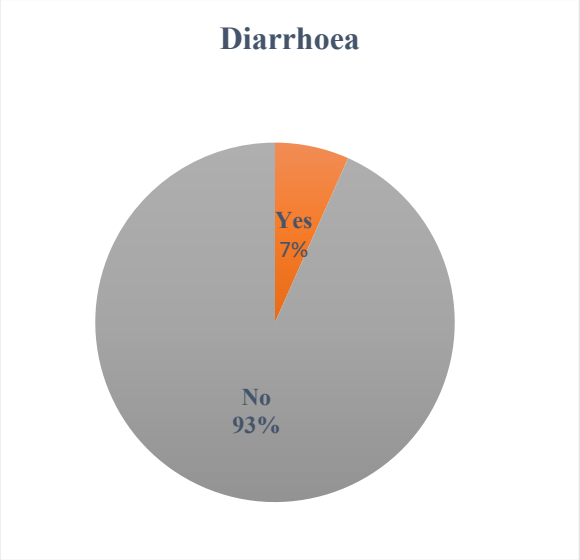


Figure 10.10: Diarrhea within three months

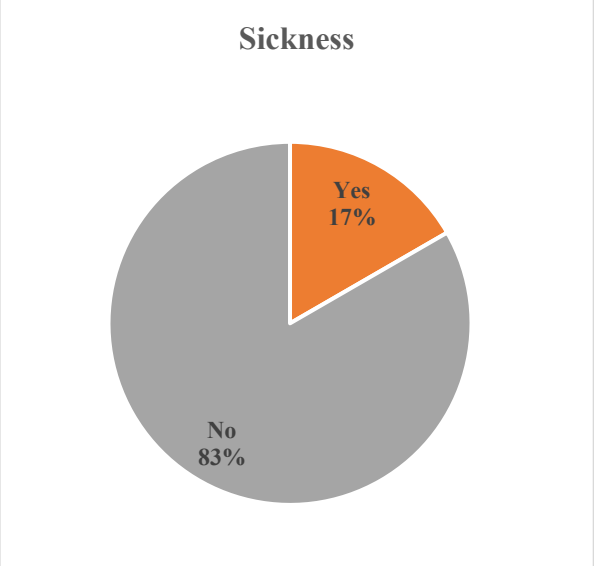


Figure 10.11: Sickness/Illness within three months

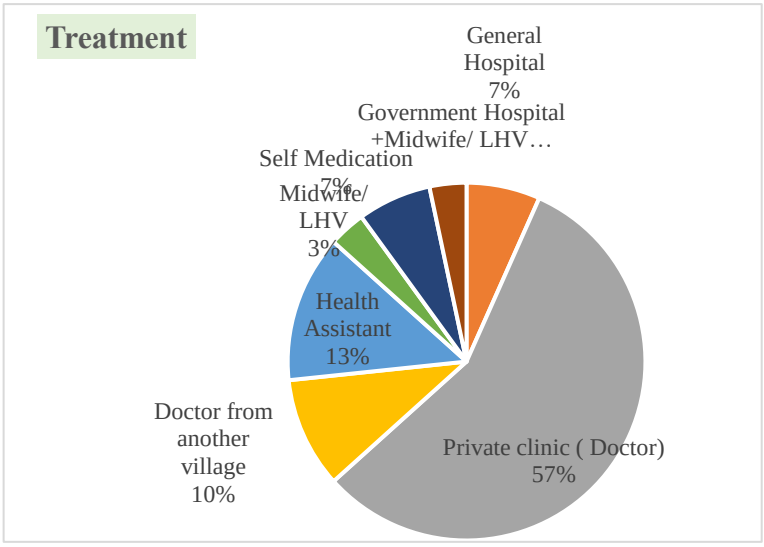


Figure 10.12: Treatment of Diseases

(ix) Household structure

It is observed that 87% households have their own house while 13% households do not own a house. In the below pie chart, 91% of respondents live with document and remaining 9% do not have any document for residence.

It is observed that sixty percent live with one storey house and 40% live in house with two storey and above.

Moreover, "***CGI***" is used as roof for 93% of houses and only 7% of surveyed households is roofed with "***Bamboo***".

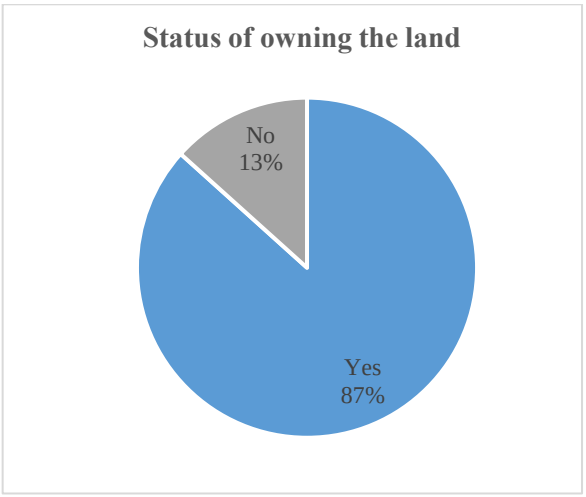


Figure 10.13: Land Ownership

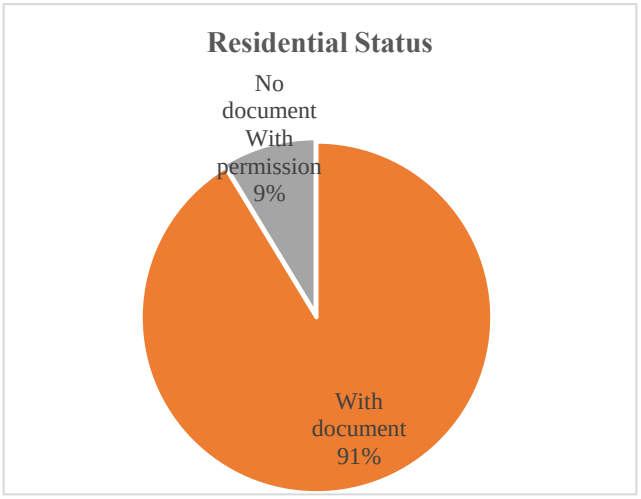


Figure 10.14: Residential Status

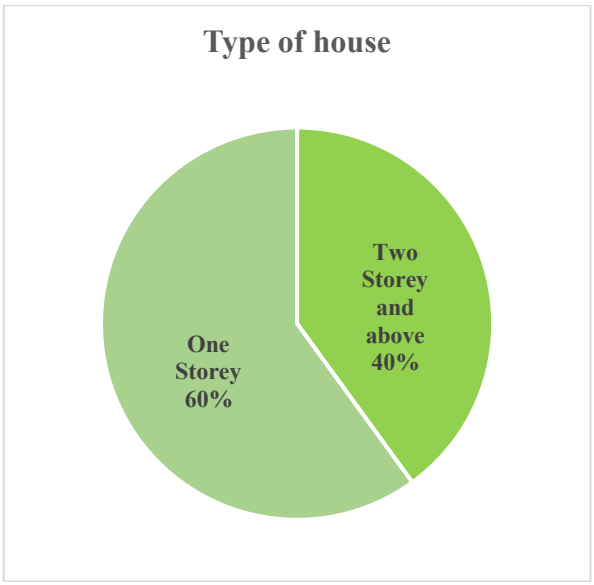


Figure 10.15: Type of House

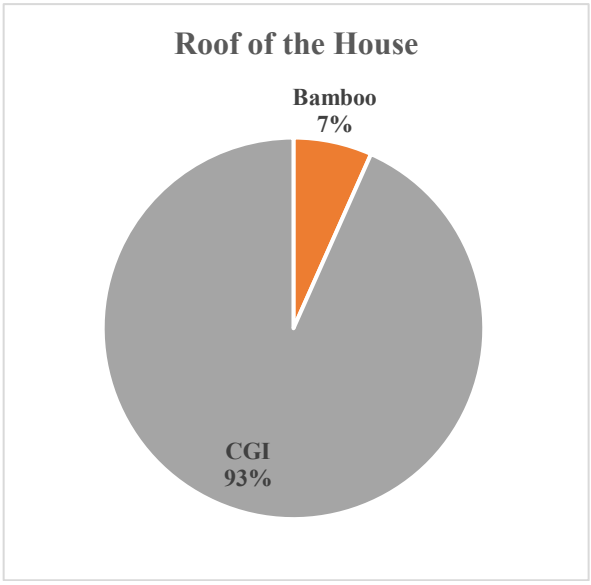


Figure 10.16: Roof of House

(x) Migration

Regarding duration of residence, 86% of local people in this area has been more than 10 years and remaining 14% are the people who live among three to ten years.

Moreover, household member migration and reasons of migration are analyzed and the following figure shows the outcomes of the respondents.

Most of the surveyed household (87%) have no family member who has migrated to different area.

Among other13%, reason of migration for half of migrated people is for jobs.

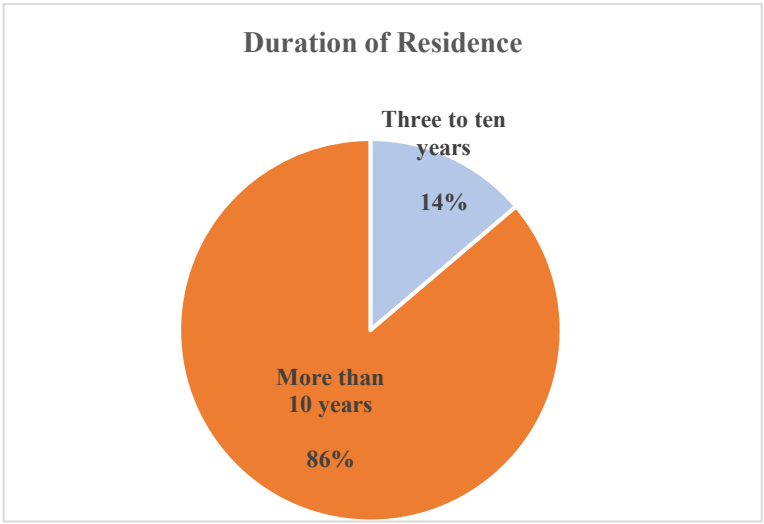


Figure 10.17: Duration of residence

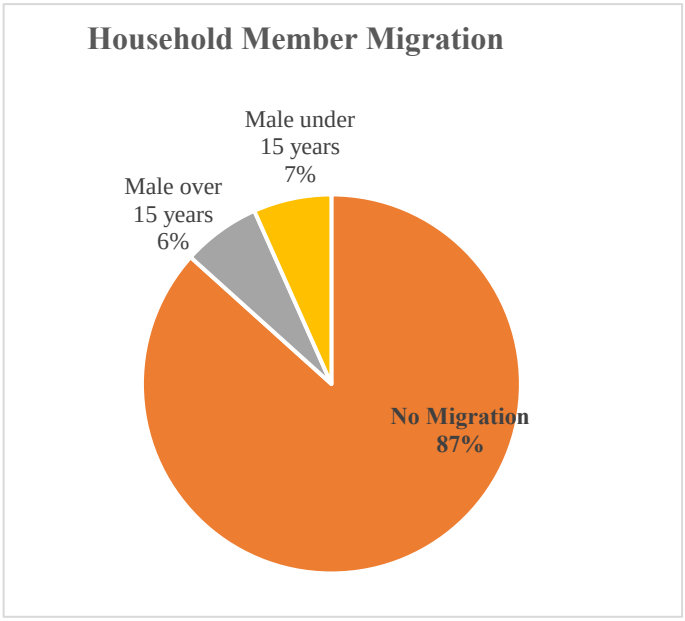


Figure 10.18: Migration

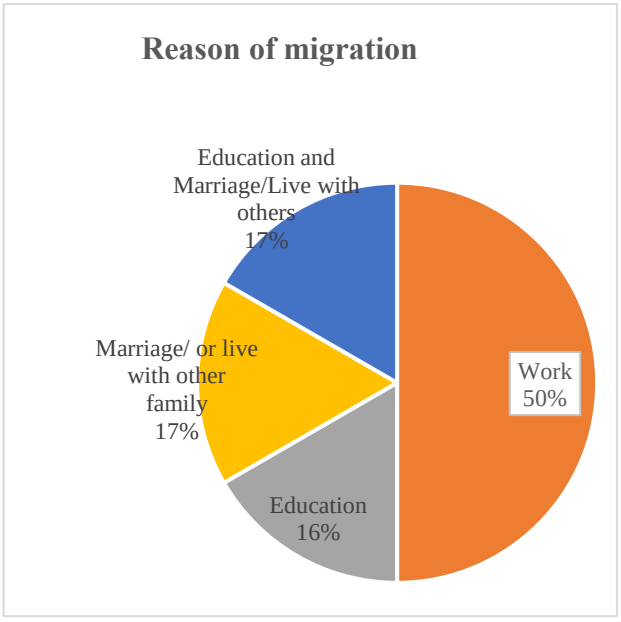


Figure 10.19: Reason of migration

(xi) Health care availability and access to education for household members

The availability of health and education for surveyed households were analyzed. For these different categories, the following figure shows the outcomes of the respondents.

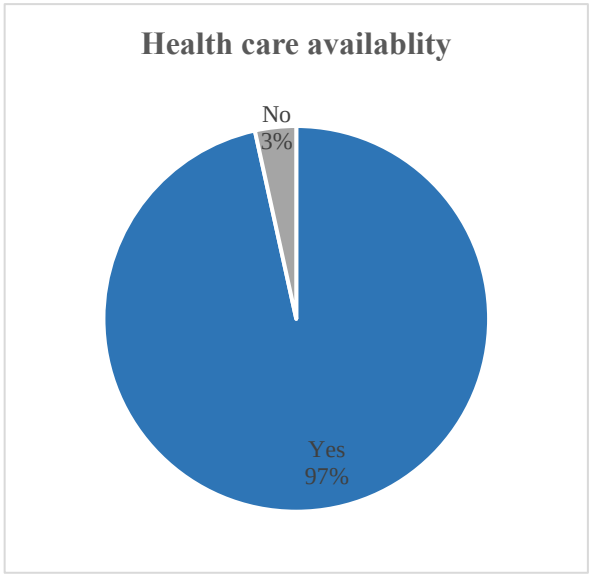


Figure 10.20: Health Care Availability

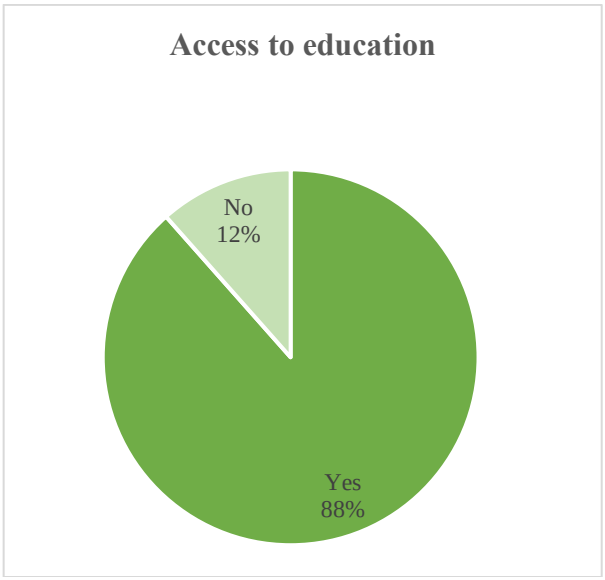


Figure 10.21: Access to Education

(xii) Sources of Lighting

It was observed that the **90%** of the respondents use "***Electricity from National Grid***", **7%** uses "***Solar***" and **3%** uses "***Candle***" for source of lighting.

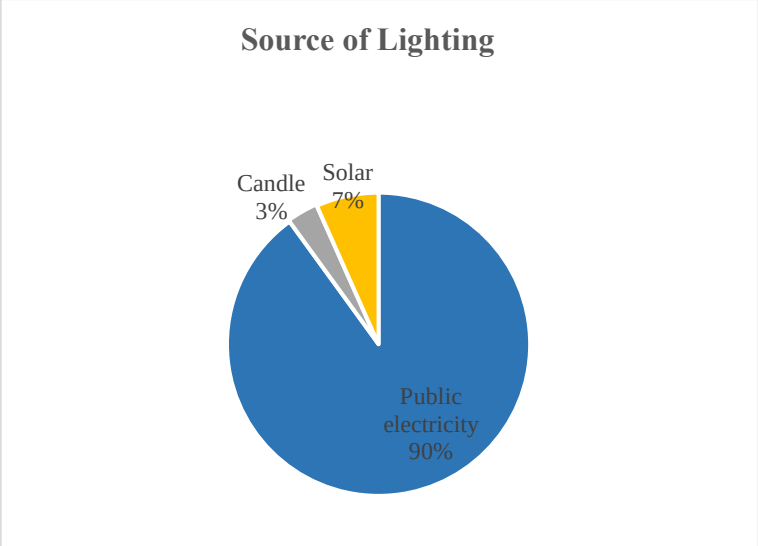


Figure 10.22: Source of Lighting

(xiii) Energy usage in cooking

The survey results showed that the various types of energy are being used for cooking by respondents including "***electricity***" (64%), "***charcoal/fuel wood substitute***" (23%), "***firewood***" (3%) and other uses combination of "***electricity and charcoal***" (7%), and "***charcoal with firewood***" (3%).

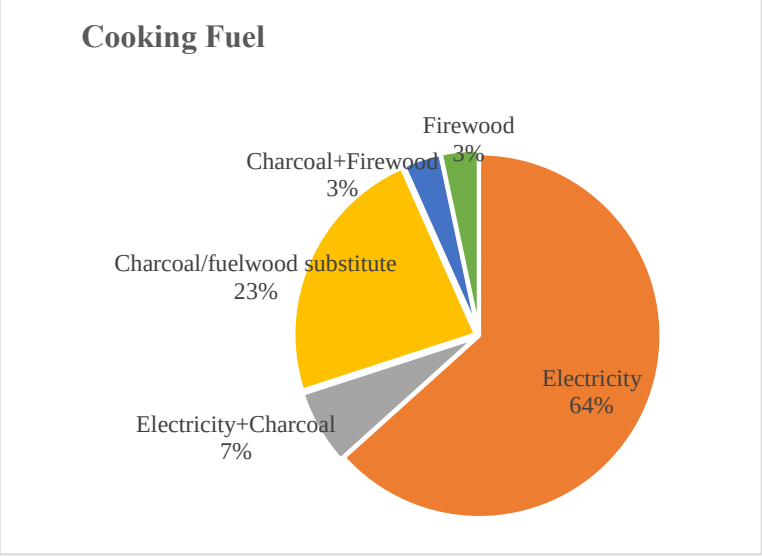


Figure 10.23: Energy used for cooking

(xiv) Different sources of drinking water

Concerning drinking water availability, most households (96%) gets from perennial source and only 4% gets from seasonal sources.

For sources of drinking water, 81% of respondents obtain from "***deep well***", 7% from "***tube well***", 4% from "***protected dug well***" and other persons gets water from combination of sources

i.e., 4% from "***both deep well and tube well***", and another 4% from "***both deep well and river water***".

It is observed that distance of drinking water source is "***household level***" for 63% of respondents and 24% has access to "***¼ mile***" followed by 7% from "***more than one mile***" and 4% "***within one mile***".

Regarding quality of water, most surveyed respondents (96%) answered that the water is good while other 4% responded for "***Hard water***".

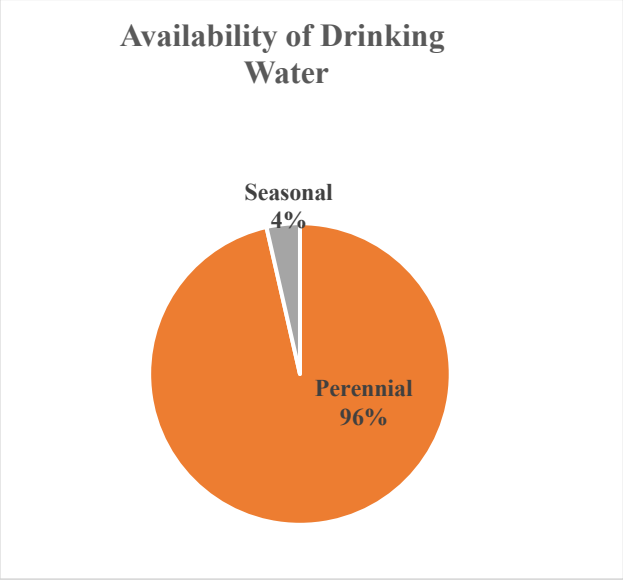


Figure 10.24: Availability of drinking water

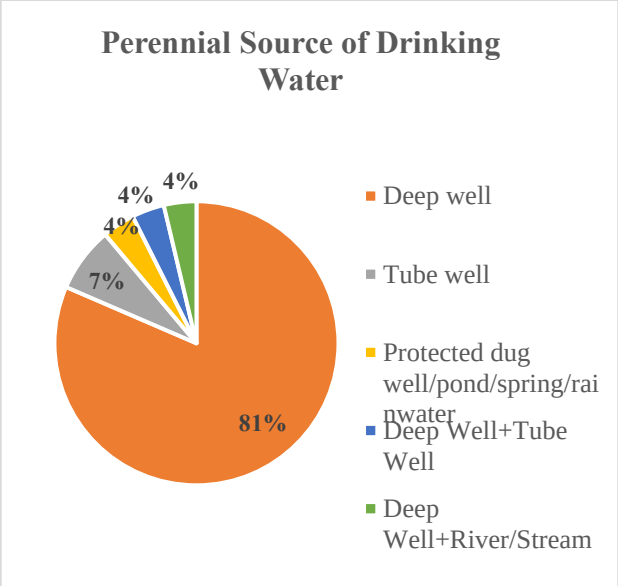


Figure 10.25: Perennial source of drinking water

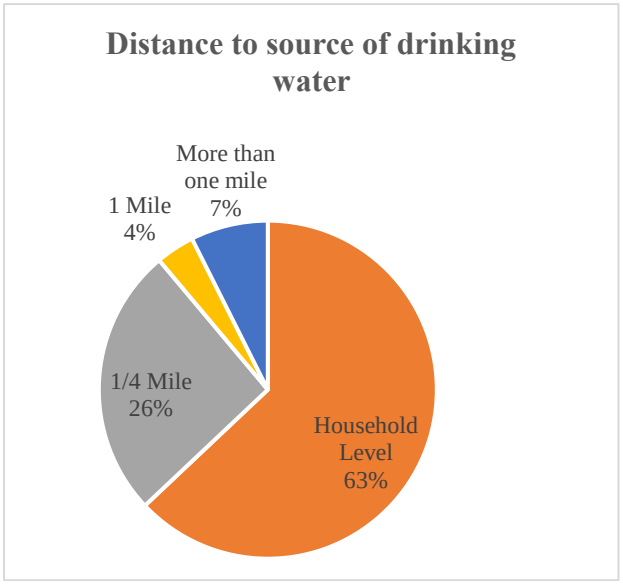


Figure 10.26: Distance to source of drinking water

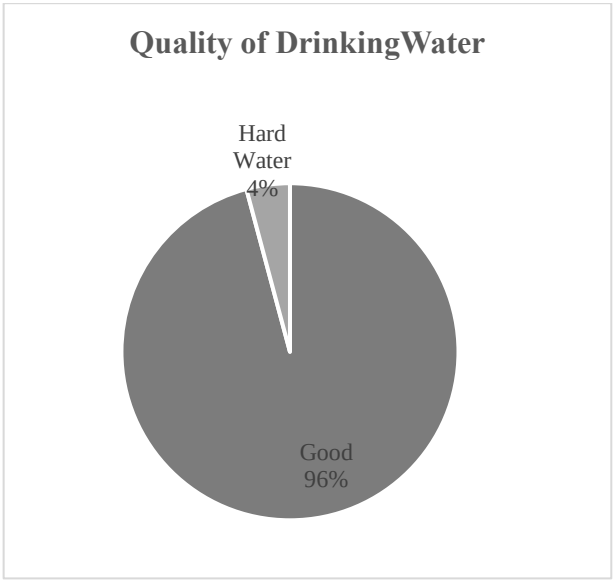


Figure 10.27: Quality of drinking water

(xv) Drinking water disinfection

Among the outcomes of the respondents, all of them treated drinking water and the following figure showed that the various types of making water safe to drink including 50% for "***Boiling***", 23% for "***Sedimentation***", 17% for "***Purified water***", 7% for "***Chlorination***" and other 3% for both method "***Sedimentation + Boiling***".

Moreover, 86% of respondents said that the quality of water has not changed while 14% of them answered that the quality has changed.

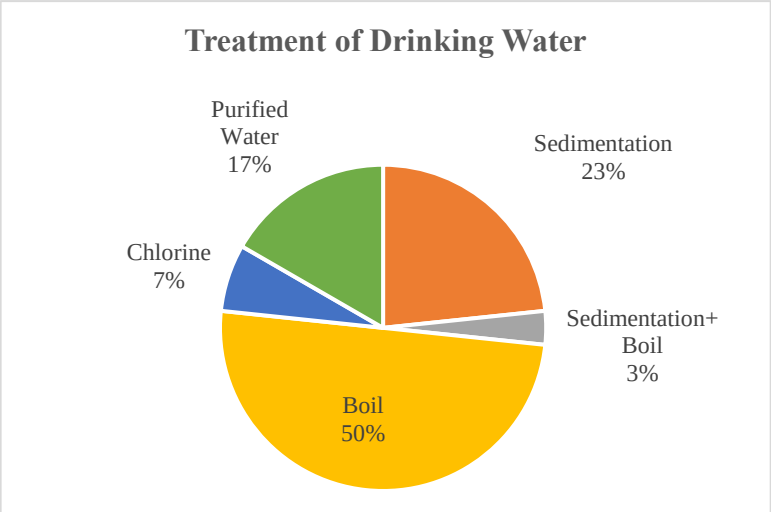


Figure 10.28: Treatment of drinking water

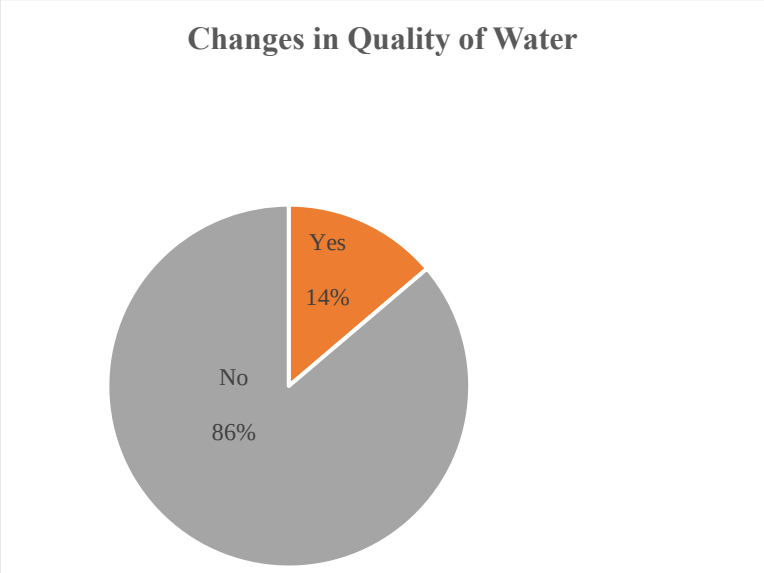


Figure 10.29: Changes in quality of water

(xvi) Type of Latrine

Regarding to type of latrine, there are 89% of respondents used "***Pour Flush Latrine***" and only 11% used "***Flush Latrine***".

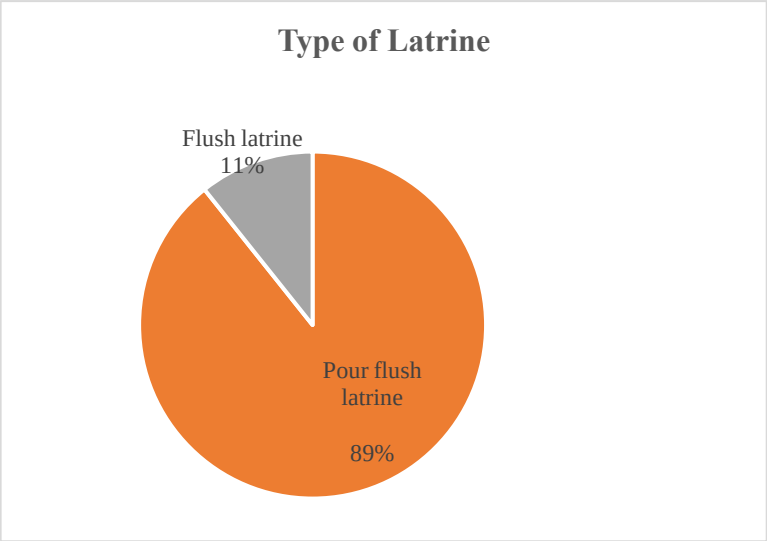


Figure 10.30: Type of Latrine

(xvii) Waste Collection and Disposal

The study has identified the "Waste Collection and Disposal method" in the surrounding community of the project. It was found out that majority is practicing open waste burning.
The following figure shows the method used for waste disposal in current.

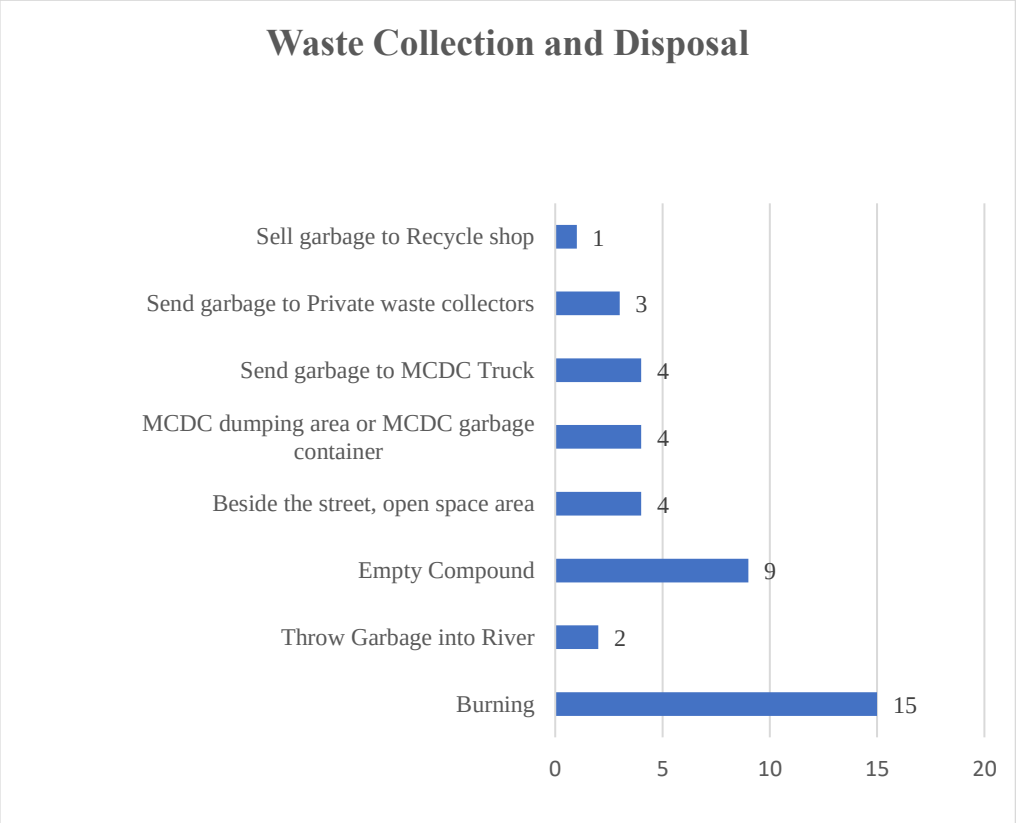


Figure 10.31: Waste Collection and Disposal

(xviii) Internet Usage and Communication

Concerning online communication, 87% of respondents are using internet and communicate with each other.

"Facebook" application is most common (96%) among them including 14% of those respondents who use both application which are "***Facebook and Viber***".

It is observed that only 11% of respondents can use internet "***Very well***", 58% can use it "***Well***" and 11% can use "***Just a little***".

Regarding communication about project activities and project information via Facebook application, 76% said that it is available to do so while 14% answered that they cannot be connected via Facebook.

Among surveyed respondents, 10% stated that communication via Facebook application can be possible if the technology how to communicate via that application is explained by a family member.

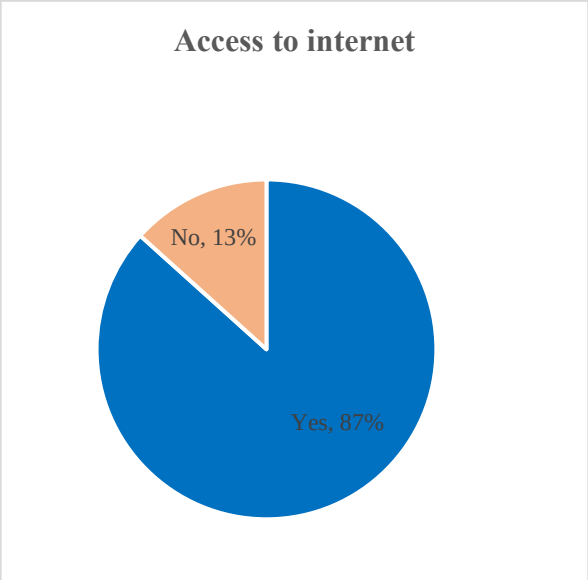


Figure 10.32: Access to internet

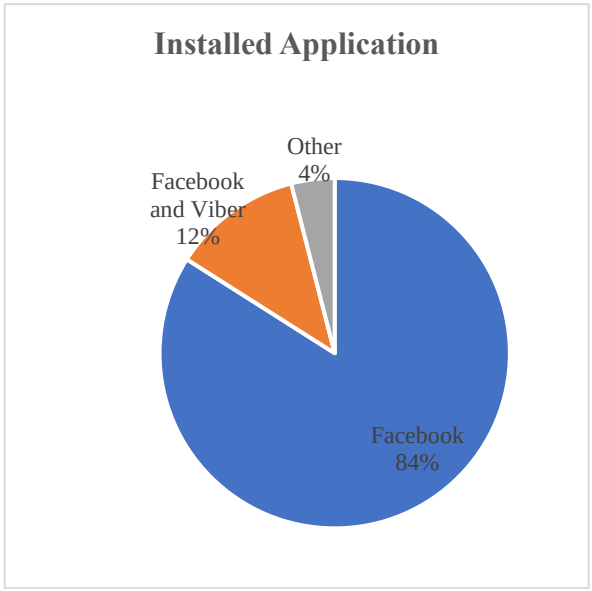


Figure 10.33: Installed Application

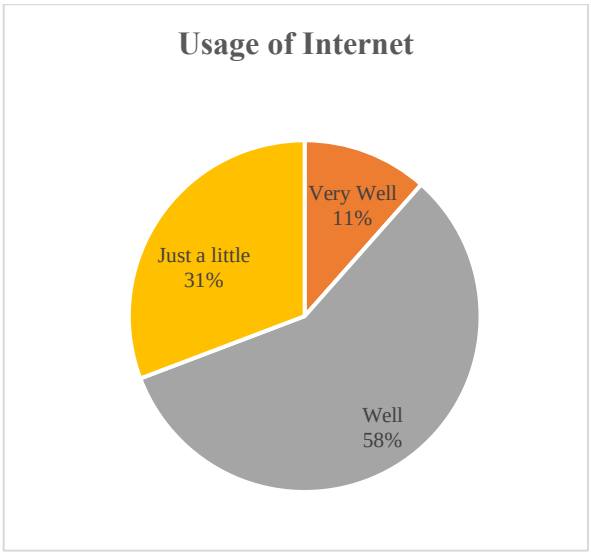


Figure 10.34: Usage of internet

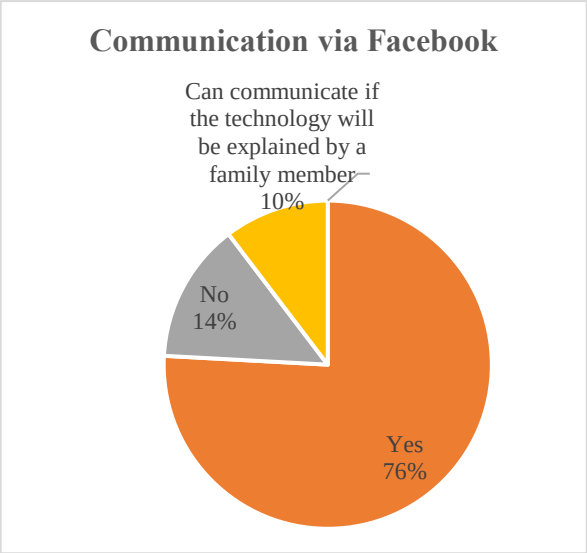


Figure 10.35: Availability for communication via Facebook

(xix) Cultural aspect

The important decisions in the community are made by the village leader.

There are 90% of respondents who answered religious sites around proposed project and 79% said that those sites are adequately protected.

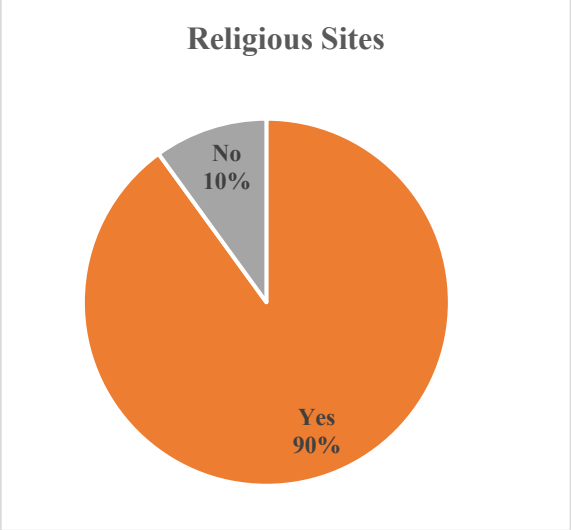


Figure 10.36: Historic sites around project area

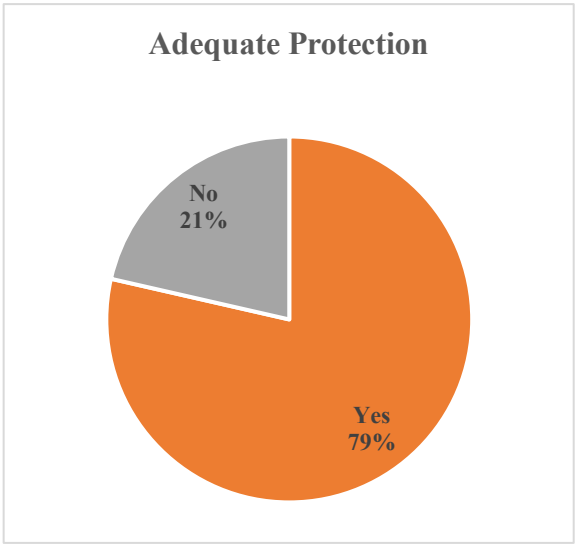


Figure 10.37: Protection of Historic sites

(xx) Air quality and climate changes

The study has identified the environmental changes of the surrounding area of the proposed project.

Most respondents (57%) answered that air quality is not changed while 39% thinks that it is improved and 4% stated that air quality is declined.

Among the respondents, 75% of stakeholders said that the weather is more warming, 4% said cooler and the remaining 21% said that the weather condition is not changed.

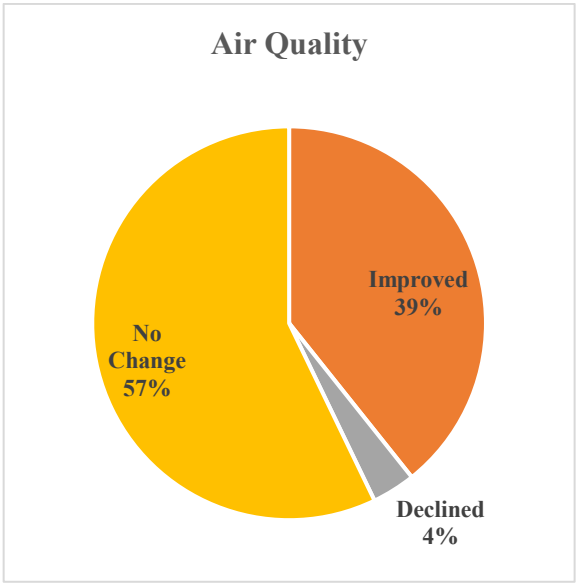


Figure 10.38: Attitude about air quality

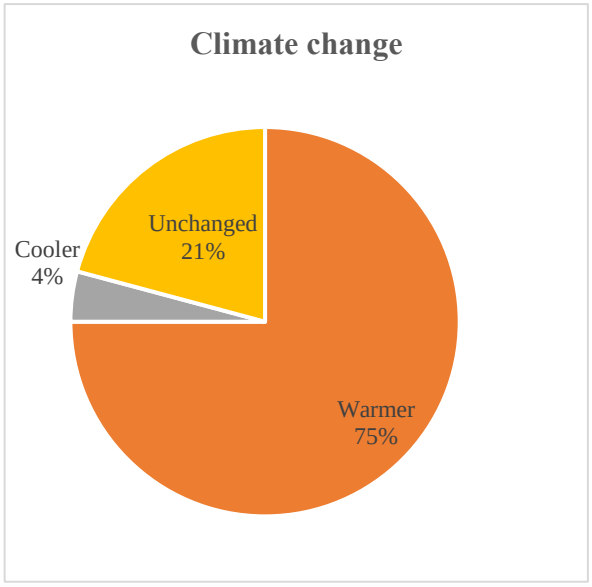


Figure 10.39: Attitude about climate change

(xxi) Awareness on the proposed project

The chart represents the data about the awareness of the local people about the proposed project. There are 38% of respondents do not know about the project and 62% of the total households know a little.

Regarding obtaining information about the project, currently, (46%) of respondents from "***Government Agencies***", 27% from "***Family members and Friends***", 23% from "***Community Leaders***" while 4% is still unaware about the project.

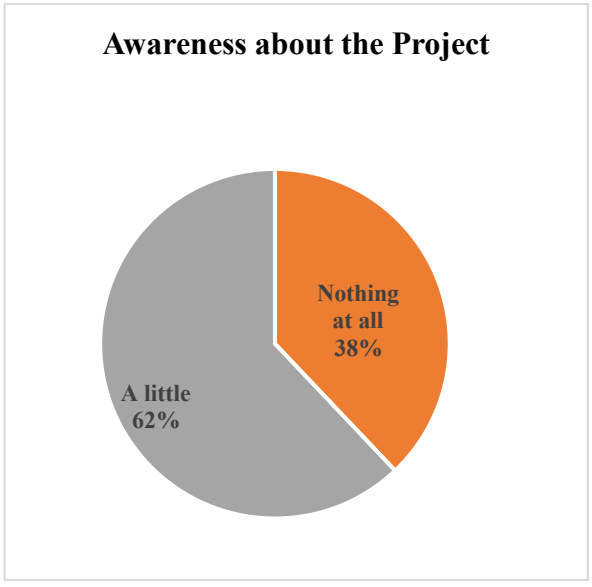


Figure 10.40: Awareness of the project

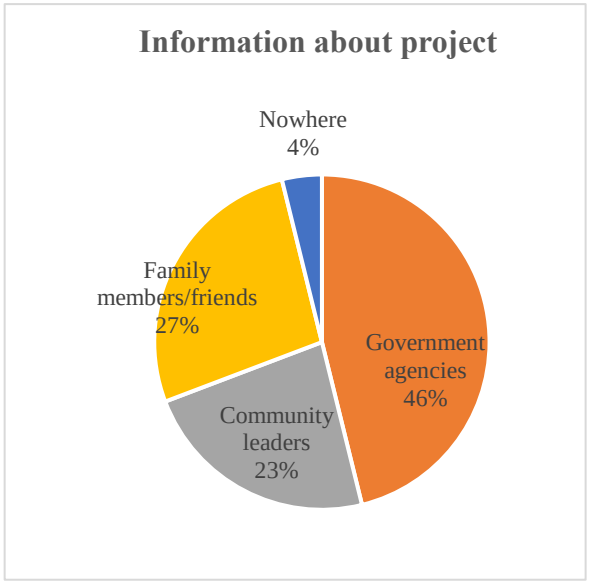


Figure 10.41: Source of information about the project

(xxii) Perception on the importance of project

It is found out that 60% of respondents mentioned that Kyar Ni Kan Landfill Gas to Energy Project is "***Important***" and 8% stated that the project is "***Very important***", but 16% mentioned that it is "***Not important***" for the community.

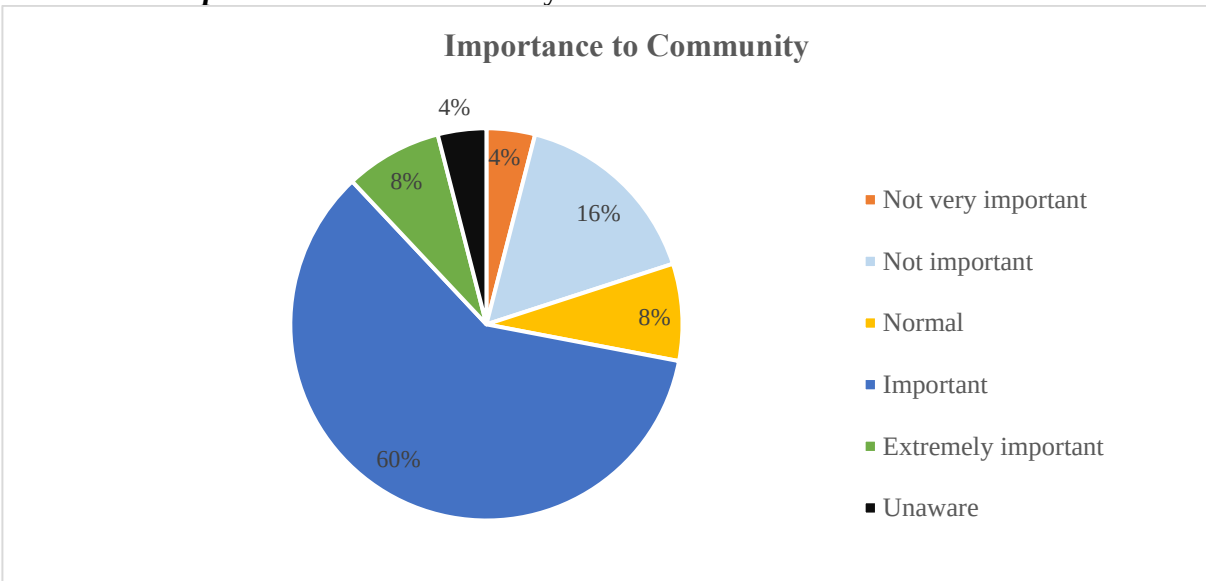


Figure 10.42: Importance to community by the project

(xxiii) Experience of the previous projects

Regarding previous projects among community, 71% mentioned that they did not experience any project while 17% have experience of road/railway and 12% for bridge project.

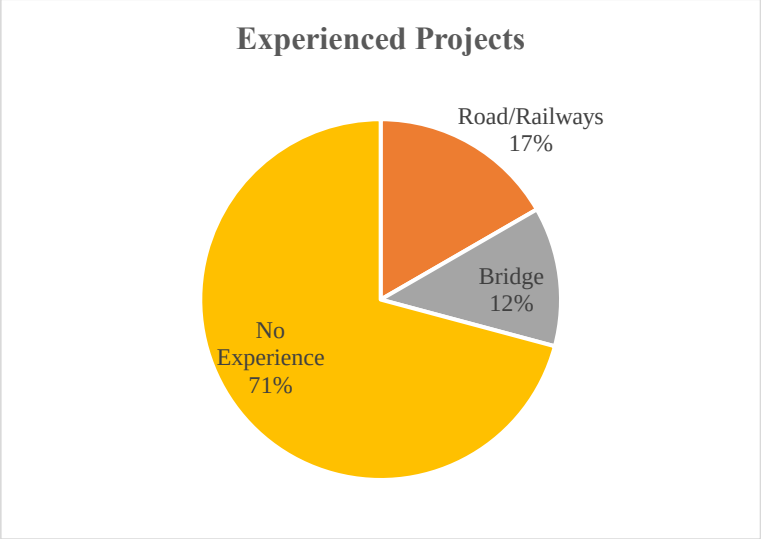


Figure 10.43: Experiences of previous projects

(xxiv)Attitude about positive and negative groups

The following chart shows the respondents' attitudes of the impact on community caused by the previous projects. Among the total households, 69% of respondents said that there is positive impact on the environment by those projects. However, 6% of the households said that they have some negative impacts. Then, up to 25% of respondents mentioned that there is neither positive nor negative impact on the environment.

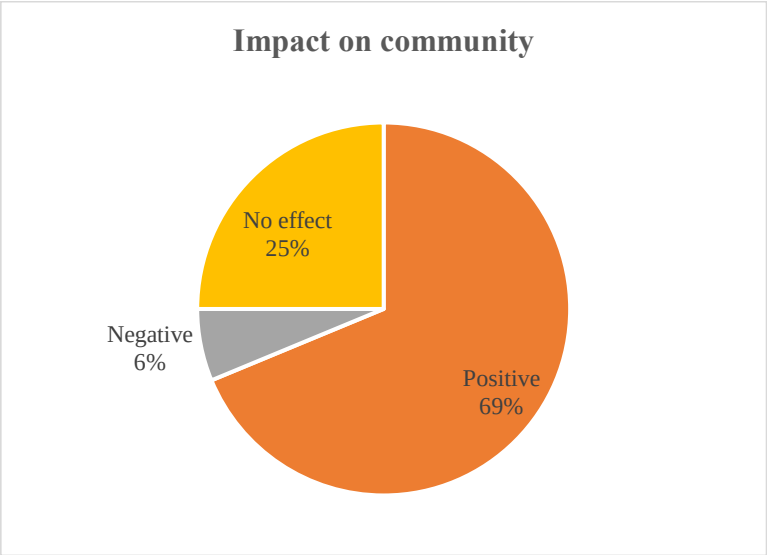


Figure 10.44: Impact on community by previous projects

The following chart shows the respondents' attitudes on vulnerable groups concerning positive and negative impacts by the proposed project.

It is observed that majority of respondents (64%) are not worried about negative impacts on "**Specific groups or categories of people**" by the proposed project.

However, 5% of surveyed respondents is worried about negative impacts on "***Unskilled workers***", other 5% is worried for "***Ethnic minorities***", 4% is worried for "***Women***" and another 4% is worried about negative impacts on "***Children***". Remaining 18% chooses "***Other groups***" which were not listed in the survey.

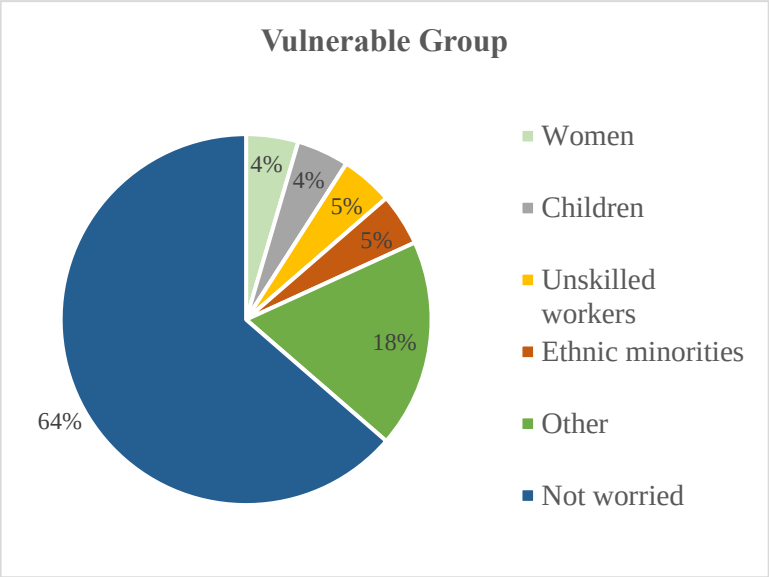


Figure 10.45: Vulnerable groups

(xxv) Community's perception on positive Impacts

The following figure shows the community's perception on development and improvement of the community due to the existence of the proposed project. Among the total households, 39% of respondents is unaware about the positive impacts by the proposed project and 38% stated improved environment, 21% for increased employment and 4% mentioned about the combined positive outcomes.

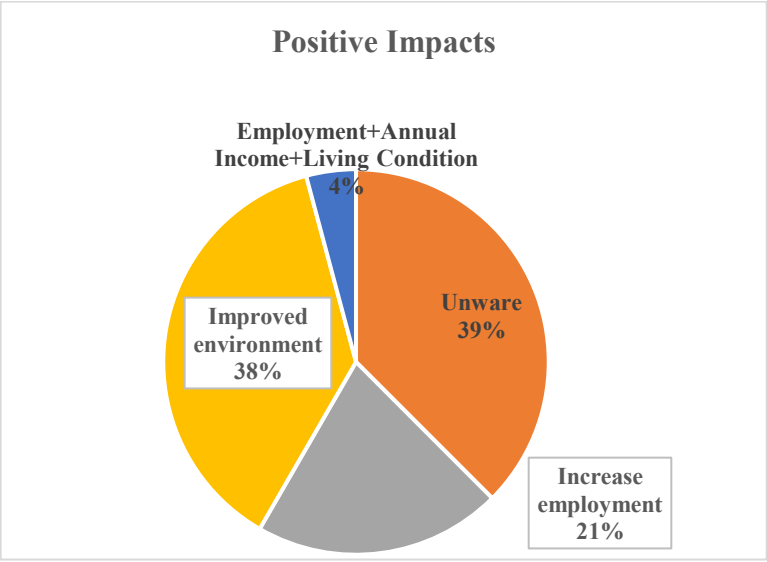


Figure 10.46: Attitude about positive impacts by proposed project

(xxvi) Community's perception on negative impacts

The following figure shows the negative impacts of the community due to the existence of the proposed project.

Majority (82%) responded that there is no negative impacts by the project. 5% pointed the negative impact on increased cost due to impact on environment and health while 4% are on health negative impact.

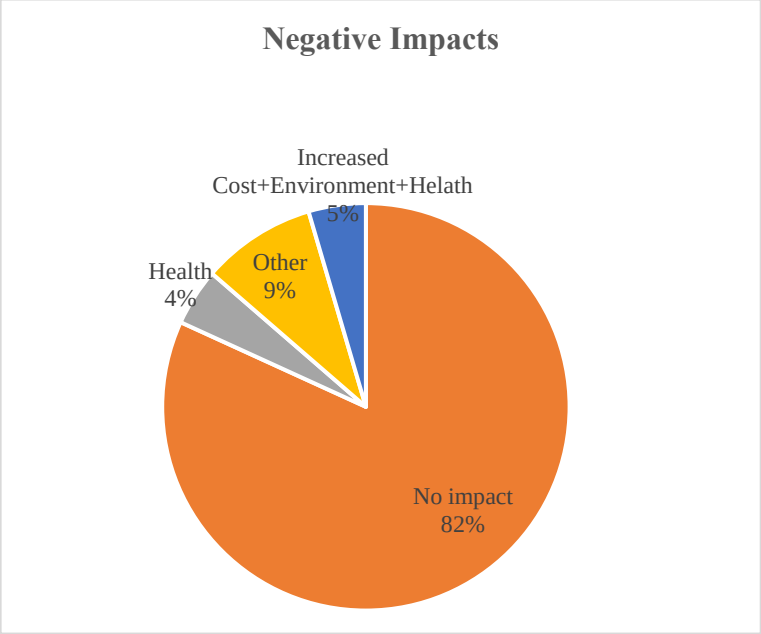


Figure 10.47: Attitude about negative impacts by proposed project

(xxvii) Priotization for improvement of community

The following figure shows the priority development which are desired by the surveyed community in Kyar Ni Kan. Majority of respondants metioned about improvement of "***education sector***" (75%) as first priority, "***solid waste disposal***" (25%) as second priority, and improvement for "***transportaion***" (41%) followed by "***employment opportunities***" (36%) as third priority.

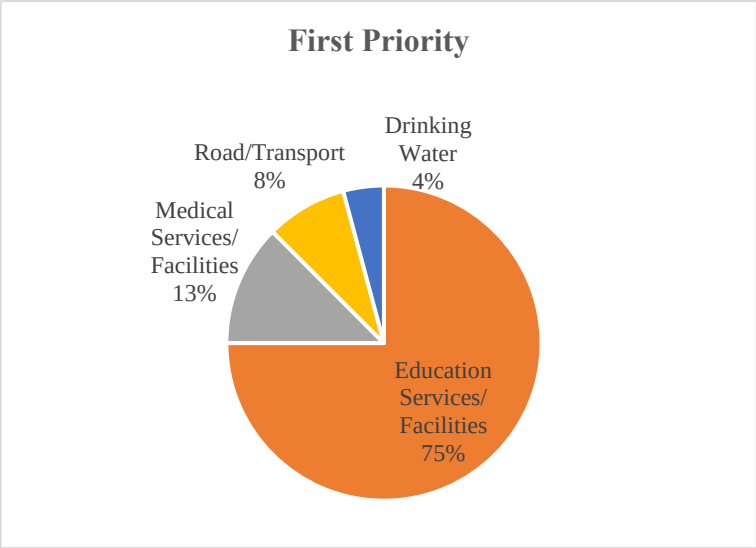


Figure 10.48: First priority for community development

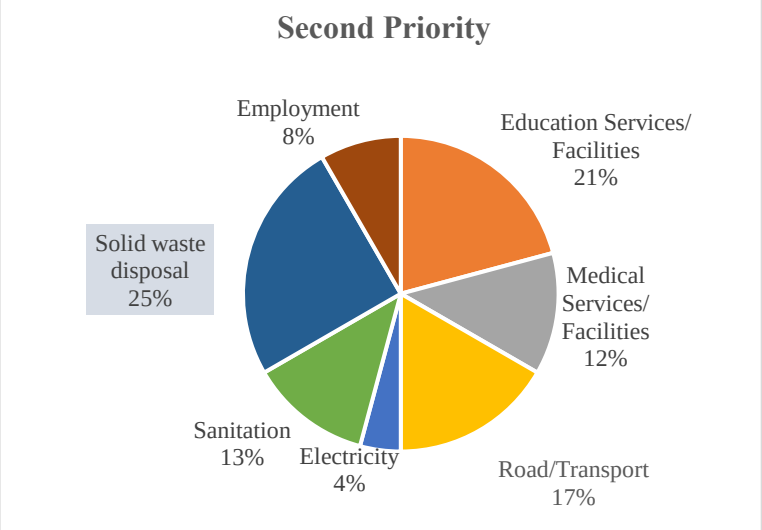


Figure 10.49: Second priority for community development

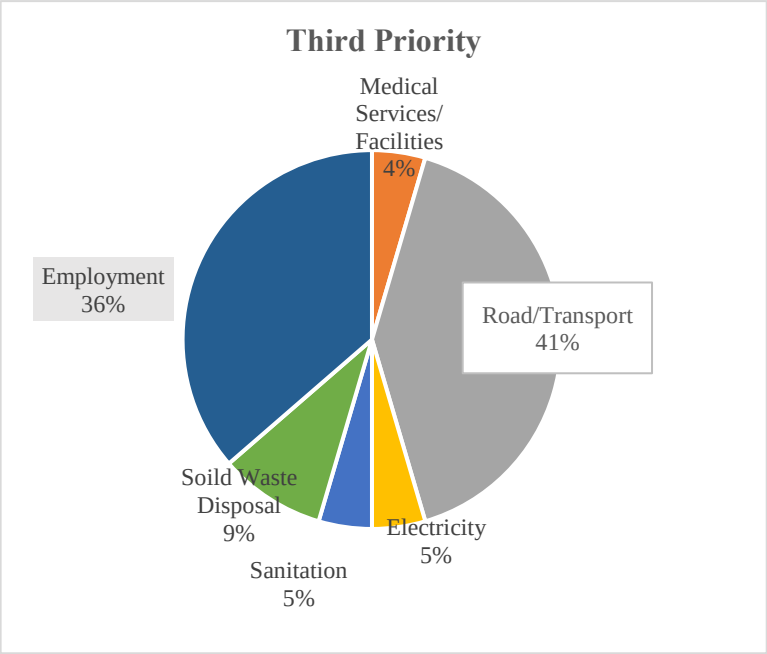


Figure 10.50: Third priority for community development

(xxviii) Agricultural sector, livestock and fishing

The following figure shows the local community's current economic activities and the effect by Kyar Ni Kan landfill site.
Regarding farming activities, majority of them (71%) possess own farmlands.

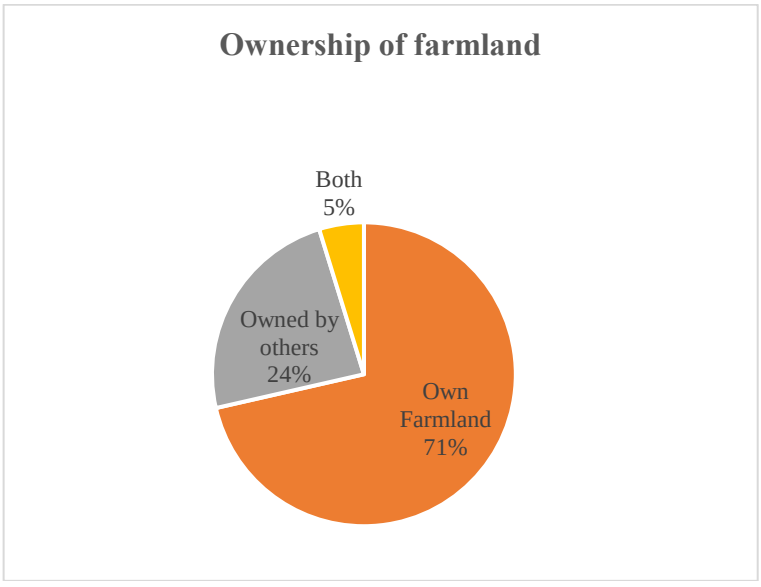


Figure 10.51: Ownership of farmland

(xxix) Type of agricultural land and main crops

Majority of lands (86%) are "***crop land***" and other (14%) is for "***perennial plantation***".

Rice (95%) is the most common crop, grown in the community and other 5% is growing "***vegetable***".

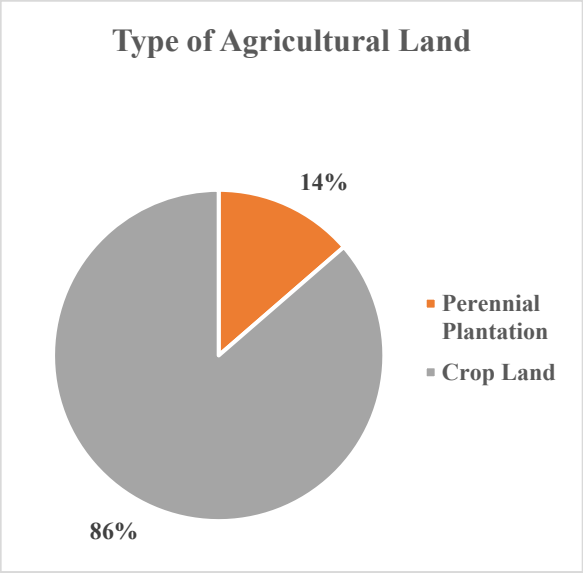


Figure 10.52: Type of agricultural land

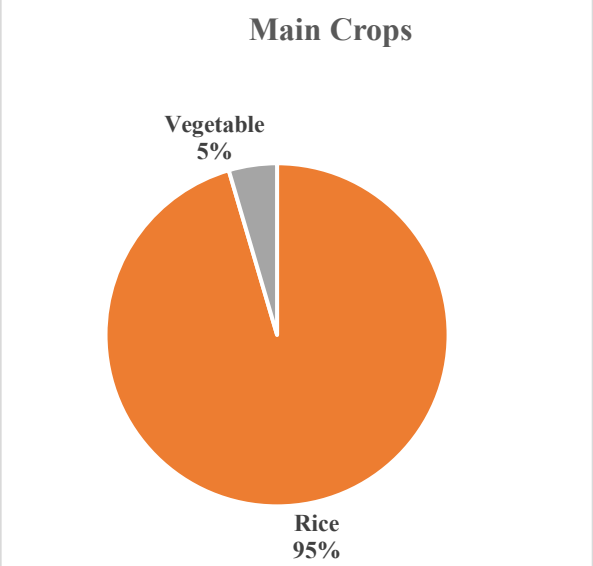


Figure 10.53: Main Crops

(xxx) Previous land acquisition

There is no experience for previous land acquisition in 83% of surveyed respondents.

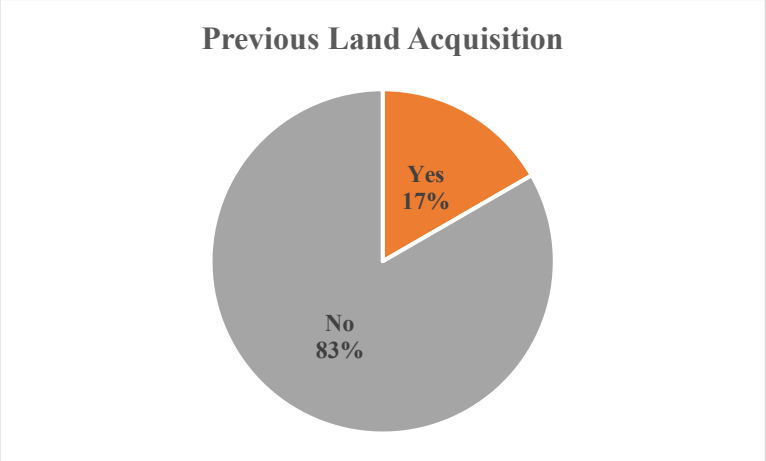


Figure 10.54: Previous land acquisition

(xxxi)The effect of current landfill site on agricultural sector

Regarding productivity and quality of rice before and after landfill site, most of them, majority (75%) and (80%) respectively, answered that there would not be any impact on productivity as well as quality.

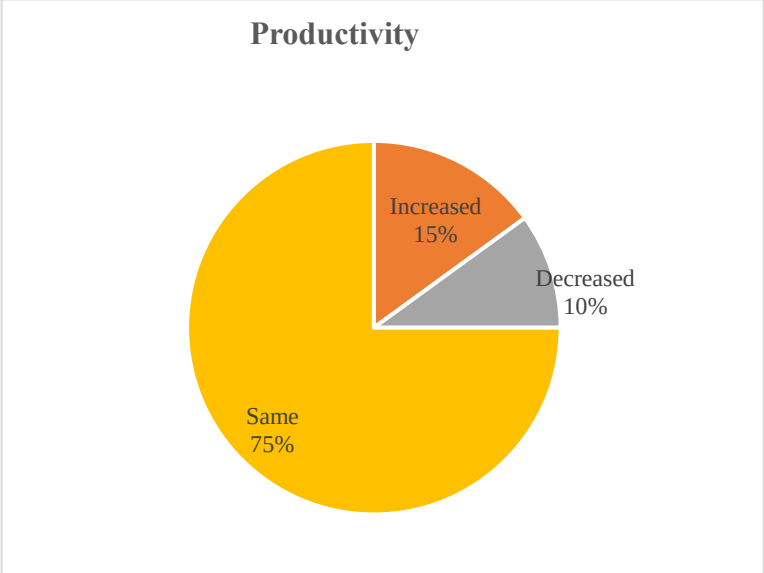


Figure 10.55: Attitude about changes in productivity

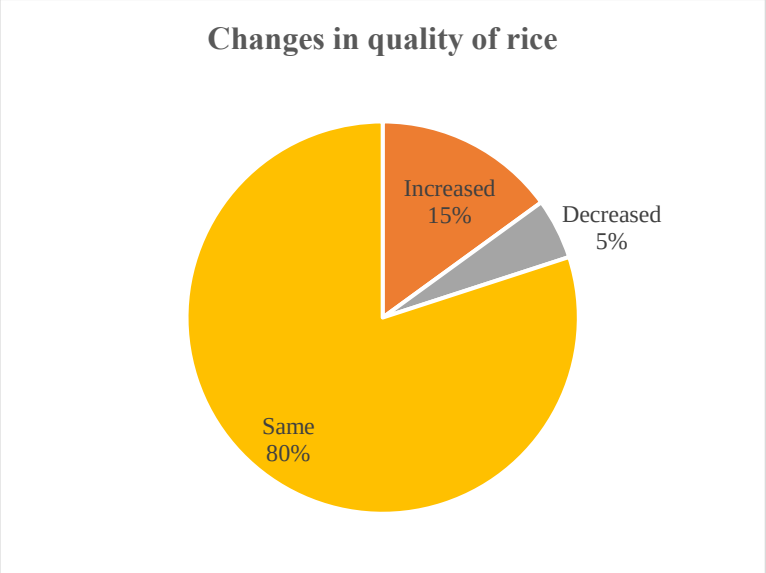


Figure 10.56: Attitude about changes in quality of rice

(xxxii) Livestock breeding and Fishing

It is observed that 70% of respondents breed animals and "***cow***" (60%) is most common animal for breeding in the community which is followed by "***poultry***" (20%) and "***pig***" (15%). Majority of respondents breed animals for selling (80%) and other 20% is for using in agriculture.

According to the surveyed respondents, there is no fisherman in the household.

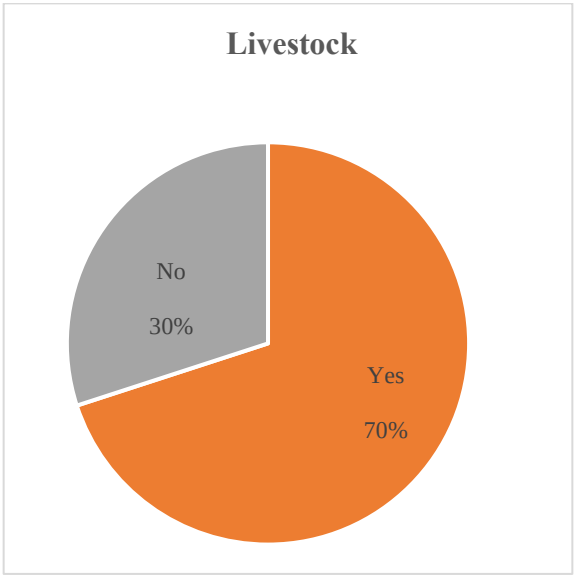


Figure 10.57: Livestock breeding

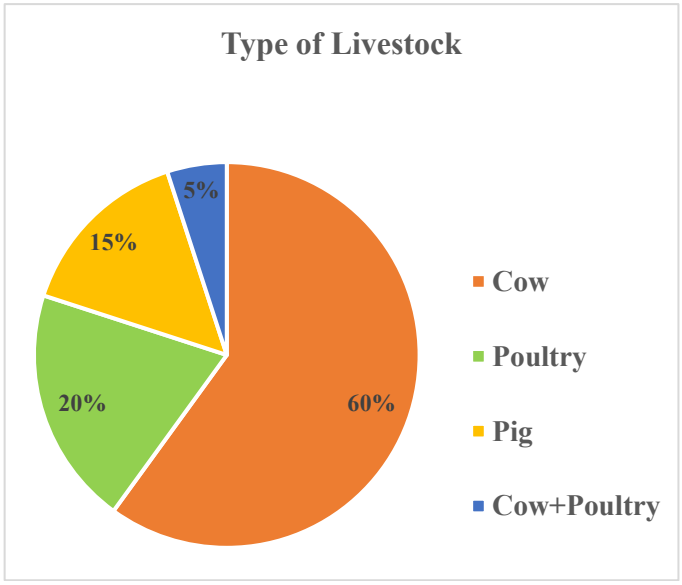


Figure 10.58: Type of Livestock

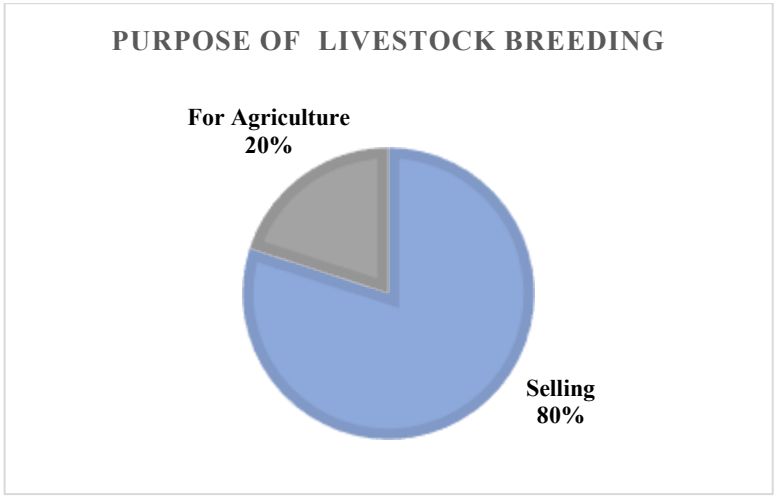


Figure 10.59: Purpose of Livestock breeding

(xxxiii) Social groups in the community

Concerning social groups in the community, there are "***Saving and loan association***" and "***Youth group***" which has total strength of 6 persons and 15 persons respectively.

(xxxiv) Perception on the development of the project

Looking at the attitudes of the respondents towards the development of the project, 76% of the respondents said that they agree with the development of the project , 4% of the households do not agree whereas 20% are not sure for the development of the project.

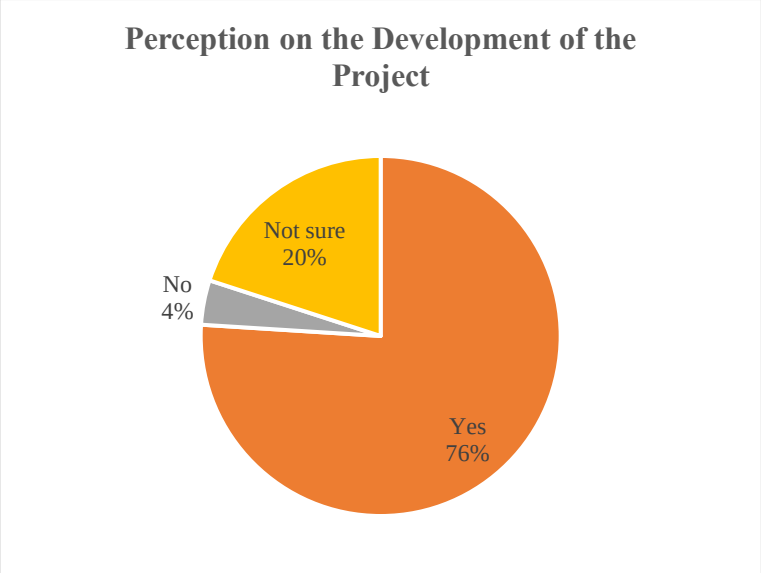


Figure 10.60: Perception on development of the project

(xxxv) Perception on the socio-economic impacts by the project

1. The effect on physical resources

Regarding the effect on physical resources including soil quality, surface water quality, ground water quality, air quality and noise, the following figure shows the outcomes of the respondents. It is found out that most resources have no negative effect due to the proposed project activities.

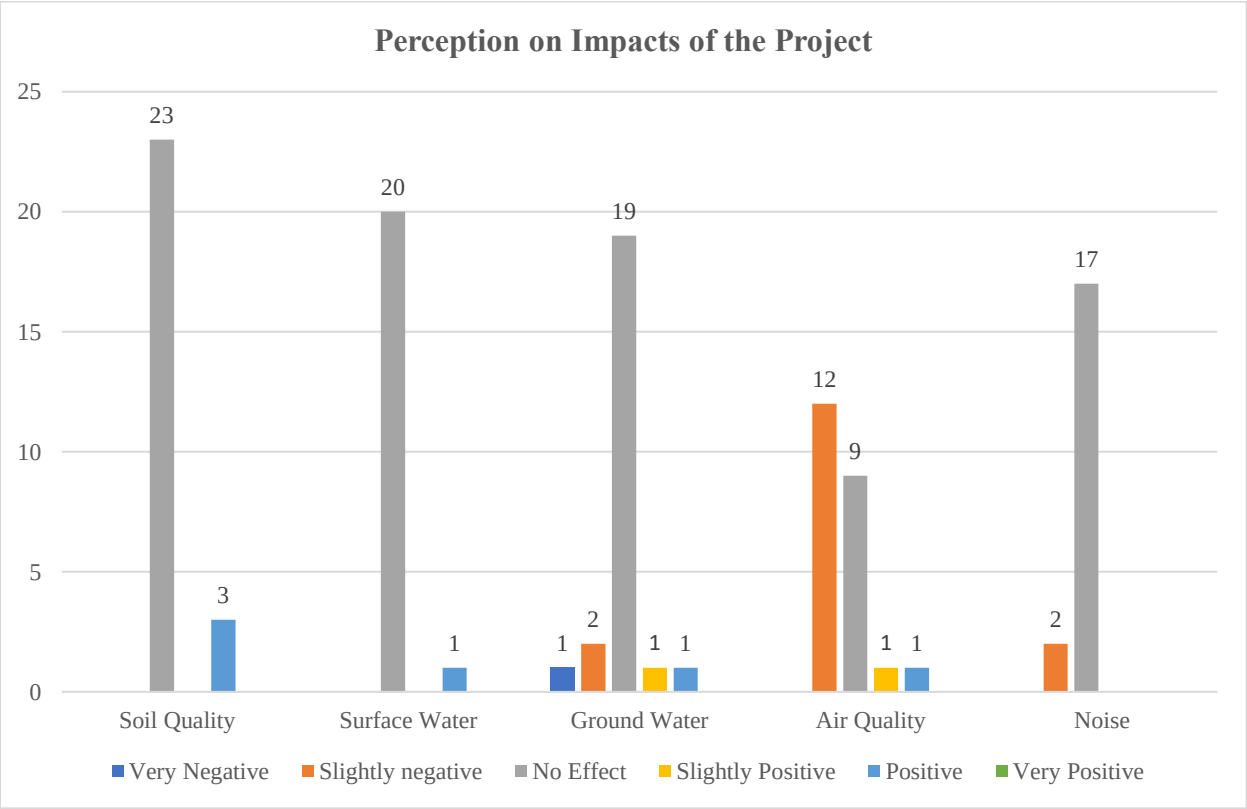


Figure 10.61: Perception on environmental impacts by the project

2. The effect on biological resources

In summary, the following figure presented the community perception on effect of the project development on biological resources especially forestry, agriculture, local animals, pasture and aquatic animals. There is no negative effect on aquatic animals and but some effect on local animals.

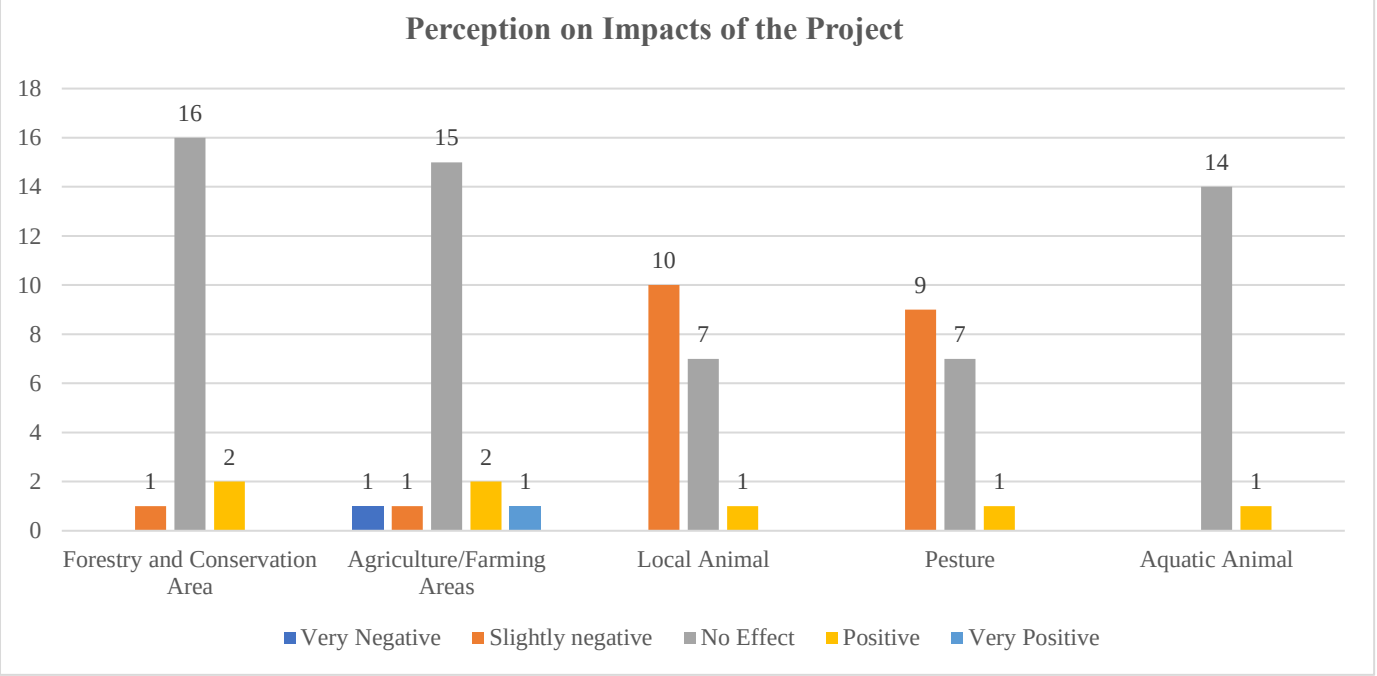


Figure 10.62: Perception on biological impacts by the project

3. The effect on human use

The following figure shows the effect on human use including local fisheries, local livestock, local vegetation, local industry, local transportation, local price, recreation and local economy.

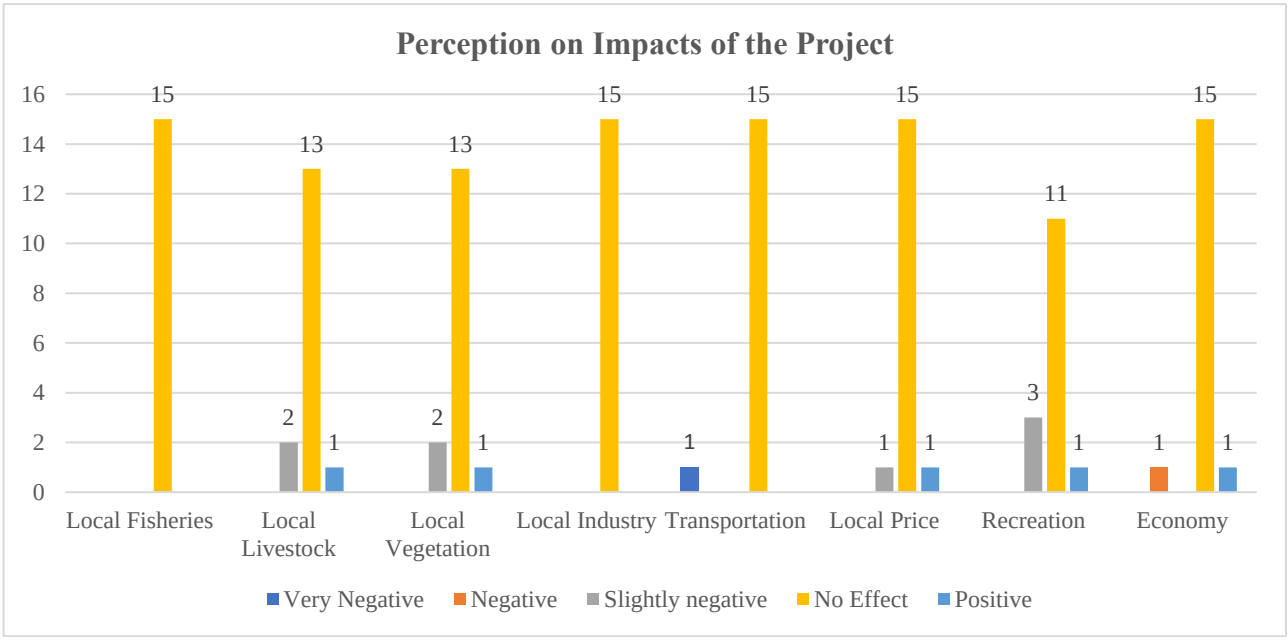


Figure 10.63: Perception on impacts on human use by the project

4. Effect on the quality of life

The quality of life is also considered as the main issue in the social impact assessment. In this regard, there are different categories divided for the analysis of the quality of life as shown in the following figure. According the survey, there is no significant negative effect on the quality of life.

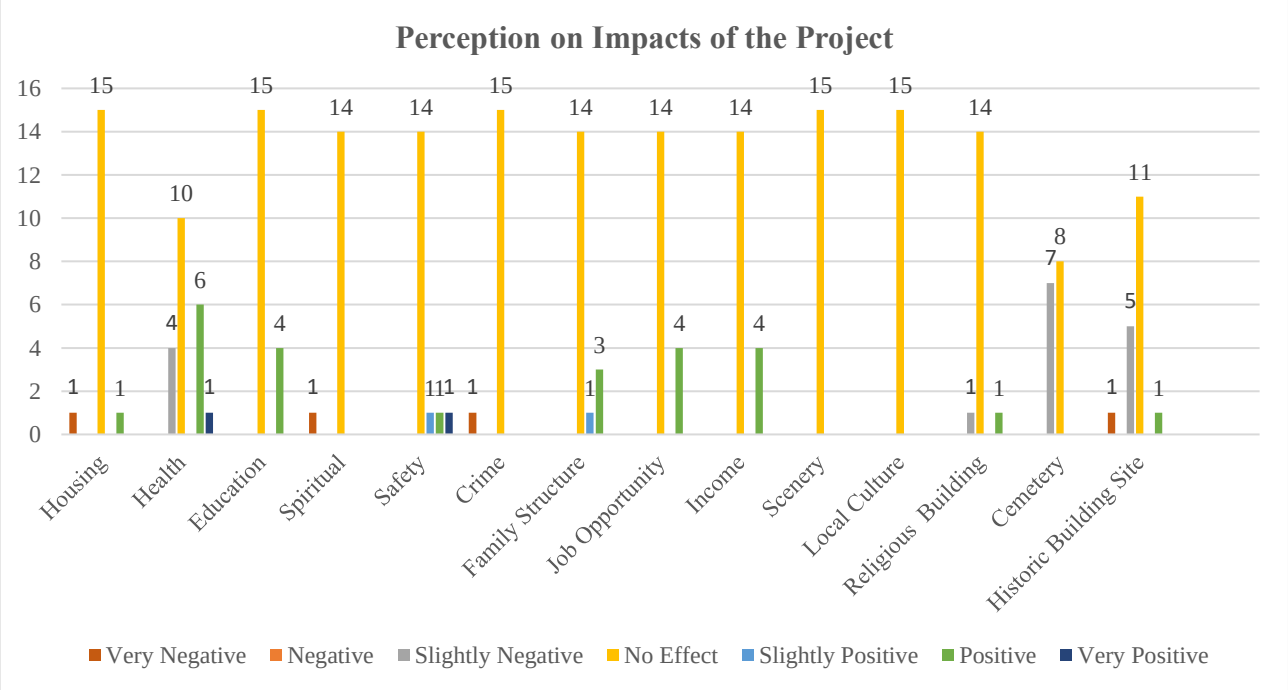


Figure 10.64: Perception on impact of the quality of life

5. Effect on cultural heritage

The effect on cultural heritage is also considered as a common factor for the impact by the

industry. In the issue of the cultural heritage, the main three different parameters including religious building, cemetery and historical buildings were analyzed. The figure shows the community perception on the cultural heritage and impact by the proposed project landfill gas recover project. It was found out that mostly has no negative effect.

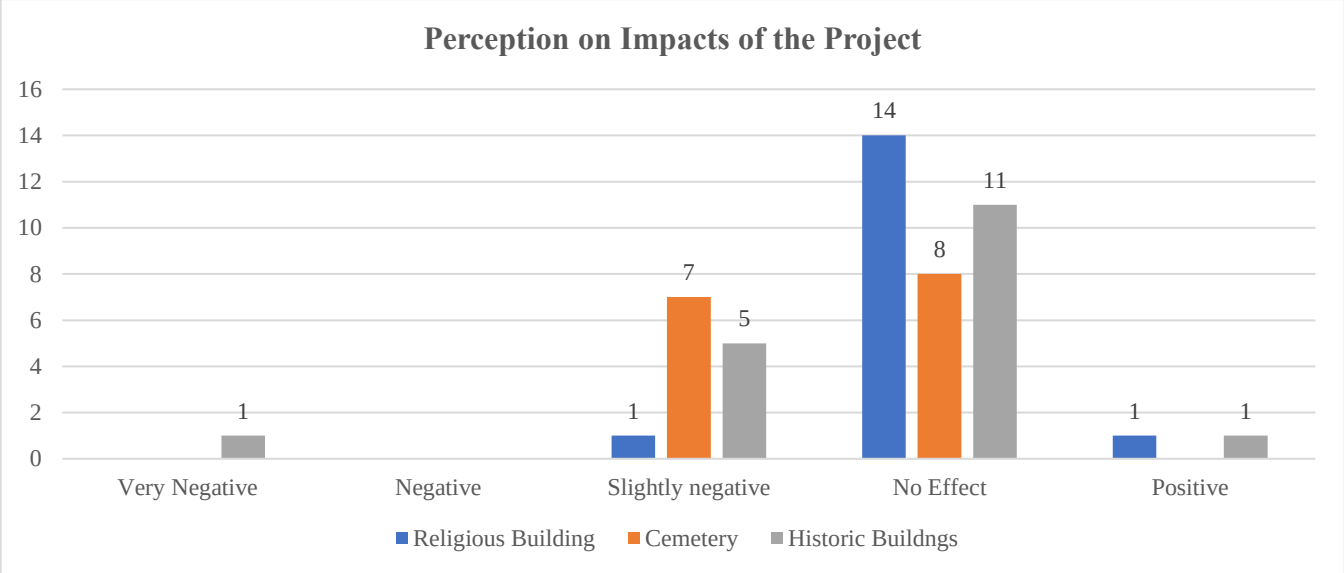


Figure 10.65: Perception on impact of cultural heritage

10.5 Socio-Economic Surveys on nearest community relying on the landfill site for their income

10.5.1 Socio-Demographic of the community

(i) Distribution of population responding questionnaires

Concerning nearest community living at the landfill site, 10 respondents were randomly selected and questionnaires were given. Among the survey respondents, 70% is male and remaining 30% is female. Most respondents comprised of head of households and housewives. According to the results, almost all household members are Buddhist.

The ethic occupied by the population lived around the proposed project is Burma. The family size of the respective household member is within the range of 3 to 5 numbers.

Regarding vulnerable persons in family, all selected households for the survey do not have a family member who is over 65 years of age and disabled person above 16 years old. However, there is one disabled person, under 16 years old, in a household.

(ii)Occupation status

According to the result, all respondents are "***Casual workers***" at the current Kyar Ni Kan landfill site.

(iii)Income level

The annual income of households was assessed through the survey of household's characteristics.

In the figure below shows the percentage of annual income level in the community.

The majority (70%) is between 2,000,000 to 3,000,000 kyats per year.

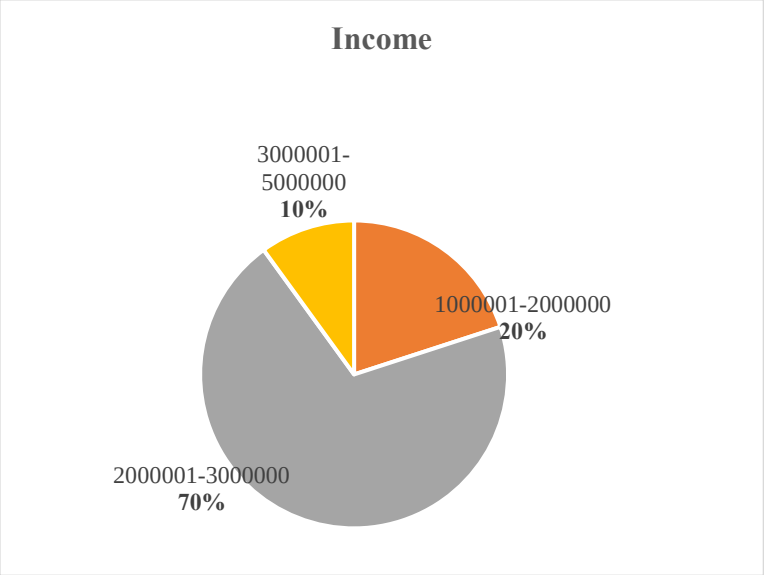


Figure 10.66: Percentage of income level at community

(iv)Education

It is observed that 50% of respondents have "***Monastic education***", 40% have "***Primary school***" education level and 10% have "***Never attended a school***".

For Highest education level in family, most households (40%) have "***Primary school***" education level followed by "***Middle school***" Level (30%).

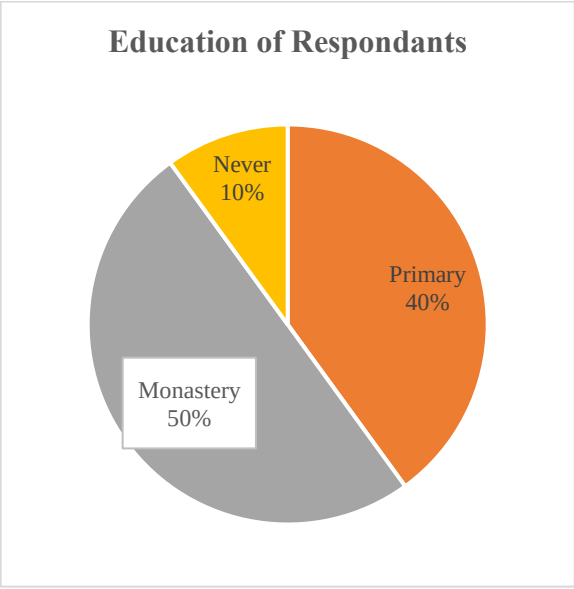


Figure10.67: Education level of respondents

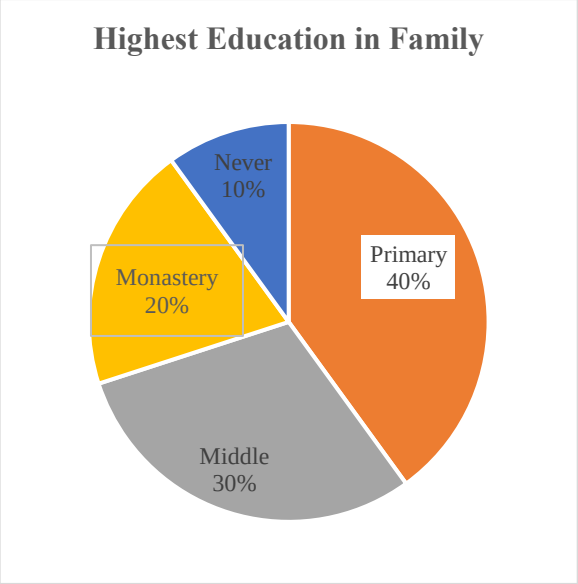


Figure10.68: Highest Education level in Family

(v)Total Expenditure

Among respondents, yearly expenditure ranges from 3,672,000 to 7,104,000 kyats.

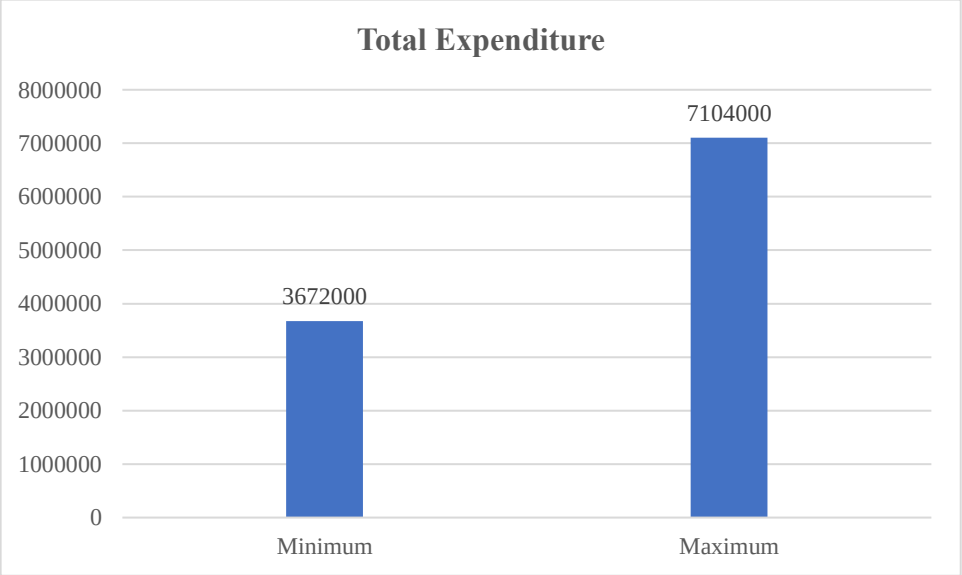


Figure 10.69: Percentage of total household expenditures

(vi)Household health condition

According to the survey, the common sickness of household members are "***Muscle Pain***" (60%) followed by "***Hypertension***" (20%), "***Asthma***" (10%) and "***Catching a cold***" (10%).

For incidence of diarrhea within three months, 80% of surveyed families did not experience that disease.

For incidence of any sickness within three months, 80% of surveyed families did not experience any sickness.

All of surveyed respondents get treatment from "***Private clinic with doctor***" for any sickness.

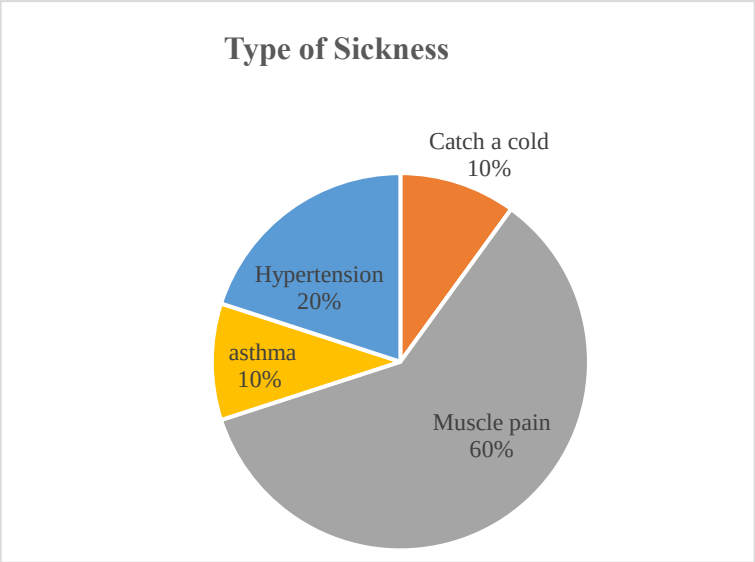


Figure 10.70: Health condition

(vii)Household structure

It is observed that all households do not own their houses and they all are living in "***huts***" with "***tarpaulin roof***".

(viii)Migration

Regarding migration, the following figure shows the duration of residence of surveyed respondents who are currently residing at the current landfill site.

There is no household member leaving for work due to job scarcity in the past 12 months.

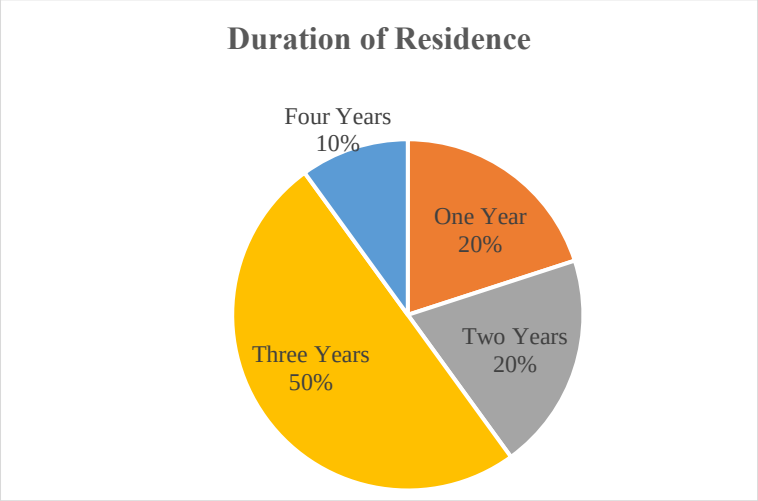


Figure 10.71: Duration of Residence

(ix) Healthcare availability and access to education for household members

Health and education availability for household members were analyzed. All respondents have access to healthcare services but majority of the surveyed respondents (56%) are not able to attend a school due to "***poor economic status***".

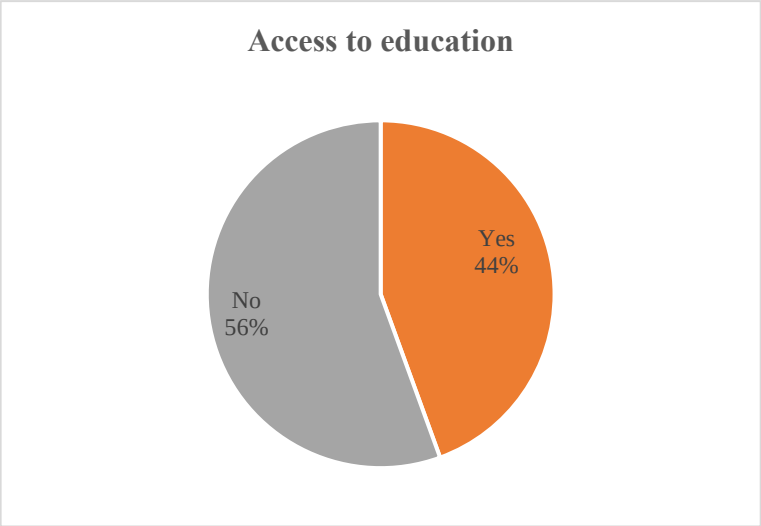


Figure 10.72: Access to education

(x) Sources of electricity

It was observed that all respondents use "***Solar*****"** for lighting purposes and use "***Firewood*****"** for cooking. Majority of them (60%) get the firewood from old landfill site.

(xi) Sources of drinking water

Concerning to drinking water availability, all households living nearby landfill site gets "***Purified drinking water*****"**.

(xii) Type of Latrine

Regarding to type of latrine, all respondents used "***open latrine***".

(xiii) Waste Collection and Disposal

The study has identified the Waste Collection and Disposal method in the surrounding community of the project.

Majority of them dispose their wastes at MCDC dumping area or MCDC garbage container.

(xiv) Internet Usage and Communication

Concerning online communication, 70% of respondents used internet and communicate with each other.

Facebook application is most common application and most of them cannot use internet well.

Regarding communication via Facebook application, majority of respondents answered that the communication about project via Facebook will not be available for them.

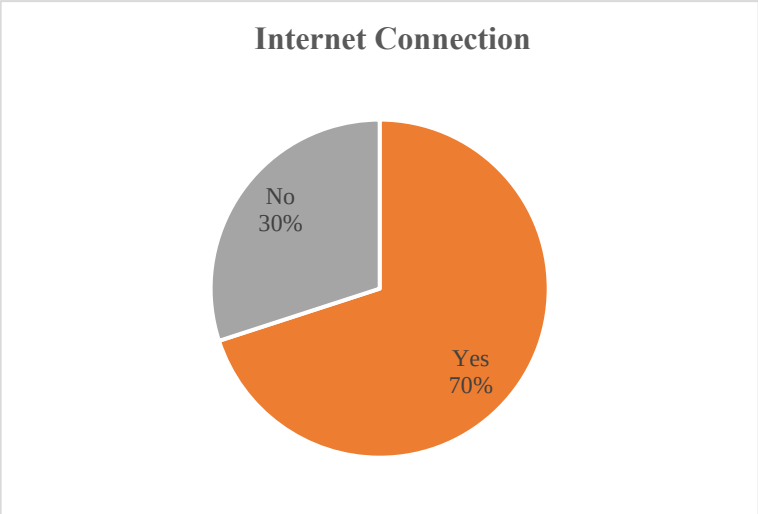


Figure 10.73: Connection to internet

(xv) Cultural aspect

The important decisions in the community are made by the village leader.

All respondents answered that there are religious sites around proposed project and 80% said that those sites are adequately protected.

(xvi) Air quality and climate changes

The study has identified the environmental changes of the surrounding area of the proposed project.

Most respondents (20%) answered that air quality is not changed while 80% thinks that it is improved.

Among the respondents, 80% of stakeholders said that the weather is more warming and the remaining 20% said that the weather condition is not changed.

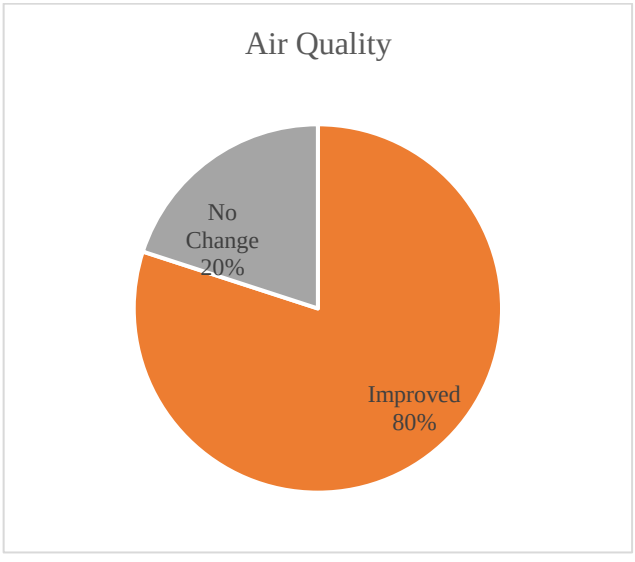


Figure 10.74: Attitude about air quality

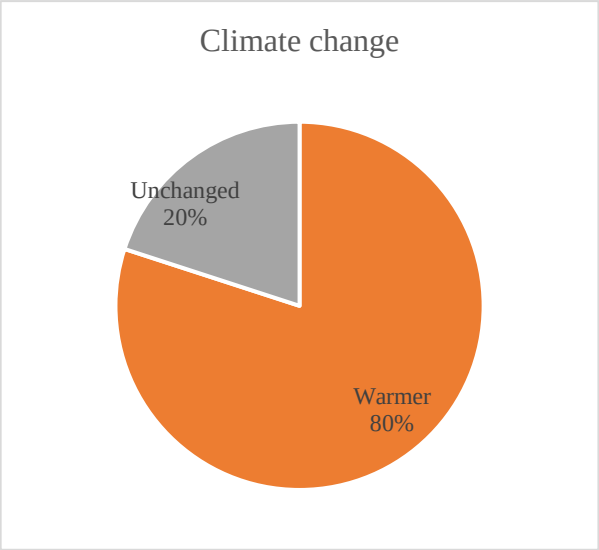


Figure 10.78: Attitude about climate change

(xvii) Awareness on the proposed project

Regarding awareness about the proposed project, all respondents do not know about the project at all and get information from nowhere. Thus, 80% of respondents cannot answer the question concerning about the importance to community by this project.

Moreover, majority of the respondents (80%) have no experience of previous project activity and impact.

(xviii) Attitude about Positive Impacts on the community

Concerning respondents' attitudes about positive impacts by the proposed project, most of them unaware about that while 20% anticipates for increased employment and 10% expects for improved environment.

(xix) Attitude about Negative Impacts on the community

Majority of respondents (60%) are worried for the employment and income disruption while other 40% is unaware about any negative impacts.

(xx) Priotization for improvement of community

The following figure shows the priority developments which are desired by the community at the Kyar Ni Kan landfil site. Majority of respondants metioned about "***employment opportunity***" (29%) followed by "***medical service***" (25%).

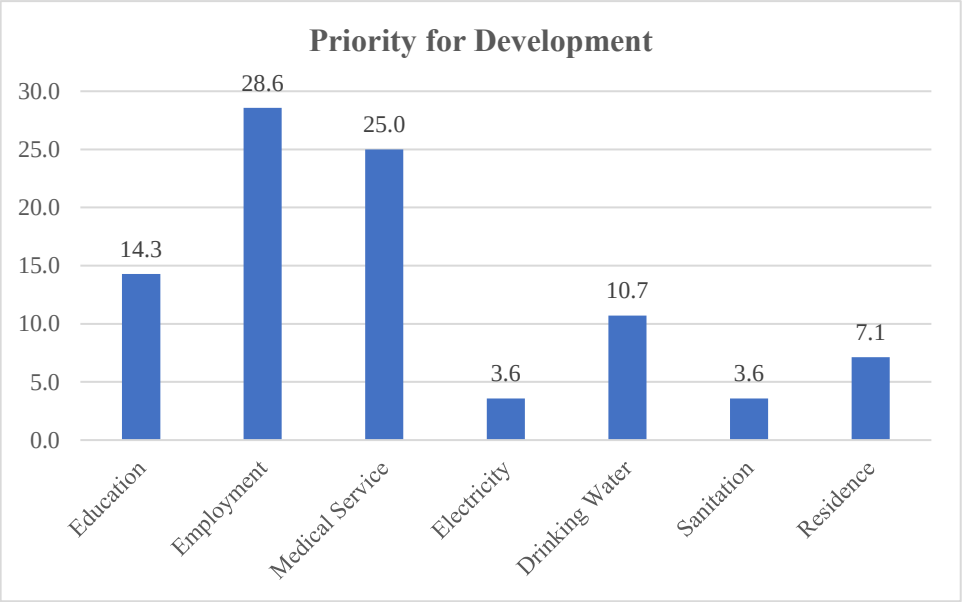


Figure 10.79: Priority for development

(xxi) Vulnerable Household Members

Majority of respondents (80%) do not have any pregnant woman in family.
There is no infant in surveyed households but 20% has children under 5 years old.
Regarding experience of child death under 5 years old, all surveyed respondents has no experience about that.

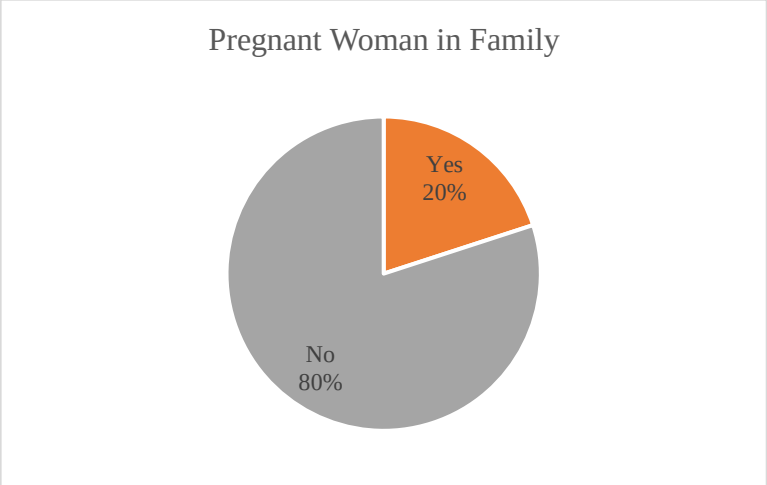


Figure 10.80: Pregnant woman in family

(xxii) Place of work and type of recyclable wastes

All respondents answered that they collect recyclable wastes from current dumping area at Kyar Ni Kan landfill site and do not collect from old dumping area.
Among surveyed respondents who collect recyclable wastes, 100% of them collect "***Metal, empty metal bottles and container***", 70% "***Plastic bag and stuffs***" and construction wastes and 50% of them collect "***Paper, books and paper board***".

There is no collection of "***Glassware***", "***Clothes***" and "***Hazardous wastes***" from the landfill site.

(xxiii) Individual daily income
Majority of respondents earns 5,000 kyats and 10,000 kyats per day. Range of income by collecting recyclable wastes is 5,000 t0 10,000 kyats per day for an individual.

(xxiv) Smoking, drinking and betel chewing
Regarding unhealthy habits among community, there are only 30% of responded households for "***smoking and alcohol consumption***".

However, majority of community has habit of "***Betel chewing***".

(xxv) Plantation, fishing and breeding of animals around landfill site
Among the outcomes of the respondents, there is no fishing and plantation but there have some chickens around landfill site.

(xxvi) Negative impacts of current landfill site
All surveyed respondents answered that there are bad odors, rodents and flies at the current landfill site.
For impact on their job and income, majority of respondents (80%) anticipates about negative impacts due to proposed project.

There are 60% of respondents who anticipates about negative impacts on lifestyle and quality of life due to the project.

However, 90% of them do not anticipate about the impacts on health status while 10% expects positive impact on health by Landfill Gas to Energy project.

10.6 Estimation of socio-economic impact likely affected by the project operation

The following methodology has been applied to assess the socio-economic impacts of the project during construction, operation and decommissioning phases mainly on livelihoods, education, infrastructure, water quality, physical resources, biological resources, human use, quality of life and cultural heritage. Each source of impacts has been assessed by two parameters namely magnitude and Probability along with five scores assessment as well. Detail methodology can be seen in annex (B).

Table 10.1: Impact Assessment Parameters and its scores

Assessment	Score				
	1 (very low)	2 (Low)	3 (Medium)	4 (High)	5 (Very High)

Magnitude	Insignificant	Small and will have on the socio-economic environment	Moderate and will result in minor changes on community	High and will result in significant changes on community	Very high and will result permanent changes on community
Probability	Insignificant	Little socio-economic challenges	Indirect Socio-economic challenges	Direct socio-economic challenges	Direct and significance socioeconomic challenges

Then, significant rating is calculated by the following formula.
Significant point = Magnitude x Probability
Impact Significance Level: Based on the calculated significant point, impact significance can be categorized as follows;

Table 10.2: Impact Significance Levels

Risk level	Rating	Definition
Very low	1-3	No impacts occur.
Low	4-9	Acceptable level without controlling impacts/ does not require additional management.
Medium	10-16	Acceptable level/but must be controlled to prevent increased risk to unacceptable levels.
High	17-25	Unacceptable level/ the impact must be managed/must be reduced to an acceptable level.
Very High	Above 25	Unacceptable level/ the impact must be managed/ reduced to an acceptable level immediately.

Table 10.3: Analysis of Socio-economic Impact
(a) Construction phase

No.	Socio-economic impacts	Significance of potential socioeconomic impacts			Impact significance
		Magnitude	Probability	Impact significance	
The effect on Physical Resources					
1	Soil quality	3	4	12	Medium

2	Surface water quality	2	3	6	Low
3	Ground water quality	2	3	6	Low
4	Air quality	3	3	12	Medium
5	Noise	3	4	12	Medium
Effect on Biological Resources					
6	Forestry and conservation Areas	2	3	6	Low
7	Agriculture/Farming areas	3	4	9	Medium
8	Local animals	1	2	2	Very low
9	Pasture	1	2	2	Very low
10	Aquatic animals	1	2	2	Very low
Effect on human use					
11	Local fisheries	1	2	2	Very low
12	Local livestock	1	2	2	Very low
13	Local vegetation	3	3	9	Low
14	Local industry	1	2	2	Very low
15	Local transportation	3	3	9	Low
16	Local price	1	2	2	Very low
17	Recreation	1	2	2	Very low
18	Local economy	1	2	2	Very low
Effect on Quality of life					
19	Housing	1	2	2	Very low
20	Health	1	2	2	Very low
21	Education	1	2	2	Very low
22	Spiritual	1	2	2	Very low
23	Safety	3	3	9	Low
24	Crime	3	3	9	Low
25	Family Structure	1	2	2	Very low
26	Job opportunities	3	4	12	Medium
27	Income	3	3	9	Low
28	Scenery	1	2	2	Very low
29	Local culture	1	2	2	Very low
Effect on Cultural Heritage					
30	Religious building	1	2	2	Very low
31	Cemetery	1	2	2	Very low
32	Historic buildings	1	2	2	Very low

(b) Operation phase

No.	**Socio-economic impacts**	**Significance of potential socioeconomic impacts**			**Impact significance**
		Magnitude	**Probability**	**Impact significance**	
The effect on Physical Resources					
1	**Soil quality**	**3**	**3**	**9**	**Low**
2	**Surface water quality**	**2**	**2**	**4**	**Low**
3	**Ground water quality**	**2**	**2**	**4**	**Low**

4	Air quality	3	4	12	Medium
5	Noise	3	3	9	Low
Effect on Biological Resources					
6	Forestry and conservation Areas	1	2	2	Very Low
7	Agriculture/Farming areas	1	2	2	Very Low
8	Local animals	1	2	2	Very low
9	Pasture	1	2	2	Very low
10	Aquatic animals	1	2	2	Very low
Effect on human use					
11	Local fisheries	1	2	2	Very low
12	Local livestock	1	2	2	Very low
13	Local vegetation	1	2	2	Very Low
14	Local industry	1	2	2	Very low
15	Local transportation	3	3	9	Low
16	Local price	1	2	2	Very low
17	Recreation	1	2	2	Very low
18	Local economy	1	2	2	Very low
Effect on Quality of life					
19	Housing	1	2	2	Very low
20	Health	2	2	4	Low
21	Education	1	2	2	Very low
22	Spiritual	1	2	2	Very low
23	Safety	3	3	9	Low
24	Crime	3	3	9	Low
25	Family Structure	1	2	2	Very low
26	Job opportunities	3	4	12	Medium
27	Income	3	3	9	Low
28	Scenery	1	2	2	Very low
29	Local culture	1	2	2	Very low
Effect on Cultural Heritage					
30	Religious building	1	2	2	Very low
31	Cemetery	1	2	2	Very low
32	Historic buildings	1	2	2	Very low

(c) Decommission phase

No.	Socio-economic impacts	Significance of potential socioeconomic impacts			Impact significance
		Magnitude	Probability	Impact significance	
The effect on Physical Resources					
1	Soil quality	3	3	9	Low
2	Surface water quality	2	2	4	Low
3	Ground water quality	2	3	6	Low
4	Air quality	3	4	12	Medium
5	Noise	3	4	12	Medium

Effect on Biological Resources					
6	**Forestry and conservation Areas**	**2**	**3**	**6**	**Low**
7	**Agriculture/Farming areas**	**3**	**3**	**9**	**Low**
8	**Local animals**	**1**	**2**	**2**	**Very low**
9	**Pasture**	**1**	**2**	**2**	**Very low**
10	**Aquatic animals**	**1**	**2**	**2**	**Very low**
Effect on human use					
11	**Local fisheries**	**1**	**2**	**2**	**Very low**
12	**Local livestock**	**1**	**2**	**2**	**Very low**
13	**Local vegetation**	**3**	**3**	**9**	**Low**
14	**Local industry**	**1**	**2**	**2**	**Very low**
15	**Local transportation**	**3**	**3**	**9**	**Low**
16	**Local price**	**1**	**2**	**2**	**Very low**
17	**Recreation**	**1**	**2**	**2**	**Very low**
18	**Local economy**	**1**	**2**	**2**	**Very low**
Effect on Quality of life					
19	**Housing**	**1**	**2**	**2**	**Very low**
20	**Health**	**1**	**2**	**2**	**Very low**
21	**Education**	**1**	**2**	**2**	**Very low**
22	**Spiritual**	**1**	**2**	**2**	**Very low**
23	**Safety**	**3**	**3**	**9**	**Low**
24	**Crime**	**3**	**3**	**9**	**Low**
25	**Family Structure**	**1**	**2**	**2**	**Very low**
26	**Job opportunities**	**3**	**4**	**12**	**Medium**
27	**Income**	**3**	**3**	**9**	**Low**
28	**Scenery**	**1**	**2**	**2**	**Very low**
29	**Local culture**	**1**	**2**	**2**	**Very low**
Effect on Cultural Heritage					
30	**Religious building**	**1**	**2**	**2**	**Very low**
31	**Cemetery**	**1**	**2**	**2**	**Very low**
32	**Historic buildings**	**1**	**2**	**2**	**Very low**

10.7 Socio-Economic Impact Assessment on the community

The primary data (survey data) was used to assess socio-economic impacts on the local communities. According to the analysis socio-economic data, most of the impacts on socioeconomic is not significant. The effect on physical resources namely soil quality, surface water and ground water quality have low impacts due to the proposed project. But, the impact on noise quality has medium range because of the operation activities. There will be very low effect on human use, quality of life and cultural heritage.

As the result of analysis, most of the project activities have no significant impact on the environment, livelihood and cultural heritage. However, there will be positive impacts on air quality as proposed project is Clean Development Mechanism (CDM) project reducing methane (GHG) emission into the environment.

During pre-operation and decommissioning phase, there will be negative medium impacts on air quality, by particulate matters, due to construction and decommissioning activities.

However, all these impacts are low scale and can be mitigated accordingly. The mitigation measures are detailed in the chapter (6): **Impact Assessment and Mitigation Measures** and chapter (8): **Environmental Management Plan** accordingly.

10.8 Photo Session

Following figures are sample pictures of surveyed respondents while carrying out of survey questionnaires at their households.

(a) Survey questionnaires on respondents residing at the nearest village (In Gel village)

Figure 10.81: Socio-economic survey questionnaires on nearest village (In Gel village)

(b) Survey questionnaires on nearest community who live at the landfill site and relying on the landfill site for their income

Figure 10.82: Socio-economic survey questionnaires on nearest community who live at the landfill site

10.9 List of Socio-economic survey participants

(a) List of respondents residing at the nearest village (In Gel village)

No.	Name	Gender	Age
1	Daw Than Than Nu	Female	50-60
2	Daw Mar Tin	Female	50-60
3	Daw naw Li Zar	Female	30-40
4	Daw Su Su Maw	Female	40-50
5	Daw Thae Nu New	Female	20-30
6	Daw Me	Female	15-20
7	Daw Lae Lae Moe	Female	20-30
8	Daw Khin Myo Phyu	Female	40-50
9	Daw Yin Yin Aye	Female	40-50
10	Daw Nyo Nyo	Female	40-50
11	Daw Khaing San	Female	40-50
12	Daw Myo Myo	Female	20-30
13	U Kyaw Myo Hlaing	Male	40-50
14	U Ye Htet	Male	20-30
15	Daw Than Than Soe	Female	30-40
16	Daw Toke	Female	70+
17	U Hnyet Yoe	Male	60-70
18	U Chit Ko Ko	Male	40-50
19	U Phone Lwin	Male	40-50
20	U Zaw Soe	Male	40-50
21	U Thein Htun	Male	30-40
22	Ma Cho Cho Khaing	Female	30-40
23	U Htwe	Male	60-70
24	U Zayyar Oo	Male	15-20
25	Daw Kyi Than	Female	50-60
26	U Than Naing	Male	40-50
27	U San Myint Maung	Male	50-60
28	Daw Sander Maw	Female	30-40
29	Daw Zar Phyu Thin	Female	15-20
30	Daw Sein Sein Moe	Female	40-50

(b) List of respondents who live at the landfill site and relying on the landfill site for their income

No.	Name	Gender	Age
1	U Kyaw Htay	Male	30-40
2	U Hla Tun	Male	50-60
3	U Nay Htoo Aung	Male	20-30
4	U Chit Hmwe	Male	20-30
5	U Phoe Khwar	Male	20-30
6	U Hla Myint	Male	50-60
7	U Myint Thu Aung	Male	20-30
8	Daw Win Yee	Female	50-60
9	Daw Thein San	Female	40-50
10	Daw Ngwe	Female	50-60

Chapter 11

Conclusions and recommendations

11. Conclusions and recommendations

The EMP for the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation Project was carried out based on the extensive literature surveys, existing baseline environmental monitoring, public consultation meetings with the respective stakeholders including administrative personnel, local community, interested persons etc. and socioeco surveys along with consultation with the community.

As defined in chapter (5), in-depth environmental existing baseline situations were assessed. This project has defined all environmental and social impacts associated with the construction, operation and decommission phase of the proposed project.

The characteristics of the proposed LFG recovery project particularly its medium significance of the potential environmental impacts (air, noise, vibration, water, soil, waste and biodiversity) on the working community and the nearest environment can be reduced and prevented by complying with the mitigation measures.

Based on the impact assessment made in chapter (6), the environmental management plan in chapter (8) together with the significant appropriate mitigation measures and plans on environmental monitoring along with emergency response plans chapter (9) were developed accordingly.

In conclusion, EQM has considered that:

- The prevention and mitigation measures defined are capable of providing the appropriate environmental management system to ensure that environmental and social impacts are prevented or minimized.

- As explained in chapter (8) and (9), the EMP on the various environmental issues are capable of detecting and solving the potential emergencies including Flare & Generator plant that will be operating at the proposed Kyar Ni Kan project.

In terms of recommendations,

EQM has suggested the Environmental Management Plan that is designed to:

- Provide the framework for the compliance auditing and monitoring programmes that will lead the proposed LFG recovery project to carry out its operation activities in accordance with the Myanmar environmental rules and regulations; International practices, and Health and safety regulations.

- In conclusion, this report gives the proposed project's employers the guidance and framework in order to maintain the sustainable green development, provide their employees with a workplace free from recognized hazards and review the compliance with Myanmar environmental rules and regulations; environmental management plans, mitigation measures and monitoring programmes accordingly.

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Giles Lambertson, Industry Begins Grappling With Rising Fuel Costs, Mon May 15, 2006 National Edition
https://www.constructionequipmentguide.com/industry-begins-grappling-with-rising-fuel-costs/7008#

Characterization of Municipal Solid Waste Collection Operations
https://www.sciencedirect.com/science/article/am/pii/S0921344916301860

Forklift fuel consumption and efficiency
https://www.toyotaforklift.com/resource-library/material-handling-solutions/parts-services/forklift-fuel-consumption-

The Letter of Commitment

As per the Administrative Instruction of Environmental Impact Assessment procedure, Korea East West Power Limited and HANATEC Limited required Environmental Management Plan (EMP) for the Mandalay Kyar Ni Kan Landfill Gas Recovery and Generation project to be prepared and submitted to the Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation Department (MONREC) for approval.

Thus, this EMP study has been completed in accordance with Article 8, 9, 10, 1, 23, 24, 25 and 26 of the Myanmar EIA procedure (2015) by the Myanmar registered consultant company Environmental Quality Management Co. Ltd. (EQM).

Korea East-West Power Limited and HANATEC Limited endorse and confirm to the Environmental Conservation Department, Ministry of Natural Resource and Environmental Conservation the following:

- The accuracy and completeness of the EMP
- The EMP has been prepared in compliance with applicable Environmental Conservation Law, Rules and Procedures, and
- That all the information contained in the report is accurate and a truthful representation of all findings as relating to the Project.
- Will comply fully with the commitments and obligations including all laws and regulations as detailed in the EMP determined to be relevant with the planned project, mitigation measures and plans set out in the EMP.

The undersigned is authorized to issue this Letter of Commitment on behalf of the Korea East West Power Limited and HANATEC Limited.

Yours sincerely,

Annex (A)

Methodology for Environmental sampling

1. Ambient air monitoring instrument

The air monitoring survey will use the Aeroquel Series 500 air quality monitoring device and Aeroquel AQM65 Wireless Environmental Perimeter Air Monitoring Station. (EPAS).

(i) The sensor intakes

The survey would deploy the sensor intakes based on the sitting criteria as specified. The survey will comply with the following guidelines as follows;

• Particulates and gas sensor intakes will be located between 2-3 meters above the ground level

• Keep unrestricted airflow located away from obstacles so that the distance from the sensor intake is at least twice the height that the obstacle protrudes above the probe

• Keep unrestricted airflow in an arc of at least 270 degrees around the inlet probe, or 180 degrees if the probe is on the side of a building

• Would be clear of optical obstructions, including potential obstructions that may move due to wind, human activity, growth of vegetation, etc.

- Spacing from trees (10-20 m)

- Spacing from roadways (10-250 m) depending on the traffic

• Observe temporary optical obstructions, such as rain, particles, fog, or snow

(ii) Location of the monitoring sites

The monitoring sites were selected based on their being broadly distributed within the project area and in proximity to the most sensitive receptors i.e. communities. Operating activities of the project would impact local air quality. Air pollution both on site and in the surrounding locality may result from release of dust and gases to the atmosphere from handling or processing of its by-products.

(iii) Sampling time and frequency of measurements

The survey will monitor 24hr continuously.

(iv) Ambient air parameters to be measured

1) Particulates: PM10, PM2.5 USEPA Criteria air pollutants

2) Gases: NO2, SO2, CO, O3

3) Meteorology: Temperature, Relative Humidity which can have the influence on both local and regional air quality

(I) Particulates and Meteorology by Aeroquel Series 500

Sensor Code	**PM**
Range	0.000 to 1,000mg/m^3
Measurement parameters	$PM_{2.5}$ and PM_{10}
Sensor type	Laser particle counter
Minimum detection limit	0.001 mg/m^3
Accuracy of factory calibration	± (0.002 mg/m^3 + 15% of reading)
Resolution	0.001 mg/m^3
Response time	5 second
Temp	0 to 40ºC
Relative humidity	0 to 90% non-condensating

(II) Gases by Aeroquel AQM 65

Gas Module	**Range (ppm)**	**Resolution**	**Noise**	**Lower detectable limit / ppm**
			Zero / ppm; Span % of reading	
Ozone O_3	0-0.5	0.001	<0.001 <1%	0.001
Nitrogen Dioxide NO_2	0-0.2	0.001	<0.001; <1%	0.001
Carbon Monoxide CO	0-25	0.001	0.020; <1%	0.040
Sulfur Dioxide SO_2	0-10	0.001	0.004; <2%	0.009
Nitrogen Oxides NO_x	0-0.5	0.001	<0.001; <1%	0.001
Hydrogen Sulfide H_2S	0-10	0.001	0.006; <2%	0.012
Carbon Dioxide CO_2	0-2000	1	<5; <1%	10

Figure 1: Ambient air quality monitoring with Aeroquel AQM 65

Figure 2: Ambient air quality monitoring with Aeroquel Series 500

1.2 Comparison of Results with Applicable Guideline

The baseline ambient air quality monitored will be compared accordingly with the following ambient quality guideline value under National Environmental Quality (Emission) Guidelines stated by Environmental Conservation Department, Dec 29, 2015 and WHO Guideline.

Parameter	**Averaging Period**	**Guideline Value µg/m^3**
Nitrogen dioxide	1-year 1-hour	40 200
Ozone	8-hour daily maximum	100
Particulate matter PM_{10}	1-year 24-hour	20 50
Particulate matter $PM_{2.5}$	1-year 24-hour	10 25
Sulfur dioxide	24-hour 10-minute	20 500
Carbon Monoxide	1-hour 8-hour	30,000 10,000

References:

Air Emissions from Municipal Solid Waste Landfills - Background Information for Proposed Standards and Guidelines, Office of Air Quality Planning and Standards, EPA-450/3-90-011a, Chapters 3 and 4, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1991.

ENVIRONMENTAL PROTECTION AGENCY (US EPA), 40 CFR Appendix E to Part 58, Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring

https://www3.epa.gov/ttnamti1/files/ambient/longpath/fropenph.pdf

Noel De Nervers, (2000), Air Pollution Control Engineering, 2nd edition, McGraw-Hill International Editions, Civil Engineering Series

General principles of Health risk assessment of air pollution, WHO , 2016

Sendai Framework for Disaster Risk Reduction 2015 – 2030, UN.

Solid Waste Management and Climate Change

https://www.researchgate.net/publication/46212886_Capacity_building_of_disaster_waste_management_for_disaster_risk_reduction [accessed Sep 29, 2017].

Technical Guidance Note (Monitoring), M17, Monitoring Particulate Matter in Ambient Air around Waste Facilities, Environment Agency Version 2 July 2013

The Impact on Health of Emissions to Air from Municipal Waste Incinerators, Health Protection Agency, September 2009

2 Ambient Noise monitoring

At each site, Baseline Sound Pressure Levels (SPLs) for (daytime (LAeq 90 D), night time (LAeq 90 N)), and 24-hour (LAeq 90) will be monitored using the Sound level Meter (Model: SL-4023SD) along with SD card real time data recorder (USB/RS232) in order to determine background ambient noise levels within the study area. This SLM meets IEC61672 class 2 with the tolerance is +/- 1.4dB.

(i) Principles

Noise monitoring on LAeq which is the A-weighted equivalent continuous sound level in decibels db(A) measured over the certain period of time (24hr continuously) will be conducted at the selected location that is considered to best represent the most affected location and also can reflect the exposure of the nearest local community and sensitive locations in accordance with the procedures described below.

Sampling location

Sampling locations will be selected according to the site visit at the operation sites and nearby sensitive receptors in order to be the representative location of the noise exposure.

Site setting

Sound level meter (SLM including microphone) will be mounted on the tripod which is the standard methodology for most noise measurements taking into account not to make noises while observing the meter and ensuring the least amount of reflective surface from the observer's body is exposed to the meter.

The device will be set up more than 3.5m away from a reflective surface (building) at minimum and a noise reading will be taken at the average height of the receptor.

Monitoring

The baseline noise surveys will be conducted for the Project site including:
Sound statistical descriptors (L10, L50, L90); and Time varying noise: LAeq,T is used to quantify the noise where the Lp varies over time. In most situations, the LAeq,T is the most appropriate descriptor used to investigate environmental noise complaints.

Along with the deployment of a meteorological station to measure wind speed data for the purpose of excluding noise measurements affected by periods of high winds (>5m/s) and/or rain.

Calibration

Calibration of the SLM is to be carried out before and after each set of noise measurements using the Lutron SC-942 which generates 94dB and 114dB at 1000Hz – and this [especially 94dB] is a very common reference point for sound level meters. The Lp shown on the meter should match the stated Lp for the calibrator being used. Standard calibration is generally 94 dB(A) but can vary slightly due to the microphone sensitivity e.g. 93.8 dB(A).

The calibration level should be confirmed with the SLM manufacturer's specifications. The variation before and after the calibrations should be no more or less than 1 dB(A). If the deviation

of the calibration is greater than 1 dB(A) then the results obtained during the assessment are invalid.
The monitoring procedures, data analysis and interpretation were carried out in accordance with USEPA operating procedure as well as the operational manufacture.

Figure 3: Baseline noise level monitoring

2.1Features and Specification of the Equipment;

(i) SOUND LEVEL METER

Model No : SL-4023SD

Description :

SD Card real time data recorder

SOUND LEVEL METER,
Model : SL-4023SD

* Real time data recorder, save the data into the SD memory card and can be download to the Excel, extra software is no need.

* Meet IEC61672 class 2
*Frequency 31.5 to 8,000 Hz
* Auto range : 30 to 130 dB.
* Manual range : 3 ranges 30 to 80 dB, 50 to 100 dB, 80 to 130 dB .
* A/C frequency weighting.
* Fast/slow time weighting,
* Peak hold, Data hold.
* Record (Max., Min.).
* RS232/USB computer interface.
* Optional wind shield ball, SB-01.
* Patented. * Patent: Taiwan, China, Japan, Germany, USA pending.

2.2 Certificate of Calibration Regarding calibration, the external calibration adjustment is used before each and every monitoring starts.

94 dB	114 dB
	

Sound Calibrator (Lutron SC 942)

HOT

2.2 Comparison of Results with Applicable Guideline

Being the environmental sound level measurement, the A-weighted sound level expressed in the A scale decibel (dBA) unit which gives greater weight to the frequencies of sound to which the human ear is most sensitive.

The baseline equivalent sound pressure levels monitored will be compared accordingly with the following Noise level guideline value under National Environmental Quality (Emission) Guidelines stated by Environmental Conservation Department, Dec 29, 2015.

Receptor	**One Hour LAeq (dBA)** [a]	
	Daytime/ 07:00 -22:00 **(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

[a] Equivalent continuous sound level in decibels

2.3 Proposed Team

EQM technician team comprising of (2) members who have been experienced with noise monitoring, data entry, analysis and reporting for years will conduct the project.

2.4 Reporting

The background ambient noise level will be described in terms of an average level which is LAeq (dBA) as the summation of all the time-varying events. Generally, the report is used to presented in average, min and max with L90 considering the background or ambient level of a noise environment.

If necessary, the report will be prepared with percentile dB (A) level (L90, L50, L10).
While determining the daily measure of environmental noise, surrounding activities will be observed and incorporated into the report to reveal the potential sources of noise emission.
The final report used to be submitted in accordance with the EQM format. If the format is available from the proponent side, it will be prepared accordingly.

References:

Noise measurement methodologies, https://www.ehp.qld.gov.au/licences-permits/.../noise-measurement-manual-em1107.p.
U.S. EPA BASE STUDY STANDARD OPERATING PROCEDURE, Environmental Health & Engineering, Inc. 60 Wells Avenue Newton, MA 02159-3210
US EPA, https://www.epa.gov/sites/production/files/2014-08/documents/indoor.pdf

3 Ambient vibration monitoring

Determination of Natural vibration which can be expressed in metric units (m/s^2) will be monitored using the vibration meter DIGICON TV 120SD having size: 68x177x45 mm with SD card data logger within the study area.

(i) Principles

Measurements of vibration accelerations is carried out using the vibration meter DIGICON TV 120SD with SD card data logger measurement system under ambient conditions.

Accelerometer area: 0.5 ~ 199.9 m / s2 (Peak)
Speed measurement range: 0.5 ~ 199.9m / s
Vibration range: 199.9 mm

Sampling location

Sampling locations will be selected according to the site visit at the operation sites and nearby sensitive receptors in order to be the representative location of the vibration exposure.

Site setting

The vibration meter is mounted on the tripod and vibration sensor with cable and magnetic base is attached to the ground on the recorded level of vibration acceleration. Accelerometers is mounted to the ground using various mounting bases anchored in the ground with one, three and four rods accordingly. The device will be set up more than 3-5m away from a reflective surface (building) at minimum.

Monitoring

The monitoring is over the certain period of time (24hr continuously) at the selected location that is considered to best represent the most affected location and also can reflect the exposure of the nearest local community and sensitive locations in accordance with the procedures described above.

Calibration

The device is factory calibrated along with the manufacturer's specifications.

Figure 4: Natura vibration level monitoring

3.1 Features and Specification of the Equipment;

DIGICON TV-120SD can measure both acceleration (Acceleration), velocity (Velocity) and vibration distance (Displacement)
Measure the vibrations of machinery and motors in order to inspect maintenance conditions
Wide frequency range: 10Hz ~ 1kHz, corresponding sensitivity according to ISO 2954
Vibration sensor and magnetic base included
Data is maintained the highest-lowest values are recorded. And can be called up to view
The data from the SD card is an Excel file with time data (year / month / day / hour / minute / second). No need to use the program when storing data via SD CARD.
Can connect to the computer via RS232 / USB port (order more cable)

3.2 Comparison of Results with Applicable Guideline

A complete assessment of exposure to vibration requires the measurement of vibration acceleration in meters per second squared (m/s^2). Vibration exposure direction is also important and is measured in defined directions.

Currently, there is no national vibration guideline or standard values yet in Myanmar.

Therefore, the following standard values are adopted to analyse the natural vibration,
For whole-body vibration (WBV), the daily exposure limit value (ELV) is 1.15 m/s2 A (8).

The daily exposure to vibration is measured by a formula known as an A(8) value. This is the average (A) exposure over an eight-hour (8) day.

Receptor	**Daily exposure limit value (ELV) (ms^2) A (8).**
whole-body vibration (WBV),	1.15 m/s^2

Safety, Health and Welfare at Work (General Application. Regulations 2007 (S.I. No. 299 of 2007) *www.hsa.ie*

3.3 Proposed Team

EQM technician team comprising of (2) members who have been experienced with vibration monitoring, data entry, analysis and reporting will conduct the project.

3.4 Reporting

The background ambient vibration level will be described in terms of an average level which is the daily ELV (ms^2). While determining the daily measure of environmental vibration, surrounding activities will be observed and incorporated into the report to reveal the potential sources of vibration.
The final report used to be submitted in accordance with the EQM format. If the format is available from the proponent side, it will be prepared accordingly.

References:

Ground-Borne Noise and Vibration in Buildings Caused by Rail Transit (2010) https://www.nap.edu/read/22951/chapter/9

Guide to the Safety, Health and Welfare at Work,(General Application) Regulations 2007 https://www.hsa.ie/eng/Publications_and_Forms/Publications/General_Application_Regulations/Control_of_Vibration_at_Work.pdf

Huan vibration, Briiel & Kjcer,1989

Measuring Vibration with Accelerometers, Updated Mar 14, 2019, https://www.ni.com/en-us/innovations/white-papers/06/measuring-vibration-with-accelerometers.html

Rail Vibration Assessment Stirling Alloa Kincardine Railway Line, Clackmannanshire Council October 2009, https://www.clacks.gov.uk/document/2464.pdf

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VIBRATION ANALYSIS OF A RESIDENTIAL BUILDING, Regina Augusta Sampaio and Remo Magalhães de Souza, 2015, https://www.matec-conferences.org

4 Groundwater Sampling Methodology

4.1 Preparation before leaving for the field site.

Sample bottles and sampling dipper were washed and cleaned with purified water as well as deionized water for three times, filled preservatives if needed and capped securely. These procedures were unnecessary for the sample bottles sent by the international lab as all bottles were already prepared and sealed.

Prepare the one page check list for the list of water parameters to be tested, label sample parameters, site identification code and a field date and time on the bottles.

Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.

Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.

Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.

4.2 Sampling procedure and sampling device

Groundwater samples will typically be collected from the discharge line of a pump or from a bailer, either from the pour stream of an up-turned bailer or from the stream from a bottom-emptying device. Efforts should be made to reduce the flow from either the pump discharge line or the bailer during sample collection to minimize sample agitation. During sample collection, make sure that the pump discharge line or the bailer does not contact the sample container.

Sampling is the process of obtaining, containerizing, and preserving (if required) a ground water sample after the purging process is complete. Non-dedicated pumps for sample collection generally should not be used. Many pumps are made of materials such as brass, plastic, rubber, or other elastomer products which may cause chemical interferences with the sample. Their principle of operation may also render them unacceptable as a sample collection device. It is recognized that there are situations, such as industrial or municipal supply wells or private residential wells, where a well may be equipped with a dedicated pump from which a sample would not normally be collected. Discretion should always be used in obtaining a sample.

One member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.

Gloves and sampling dipper

In general, water samples were collected using clean sampling dipper in order to avoid sample contamination from other sources according to the standard operation procedures.

Before sample collection, appropriate measures including wearing a clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised and rinsing of sampling dipper with native water were carried out so as to condition, or equilibrate to the sample environment and make sure that all cleaning-solution residues have been removed.

Ground-water-sampling is mainly based on site-specific conditions.

(a) Dug well

Firstly, dug well water was collected by a bucket being currently used in the well (metal, plastic, wood). Then water in the bucket was collected by sampling dipper and transferred into sample bottles.

(b) Tube well (Shallow well Deep well)

The sample was taken at the closest access to water from the well before the water enters any treatment and the distribution system. Water was collected at the outflow of a pressure and flushed (hand pump and compressor pump for shallow well and deep well respectively) for few minutes prior to sampling in order to remove any stagnant water in the well casing and to ensure that at least 95 percent of the water sample originates from the aquifer formation being sampled.
Then water was transferred to sampling plastic bucket and then filled into the bottles by using sampling dipper.

A hand-held, narrow mouth bottles

The sample bottles were partially filled and rinsed with the water to be sampled (rinse water).
For bacteriological analysis, the preconditioned sterile glass bottles directly from the analytical laboratory were used.

Onsite water quality monitoring

Total dissolved solid (TDS), Conductivity, Chlorine, Salt, PH value, Temperature were measured on-site at the sampling locations according to the standard operation procedures.

Transportation (shipping) and storage of samples through cold chain till laboratory

After sample collection, sample bottles were kept in a cooling box with ice/ice packs/ice chests until the laboratory.

4.3 Water sample to be measured

Table-1.2 Laboratory services for water analysis provided to project

Laboratory	Parameters
Public Health Laboratory	pH, Color. Turbidity, Total solids, Total Hardness, Total Alkalinity, Calcium, Magnesium, Chloride, Sulphate, Iron, Total Coliforms

References

Bartram, J., & Balance, R. (1996). Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes: CH 5 - Field Work and Sampling. United Nations Environment Programme & the World Health Organization ISBN 0 419 22320 7 (Hbk) 0 419 21730 4 (Pbk). Retrieved from http://www.who.int/water_sanitation_health/resourcesquality/waterqualmonitor.pdf

U.S. Geological Survey Techniques of Water-Resources Investigations: Book 9Handbooks for Water-Resources Investigations: CH A4.Collection of Water Samples (2006).US Geological Survey. Retrieved from http://pubs.water.usgs.gov/twri9A/

Water sampling and analysis - World Health Organization, www.who.int/water_sanitation_health/dwq/2edvol3d.pdf

Yeskis, D. * & Zavala, B. **, May 2002, Ground-Water Sampling Guidelines for Superfund & RCRA Project Managers: GROUND WATER FORUM ISSUE PAPER, EPA 542-S-02-001United States Environmental Protection Agency (USEPA). Retrieved from https://www.epa.gov/sites/production/files/2015-06/documents/gw_sampling_guide.pdf

Groundwater Sampling https://www.epa.gov/foia/groundwater-sampling

5 Surface Water Sampling Methodology

5.1 Preparation before leaving for the field site.

Sample bottles and sampling dipper were washed and cleaned with purified water as well as deionized water for three times, filled preservatives if needed and capped securely. These procedures were unnecessary for the sample bottles sent by the international lab as all bottles were already prepared and sealed.

Prepare the one page check list for the list of water parameters to be tested, label sample parameters, site identification code and a field date and time on the bottles.

Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.

Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.

Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.

5.2 Sampling procedure and sampling device

The physical location of the investigator when collecting a sample may dictate the equipment to be used. If surface water samples are required, direct dipping of the sample container into the stream is desirable. Collecting samples in this manner is possible when sampling from accessible locations such as stream banks or by wading or from low platforms, such as small boats or piers. Wading or streamside sampling from banks, however, may cause the re-suspension of bottom deposits and bias the sample. Wading is acceptable if the stream has a noticeable current (is not impounded), and the samples are collected while facing upstream. If the stream is too deep to wade, or if the sample must be collected from more than one water depth, or if the sample must be collected from an elevated platform (bridge, pier, etc.), supplemental sampling equipment must be used.
To collect a surface water sample from a water body or other surface water conveyance, a variety of methods can be used:

- Dipping Using Sample Container
- Scoops
- Peristaltic Pumps
- Submersible Pumps
- Discrete Depth Samplers
- Bailers
- Buckets

Regardless of the method used, precautions should be taken to insure that the sample collected is representative of the water body or conveyance. These methods are discussed in the following sections.

One member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.

Gloves and sampling dipper

In general, water samples were collected using clean sampling dipper in order to avoid sample contamination from other sources according to the standard operation procedures.

Before sample collection, appropriate measures including wearing a clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised and rinsing of sampling dipper with native water were carried out so as to condition, or equilibrate to the sample environment and make sure that all cleaning-solution residues have been removed.

Onsite water quality monitoring
Total dissolved solid (TDS), Conductivity, Chlorine, Salt, PH value, Temperature were measured on-site at the sampling locations according to the standard operation procedures.

A hand-held, narrow mouth bottles
The sample bottles were partially filled and rinsed with the water to be sampled (rinse water). In order to avoid suspended sand particles, water for rinsing was collected at the edge of the stream in an area of low-flow turbidity and then drained the rinse water.

Transportation (shipping) and storage of samples through cold chain till laboratory
After sample collection, sample bottles were kept in a cooling box with ice/ice packs untill the laboratory.

5.3 Water sample to be measured

Table-1.2 Laboratory services for water analysis provided to project

Laboratory	Parameters
Public Health Laboratory	pH, Color. Turbidity, Total solids, Total Hardness, Total Alkalinity, Calcium, Magnesium, Chloride, Sulphate, Iron, Total Coliforms

References:

Bartram, J., &Balance, R. (1996). Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes:CH 5 - Field Work and Sampling. United Nations Environment Programme & the World Health Organization ISBN 0 419 22320 7 (Hbk) 0 419 21730 4 (Pbk). Retrieved from http://www.who.int/water_sanitation_health/resourcesquality/waterqualmonitor.pdf

Franceska D. W. (2004). U.S. Geological Survey Techniques of Water-Resources Investigations: Book 9Handbooks for Water-Resources Investigations: CH A3.Cleaning of equipment for water Sampling (Ed).US Geological Survey. Retrieved from http://pubs.water.usgs.gov/twri9A/

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Surface Water Sampling
https://www.epa.gov/foia/surface-water-sampling

6 Soil Sampling Methodology

6.1 Soil Sampling Location

Baseline soil sampling was conducted at at the nearest village firm. In the area approximately 1 acre of land, (5) soil samples were collected at four corner of land and the center of the land respectively in accordance with the standard operation procedures. The locations of monitoring sites are presented as follows:

6.2 Manual soil sampling method

(i) Hand Augers

Hand augers may be used to advance boreholes and collect soil samples in the surface and shallow subsurface intervals. Typically, 6-inch stainless steel auger buckets with cutting heads are used. The bucket is advanced by simultaneously pushing and turning using an attached handle with extensions (if needed).

(ii) Surface soil sampling

When conducting surface soil sampling with hand augers, the auger buckets may be used with a handle alone or with a handle and extensions. The bucket is advanced to the appropriate depth and the contents are transferred to the homogenization container for processing.

(ii) Special Considerations for Soil Sampling with the Hand Auger

• Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
• Power augers, may be used to advance boreholes to depths for subsurface soil sampling with the hand auger. They may not be used for sample collection. When power augers are used to advance a borehole to depth for sampling, care must be taken that exhaust fumes, gasoline and/or oil do not contaminate the borehole or area in the immediate vicinity of sampling.
• When moving to a new sampling location, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

6.3 General

These methods are used primarily to collect shallow and deep subsurface soil samples. If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with these devices.
.

6.4 Soil sampling procedure

Soil samples were collected from drill -holes dug approximately 0.2m depth by soil auger (hand auger drill). During sample collection, wear the glove, rinse glove and soil auger with clean water. Samples were transferred into wide-mouth glass bottles and sent to an accredited laboratory. Parameters tested included basic soil chemistry as well as metals. Soil samples were collected according to the standard procedure and kept in a cooling box at 4˚C till the respective laboratory.

6.5 Soil sample to be measured

Table 1.2: Laboratory services for soil analysis provided to project

Laboratory	Parameters
Public Health Laboratory	Moisture, pH, EC, Total N, Available P, Available K_2O, Exchangeable cations K^+, Cadmium, Chromium, Lead, Zinc, Copper, Iron, Manganese, Texture (Sand, Silt, Clay)

References

CarterM.R.,& GregorichE.G. (2006). Soil Sampling and Methods of analysis (2nded.). Taylor & Francis Group, LLC. Retrieved from

http://www.niordc.ir/uploads%5C86_106_Binder1.pdf

Midwest Laboratories, Inc. Soil Sampling. Omaha: 13611 B Street. Retrieved from http://agrienergy.net/docs/lab-information/soil-sampling.pdf

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U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens,Georgia.

(1) Air Monitoring Raw Data

Main | Preferences | Header | Data | Report

Environmental Report

Record Cnt 509

Start Date 9/14/2020 9:02:00 AM

End Date 9/14/2020 5:30:00 PM

	CO ppm	NO2 ppm	O3 ppm	PM10 ppm	PM25 ppm	RH %	SO2 ppm	TmpC Deg. C	Pwr V
Ave	**.076206**	**.004183**	**.010525**	**.034838**	**.005962**	**33.2994**	**.000311**	**20.0023**	**12.0139**
Max	1.534	.036	.024	1.015	.132	68.4	.016	37.4	12.3
Min	0	0	0	.003	.002	0	0	0	12

Environmental Report

Start: 9/14/2020 9:02 AM End: 9/14/2020 5:30 PM

Collected by:

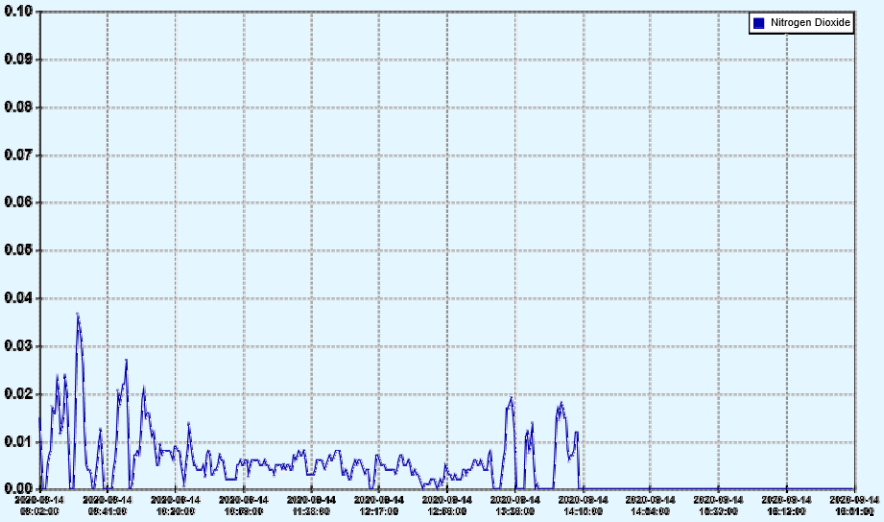
Logger ID 912005 Record Count 509

Nitrogen Dioxide

Sensor ID

Range: 0 to 10000 ppb

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.004183	.036	ppm				

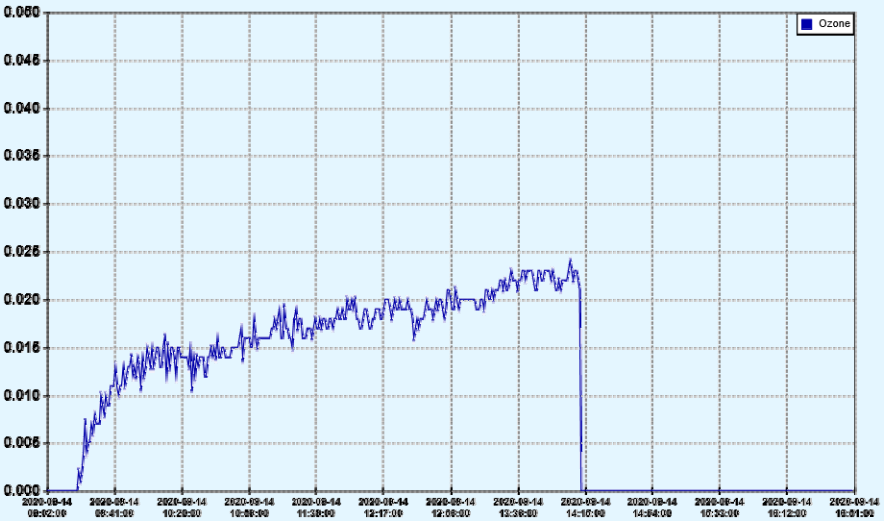


Ozone

Sensor ID

Range: 0 to 150 ppb

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.010525	.024	ppm				



Environmental Report

Start: 9/14/2020 9:02 AM End: 9/14/2020 5:30 PM

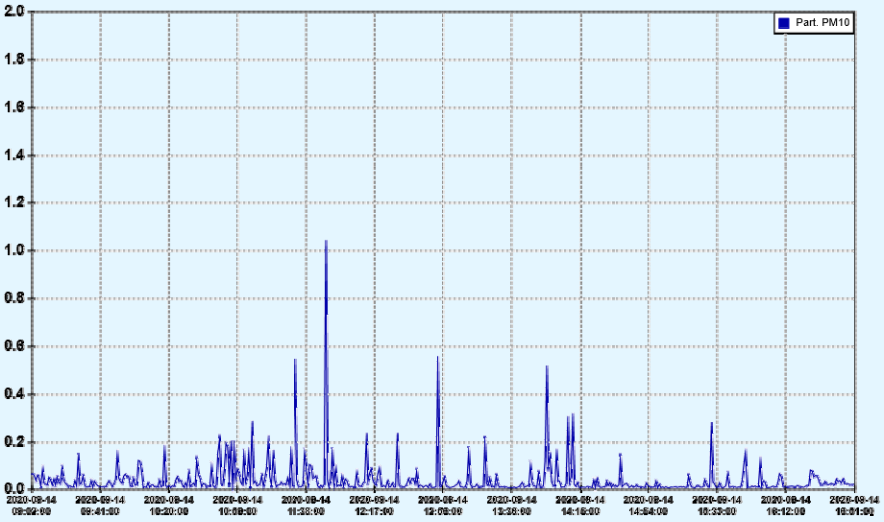
Collected by:

Logger ID 912005 Record Count 509

Prt10 **Part. PM10** Prt10 Sensor ID

Range: 0 to 20000 uG/m3

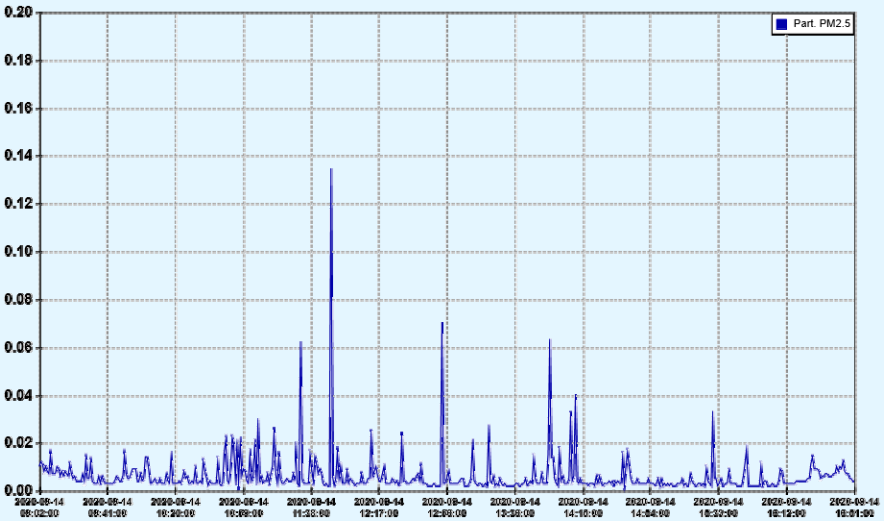
Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
.003	.034838	1.015	ppm				



Prt10 **Part. PM2.5** Prt10 Sensor ID

Range: 0 to 20000 uG/m3

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
.002	.005962	.132	ppm				



Environmental Report

Start: 9/14/2020 9:02 AM End: 9/14/2020 5:30 PM

Collected by:

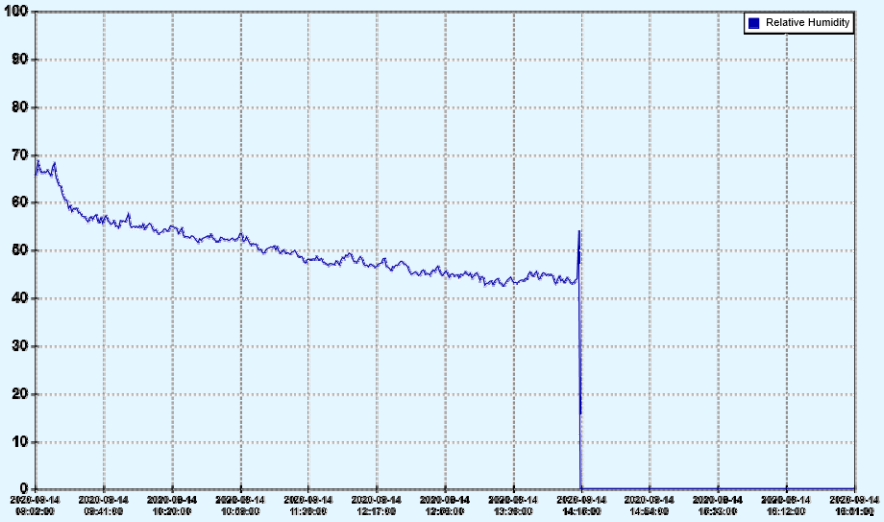
Logger ID 912005 Record Count 509

Relative Humidity

Sensor ID

Range: 0 to 100 %

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	33.2994	68.4	%				

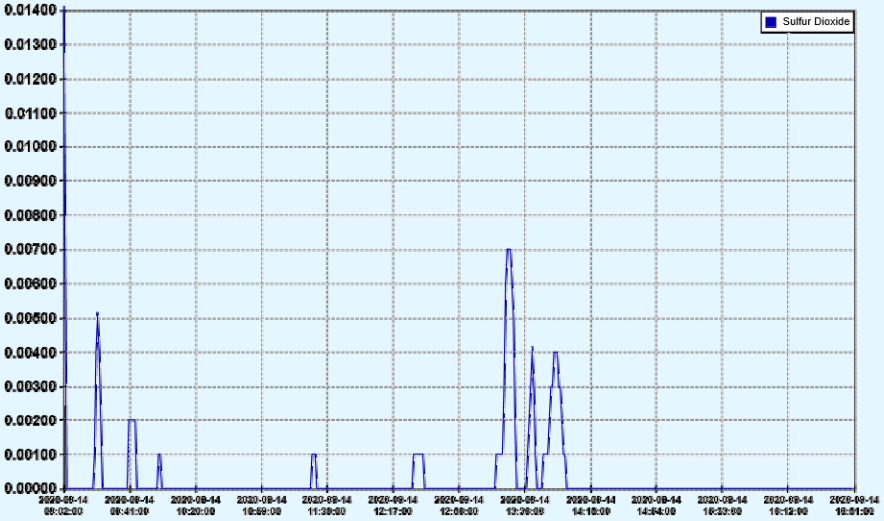


Sulfur Dioxide

Sensor ID

Range: 0 to 10000 ppb

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.000311	.016	ppm				



Environmental Report

Start: 9/14/2020 9:02 AM End: 9/14/2020 5:30 PM

Collected by:

Logger ID 912005

Record Count 509

TEMP

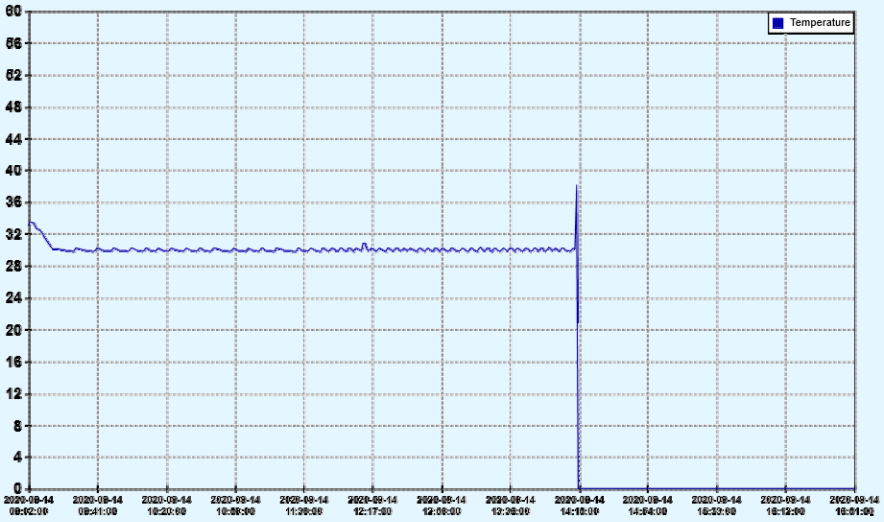
Temperature

TEMP

Sensor ID

Range: -20 to 60 Deg. C

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	20.0023	37.4	Deg. C				



CO

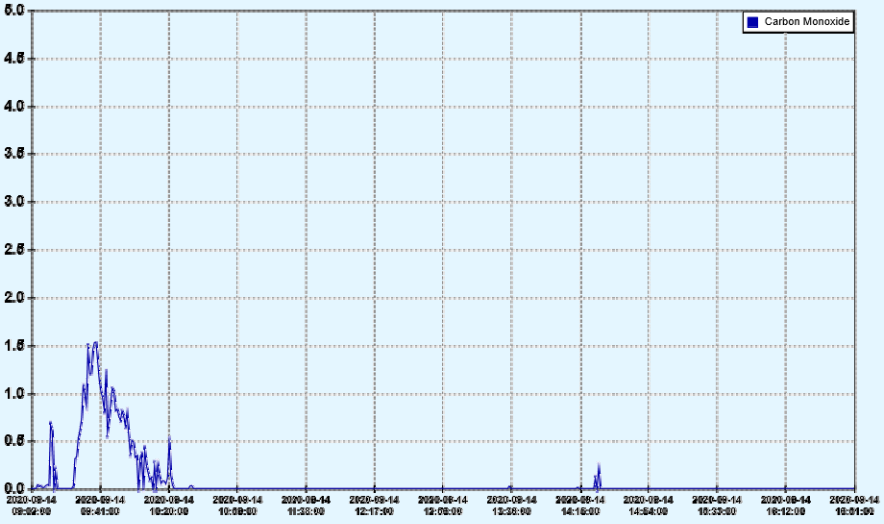
Carbon Monoxide

CO

Sensor ID

Range: 0 to 15 ppm

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.076206	1.534	ppm				



Environmental Report

Start: 9/14/2020 9:02 AM End: 9/14/2020 5:30 PM

Collected by:

Logger ID 912005

Record Count 509

Batt.

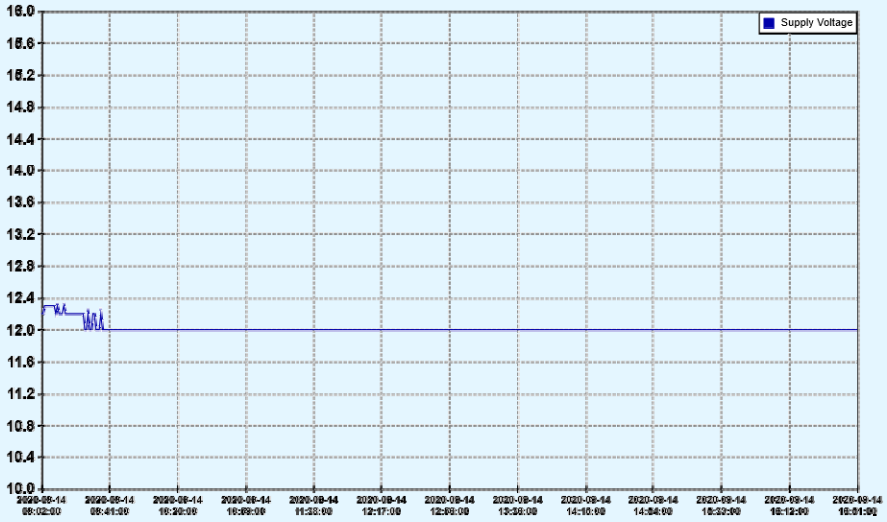
Supply Voltage

Batt.

Sensor ID

Range: 10 to 16 V

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
12	12.0139	12.3	V				



Main | Preferences | Header | Data | Report

Environmental Report

Record Cnt 1446

Start Date 9/14/2020 9:34:00 AM

End Date 9/15/2020 9:39:00 AM

	CO ppm	NO2 ppb	O3 ppb	PM10 uG/m3	PM25 uG/m3	RH %	SO2 ppb	TmpC Deg. C	WDir Deg.	WSpM m/s	Pwr V
Ave	**.095060**	**.002676**	**.018205**	**.010768**	**.003955**	**60.9495**	**.004072**	**25.3374**	**141.817**	**.610982**	**12.0139**
Max	1.949	.073	.039	.442	.042	83	.014	35.2	360	3.14	12.3
Min	0	0	0	.002	.001	0	0	0	0	0	12

Environmental Report

Start: 9/14/2020 9:34 AM End: 9/15/2020 9:39 AM

Collected by:

Logger ID 912005

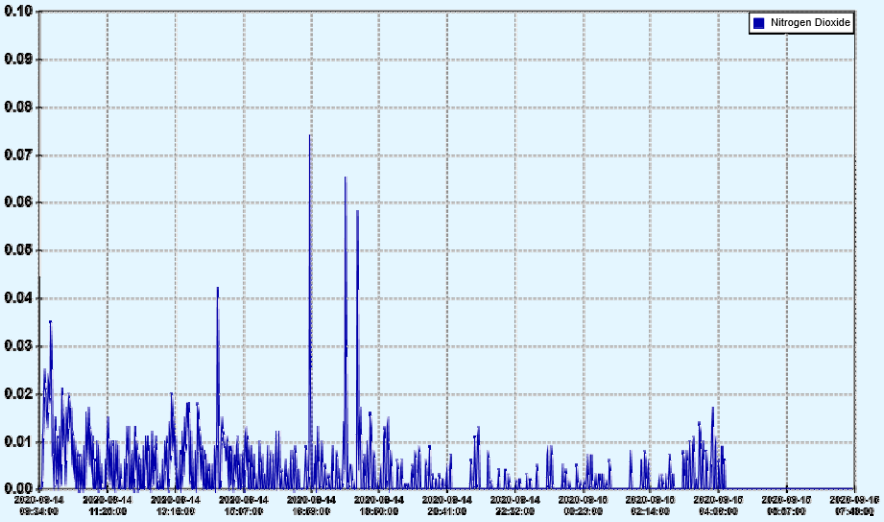
Record Count 1446

Sensor ID

Nitrogen Dioxide

Range: 0 to 10000 ppb

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.002676	.073	ppm				

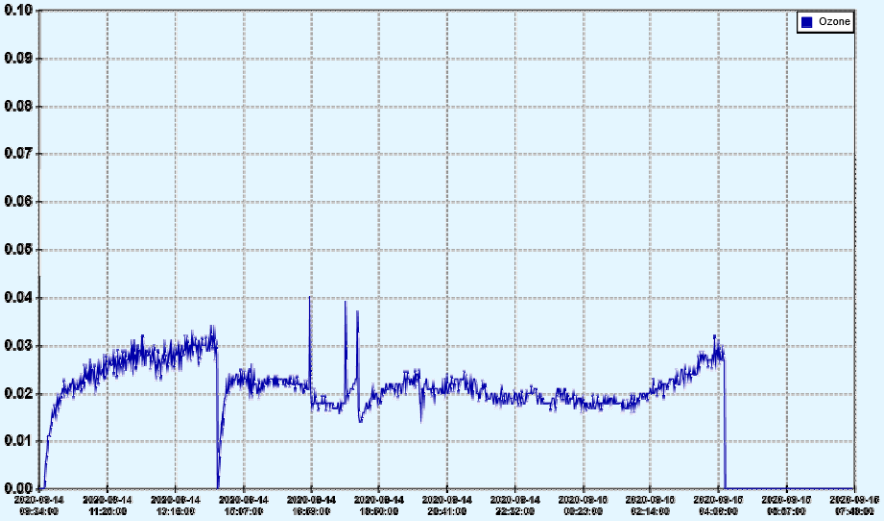


Sensor ID

Ozone

Range: 0 to 150 ppb

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.018205	.039	ppm				



Environmental Report

Start: 9/14/2020 9:34 AM End: 9/15/2020 9:39 AM

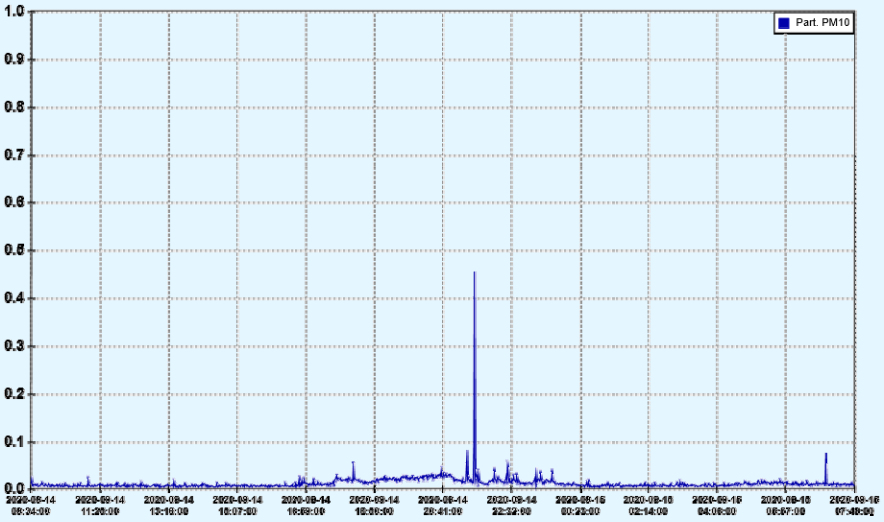
Collected by:

Logger ID 912005 Record Count 1446

Prt10 **Part. PM10** Prt10 Sensor ID

Range: 0 to 20000 uG/m3

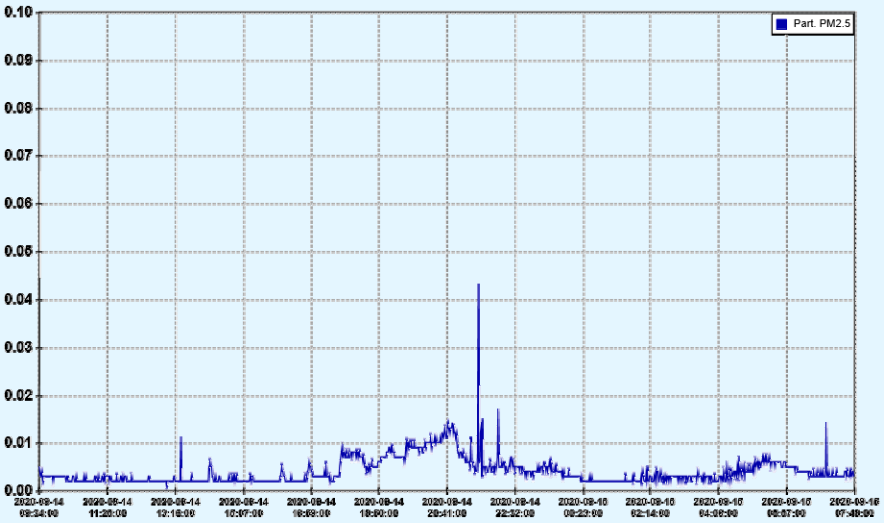
Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
.002	.010768	.442	ppm				



Prt10 **Part. PM2.5** Prt10 Sensor ID

Range: 0 to 20000 uG/m3

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
.001	.003955	.042	ppm				



Environmental Report

Start: 9/14/2020 9:34 AM End: 9/15/2020 9:39 AM

Collected by:

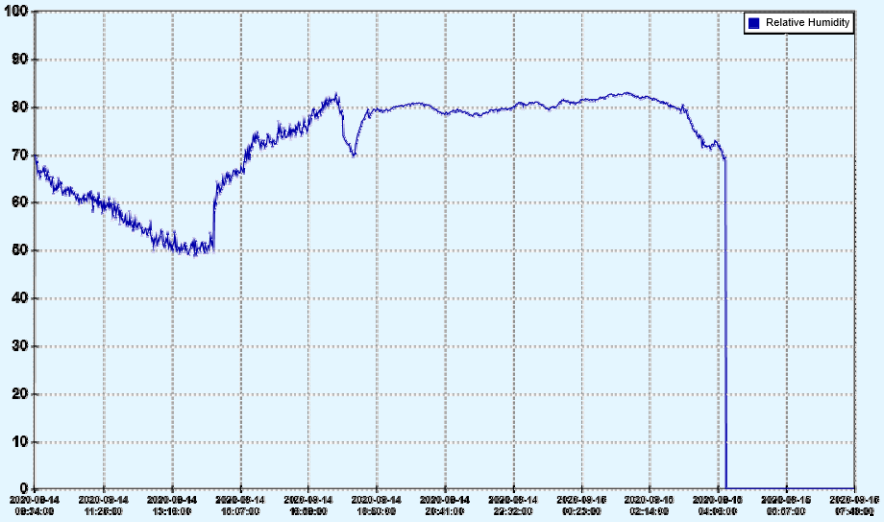
Logger ID 912005 Record Count 1446

Relative Humidity

Sensor ID

Range: 0 to 100 %

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	60.9495	83	%				

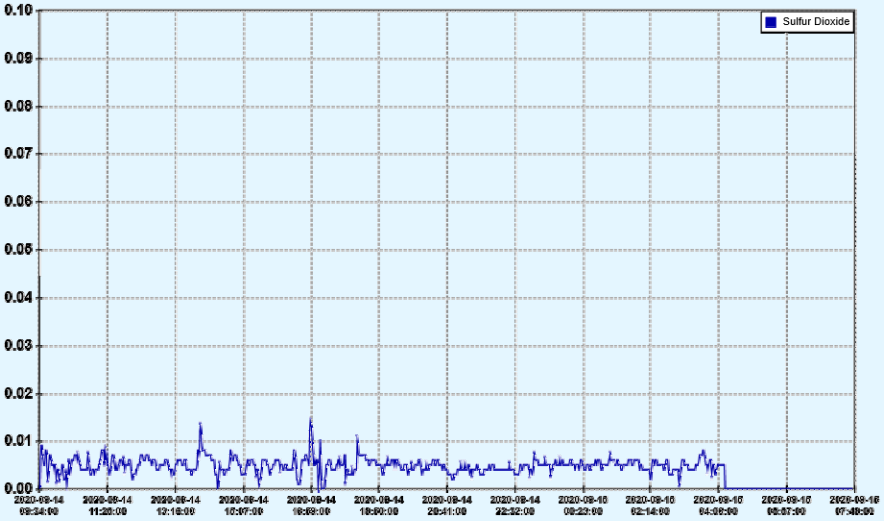


Sulfur Dioxide

Sensor ID

Range: 0 to 10000 ppb

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.004072	.014	ppm				



Environmental Report

Start: 9/14/2020 9:34 AM End: 9/15/2020 9:39 AM

Collected by:

Logger ID 912005

Record Count 1446

TEMP

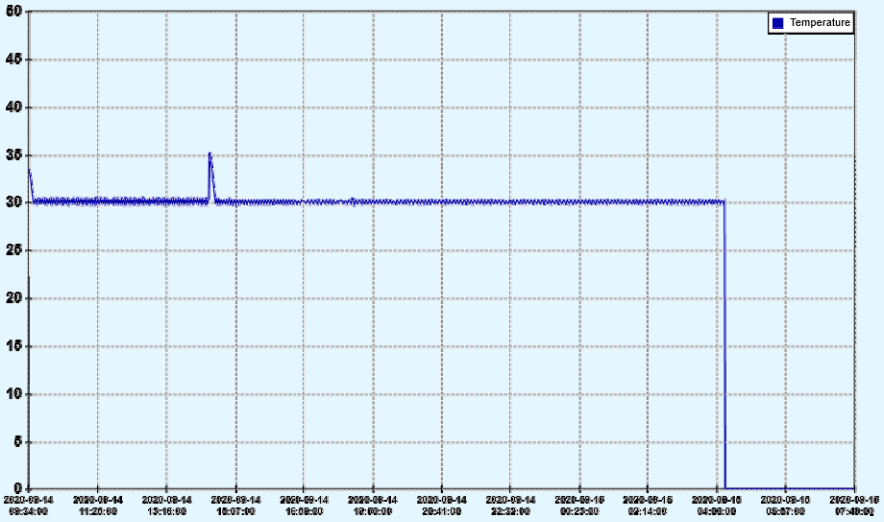
Temperature

TEMP

Sensor ID

Range: -20 to 60 Deg. C

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	25.3374	35.2	Deg. C				



CO

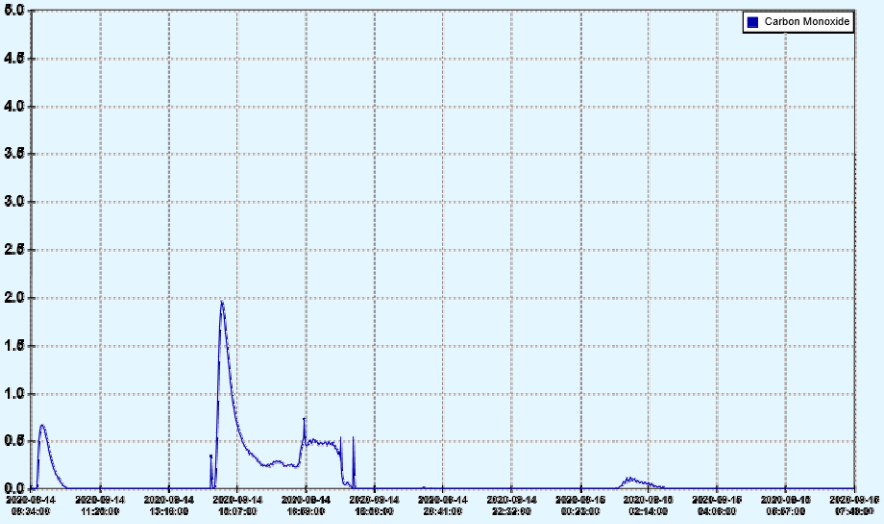
Carbon Monoxide

CO

Sensor ID

Range: 0 to 15 ppm

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.095060	1.949	ppm				



Environmental Report

Start: 9/14/2020 9:34 AM End: 9/15/2020 9:39 AM

Collected by:

Logger ID 912005

Record Count 1446

W. DIR.

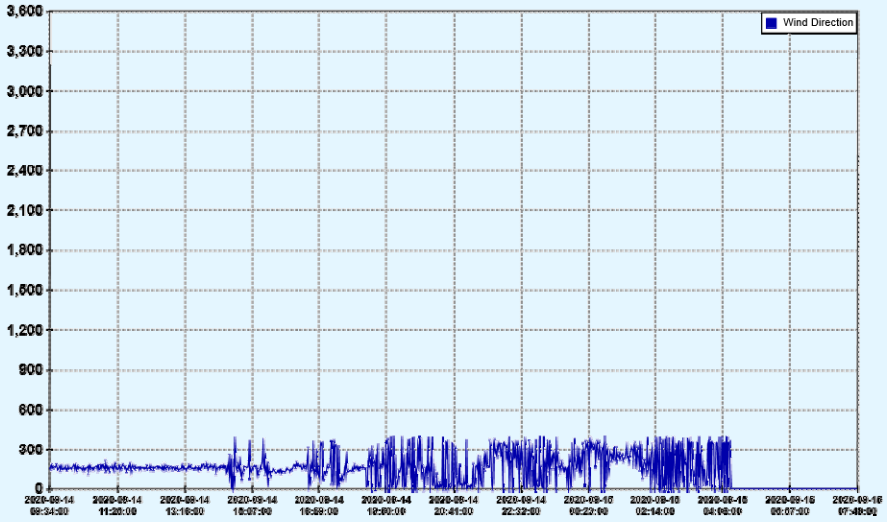
Wind Direction

W. DIR.

Sensor ID

Range: 0 to 359 Deg.

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	141.817	360	Deg.				



W. SPD.

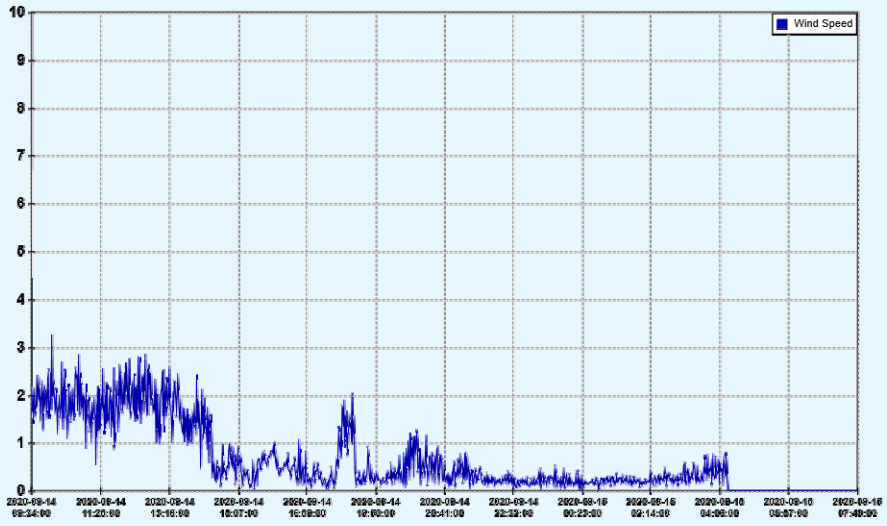
Wind Speed

W. SPD.

Sensor ID

Range: 0 to 160 kph

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
0	.610982	3.14	m/s				



Environmental Report

Start: 9/14/2020 9:34 AM End: 9/15/2020 9:39 AM

Collected by:

Logger ID 912005

Record Count 1446

Batt.

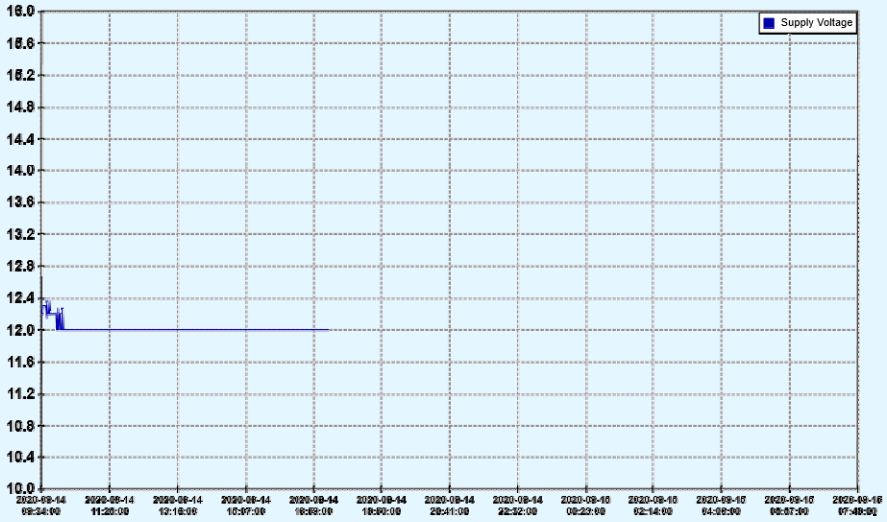
Supply Voltage

Batt.

Sensor ID

Range: 10 to 16 V

Min	Ave	Max		Hi Limit	% Above Hi	Lo Limit	% Below Lo
12	12.0139	12.3	V				



(2) Laboratory Result Data

Laboratory Results for Surface Water

THE REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF HEALTH AND SPORTS
DEPARTMENT OF MEDICAL SERVICES
PUBLIC HEALTH LABORATORY

35 Street, BETWEEN 65 &66 STREET, MAHAR AUNG MYAE Township, Mandalay

Lab ID No: PHL - 0249/ 2020

Date of Water sample received: 11.9.2020

Sender: [illegible]

Date of report: 14.9.2020

Description of sample:

1. Source of sample : [illegible]
2. Physical Properties: Normal/ Turbid/ ------Colour
3. Purpose of Analysis: Bacteriological Examination of Water

Result of Analysis

Standard Plate Count	CFU/ML					
Probable Coliform Count	0/5	1/5	2/5	3/5	4/5	5/5
E. coli Count	Isolated			Not isolated		

Remarks:

Satisfactory	Unsatisfactory

Tested By: [signature]

Approved By: [signature]

Dr May Wint War
M.B.,B.S, M. Med Sc
PhD (Microbiology)
Deputy Director
Public Health Laboratory
Mandalay

MINISTRY OF HEALTH AND SPORT

PUBLIC HEALTH LABORATORY

35th St, Bet: 64th x 65th St, Mandalay, Ph :094039839

Name--ဆလိုင်ကော်ကြီး---------- Lab Code No--၀၃၅၉၂၀----------

Date of Receipt--၁၁.၉.၂၀---------- Date of Report--၁၄.၉.၂၀----------

Source of Water--ရေတွင်းရေ------ External App: ----------------------

NO	Chemistry tested	Result	Maximum level	Unit
1	Colour	Clear /5	50	Units
2	Turbidity	–	25	NTU
3	PH	၈.၃	6.5 to 9.2	mg/l
4	Total solids	၃၃၅	1500	mg/l
5	Total Hardness (Caco3)	၁၀၀	500	mg/l
6	Total Alkalinity (Caco3)	၁၀၀	950	mg/l
7	Calcium (Ca)	၃၄	200	mg/l
8	Magnesium (Mg)	၁၀	150	mg/l
9	Chloride (Cl)	၃၀	600	mg/l
10	Sulphate (So4)	၁၉	400	mg/l
11	Iron (Fe)	Nil	1	mg/l

Remark: Potable : ဓာတုဗေဒစစ် အဖြေ ကောင်းမွန်ပါသည်။

: Unpotable : ဓာတုဗေဒစစ် အဖြေ မကောင်းပါ။

Tested by:------AKK------------ Approved by------------

Dr May Wint War
M.B.,B.S, M. Med Sc
PhD (Microbiology)
Deputy Director
Public Health Laboratory
Mandalay

Laboratory Results for Ground Water

THE REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF HEALTH AND SPORTS
DEPARTMENT OF MEDICAL SERVICES
PUBLIC HEALTH LABORATORY

35 Street, BETWEEN 65 &66 STREET, MAHAR AUNG MYAE Township, Mandalay

Lab ID No: PHL - 0869/ 2020

Date of Water sample received: 11.9.2020

Sender: ကြာနှီကန်တောကျေးရွာ

Date of report: 14.9.2020

Description of sample:

1. Source of sample : -
2. Physical Properties: Normal/ Turbid/ -------Colour
3. Purpose of Analysis: Bacteriological Examination of Water

Result of Analysis

Standard Plate Count	CFU/ML					
Probable Coliform Count	0/5	1/5	2/5	3/5	4/5	5/5
E. coli Count	Isolated			Not isolated		

Remarks:

Satisfactory	Unsatisfactory

Tested By: YON

Approved By:

Dr May Wint War
M.B.,B.S, M. Med Sc
PhD (Microbiology)
Deputy Director
Public Health Laboratory
Mandalay

MINISTRY OF HEALTH AND SPORT

PUBLIC HEALTH LABORATORY

35th St, Bet: 64th x 65th St, Mandalay, Ph :094039839

Name-- [illegible] ------ Lab Code No-- [illegible] --------------

Date of Receipt-- 11.9.20 -------- Date of Report-- 14.9.20 --------------

Source of Water----------------- External App: ----------------------

NO	Chemistry tested	Result	Maximum level	Unit
1	Colour	Clear 15	50	Units
2	Turbidity	--	25	NTU
3	PH	7.5	6.5 to 9.2	mg/l
4	Total solids	1150	1500	mg/l
5	Total Hardness (Caco3)	420	500	mg/l
6	Total Alkalinity (Caco3)	650	950	mg/l
7	Calcium (Ca)	40	200	mg/l
8	Magnesium (Mg)	77	150	mg/l
9	Chloride (Cl)	140	600	mg/l
10	Sulphate (So4)	192	400	mg/l
11	Iron (Fe)	Nil	1	mg/l

Remark: Potable : ခါတုဗေဒစစ် အဖြေ ကောင်းမွန်ပါသည်။

: Unpotable : ခါတုဗေဒစစ် အဖြေ မကောင်းပါ။

Tested by:----- ABK ---------- Approved by----------------------

Dr May Wint War
M.B.,B.S, M. Med Sc
PhD (Microbiology)
Deputy Director
Public Health Laboratory

THE REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF HEALTH AND SPORTS
DEPARTMENT OF MEDICAL SERVICES
PUBLIC HEALTH LABORATORY

35 Street, BETWEEN 65 &66 STREET, MAHAR AUNG MYAE Township, Mandalay

Lab ID No: PHL -0229/ **2020**

Date of Water sample received: - 11.9.2020

Sender: သစ်ရှုပ်ကျေးရွာ

Date of report: 14.9.2020

Description of sample:

1. Source of sample :
2. Physical Properties: Normal/ Turbid/ ------Colour
3. Purpose of Analysis: Bacteriological Examination of Water

Result of Analysis

Standard Plate Count	CFU/ML					
Probable Coliform Count	0/5	1/5	2/5	3/5	4/5	5/5
E. coli Count	Isolated			Not isolated		

Remarks:

Satisfactory	Unsatisfactory

Tested By: YDN

Approved By:

Dr May Wint War
M.B.,B.S, M. Med Sc
PhD (Microbiology)
Deputy Director
Public Health Laboratory
Mandalay

MINISTRY OF HEALTH AND SPORT

PUBLIC HEALTH LABORATORY

35th St, Bet: 64th x 65th St, Mandalay, Ph :094039839

Name---အင်ဂုလျင်ကျေးရွာ------ Lab Code No---၀၈၆၉၇၀----------

Date of Receipt---၁၁.၉.၂၀------- Date of Report---၁၄.၉.၂၀----------

Source of Water------------------ External App: ----------------------

NO	Chemistry tested	Result	Maximum level	Unit
1	Colour	Clear /5	50	Units
2	Turbidity	–	25	NTU
3	PH	၇.၃	6.5 to 9.2	mg/l
4	Total solids	၉၈၅	1500	mg/l
5	Total Hardness (Caco3)	၅၂၀	500	mg/l
6	Total Alkalinity (Caco3)	၄၅၀	950	mg/l
7	Calcium (Ca)	၇၂	200	mg/l
8	Magnesium (Mg)	၈၂	150	mg/l
9	Chloride (Cl)	၁၀၀	600	mg/l
10	Sulphate (So4)	၂၃၀	400	mg/l
11	Iron (Fe)	Nil	1	mg/l

Remark: Potable : ဓာတုဗေဒစစ် အဖြေ ကောင်းမွန်ပါသည်။

: Unpotable : ဓာတုဗေဒစစ် အဖြေ မကောင်းပါ။

Tested by:--AKK-------------- Approved by---------------------

Dr May Wint War
M.B.,B.S, M. Med Sc
PhD (Microbiology)
Deputy Director
Public Health Laboratory

Laboratory Results for Soil

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
စိုက်ပျိုးရေး၊ မွေးမြူရေးနှင့် ဆည်မြောင်းဝန်ကြီးဌာန
စိုက်ပျိုးရေးဦးစီးဌာန
(မြေအသုံးချရေးဌာနခွဲ)
မန္တလေးမြို့။

စာအမှတ်- ၈၈-၁ / ၂၀၁၉-၂၀ / ၅၇၃
နေ့စွဲ၊ ၂၀၂၀ ခုနှစ် ၊စက်တင်ဘာလ (၂၃) ရက်

အကြောင်းအရာ။ **။ မြေနမူနာ ဓါတ်ခွဲအဖြေပေးပို့ခြင်း။**
ရည်ညွှန်းချက် ။ **။ Dr. သွဲ့မူမူမြင့် မှ (၁၁.၉.၂၀၂၀) ရက်နေ့တွင်ပေးပို့လာသော မြေနမူနာ (၂) မျိုး။**

အထက်အကြောင်းအရာပါ ကိစ္စနှင့်ပတ်သက်၍ ရည်ညွှန်းချက်ဖြင့် ပေးပို့လာသော မြေနမူနာ (၂) မျိုးအား ဓါတ်ခွဲစစ်ဆေးပြီးဖြစ်၍ ဓါတ်ခွဲတွေ့ရှိချက် အဖြေများကို ဤစာနှင့်အတူ ပူးတွဲပေးပို့ပါသည်။

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Dr. သွဲ့မူမူမြင့်

မိတ္တူကို -
- ရုံးလက်ခံ။

DEPARTMENT OF AGRICULTURE (LAND USE)

SOIL ANALYTICAL DATA SHEET

Division –

Township –မန္တလေးမြို့။

Sheet No. – 1

Lab No. –

Sr. No.	Sample Name	Moisture (%)	pH (1:2.5)	EC mS/cm (1:5)	Total N (%)	Available P (ppm)	Available K_2O (mg/ 100g)	Exchangeable Cations K^+ (meq/100 g)	Texture		
									Sand (%)	Silt (%)	Clay (%)
1.	Dr. သွဲ့မူမူမြင့် (ညောင်ပင်စောက်ကျေးရွာ)	1.47	8.44	0.12	0.25	12.43	21.31	0.45	69.1	11.83	19.07
2.	Dr. သွဲ့မူမူမြင့် (ကြာနီကန်ကျေးရွာ)	1.72	8.3	0.17	0.21	7.93	15.25	0.32	46.7	31.03	22.27

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မန္တလေးမြို့။

DEPARTMENT OF AGRICULTURE (LAND USE)

SOIL INTERPRETATION OF RESULTS

Division –

Township –မန္တလေးမြို့။

Sheet No. – 2

Lab No. –

Sr. No.	Sample Name	pH	EC	Organic Carbon	Total N	Available P	Available K_2O	Exchangeable Cations K^+	Texture
1.	Dr. သွဲ့မူမူမြင့် (ညောင်ပင်စောက်ကျေးရွာ)	Strongly Alkaline	Very Low	Medium	High	High	High	High	Sandy Loam
2.	Dr. သွဲ့မူမူမြင့် (ကြာနီကန်ကျေးရွာ)	Moderately Alkaline	Low	Medium	Medium	Medium	Medium	Medium	Loam

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မန္တလေးမြို့။

DEPARTMENT OF AGRICULTURE (LAND USE)

SOIL ANALYTICAL DATA SHEET

Division –

Township –မန္တလေးမြို့။

Sheet No. – 3

Lab No. –

Sr. No.	Sample Name	Cd (ppm)	Cr (ppm)	Pb (ppm)	Zn (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)
1.	Dr. သွဲ့မူမူမြင့် (ညောင်ပင်စောက်ကျေးရွာ)	Not detected	0.69	Not detected	1.75	0.41	0.41	53.02
2.	Dr. သွဲ့မူမူမြင့် (ကြာနီကန်ကျေးရွာ)	Not detected	Not detected	3.24	1.84	2.06	55.1	89.88

For Cd, Not detected means < 0.02 ppm × 4

For Cr, Not detected means < 0.1 ppm × 4

For Pb , Not detected means < 0.1 ppm × 4

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ANNEX (B)

Impact Assessment Methodology

1 Environmental Aspect Identification

The ISO's standard for Environmental Management Systems (EMS), ISO 14001 defines an environmental aspect as:

'*An element of an organization's activities, products or services that can interact with the environment or social make-up of nearby communities.*'

This definition has been used in the identification of the proposed project's environmental, health, socio-economic, and legal aspects. To identify project aspects, all proposed activities, have been considered in terms of their direct or indirect potential to:

- Breach relevant policy, legal and administrative frameworks including Government Agreement and national legislation, relevant international legislation, standards and guidelines, and corporate environmental policy and management systems
- Interact with the existing natural environment including its physical and biological elements
- Interact with the existing socio-economic environment

1.1 Environmental Impact Assessment

An impact may result from any of the project activities identified during the screening process. The potential impacts will be assessed for their significance level (high, medium, low) based on standard criteria as outlined below.

1.1.1. Criteria for Environmental Impact Assessment

Identify criteria to specify the impact significance level (high, medium, and low) by considering magnitude, extent, duration, reversibility/irreversibility, and likelihood of impact.

1.1.2 Method for Environmental Impact Assessment

The assessment of environmental impacts for key issues consists of 3 main stages as shown below:

1. Identification of impact source and receptor
2. Impact prediction
3. Assessment of the impact significance level

Stage 1: Identification of Impact Source and Receptor

1. Identify project activities that are impact sources and explain details of these activities.
2. Identify the impact receptors and explain environmental settings of impact receptors.

Stage 2: Impact Prediction

Impact prediction is the assessment of the characteristics and magnitude of expected impacts. There are many methods used for impact assessment, and the selection of a method for impact assessment for the proposed project depends on the type of environment and resources, time, existing technology, and experience of the assessor.

Stage 3: Assessment of Impact Significance Level

Once project impacts have been predicted it is important to assess the potential significance of the impact. Impact significance is rated as insignificant, low, medium, or high. The rating of impact

significance is based on both objective and subjective criteria. The following criteria in **Table 1.1**will be considered when rating impact significance:

Table 1.1: Impact Significance Criteria

Criteria	Significance
Extent	This is the extent to which the potential impact may eventually extend (e.g., local, regional, national, global), as well as to geographical location. Regional impacts, those impacts that extend beyond the project area, are generally considered more significant than local impacts that are limited to the project area. Extent should also consider the people affected, such as how pervasive will the impact be across the population? This criterion should be used to assess both the percentage of the population affected and the extent to which it will affect different social or demographic groups, particularly the vulnerable groups (e.g. children, elderly, pregnant women, indigenous population, etc.).
Local sensitivity	To what extent is the local population aware of the impact? Is it perceived to be significant? Has it been a source of previous concern in the community? Are there any organized interest groups likely to be mobilized by the impact?
Expense	Costs and expenses required to reduce or clean up impacts, the responsible person or entity who has to bear the expenses, and whether the expense has to be paid immediately or not.
Potential of related organizations	Current potential of related organizations to manage impacts, whether supporting laws and regulations exist, and whether local governmental organizations can handle the impacts.
Risk	The probability/predictability of an impact occurring. For many environmental impacts, qualitative assessments would be appropriate (high, medium, low).
Duration and Frequency	The length of time (day, year, decade) for which an impact may be discernible, and the nature of that impact over time (is it intermittent and/or repetitive?). Long-term impacts, those impacts that may last for an extended period of time are considered more significant than short-term impacts that are limited to a few days or months.
Reversibility	How long will it take to mitigate the impact by natural or man-induced means? Reversible impacts, those impacts that will be fully reversed after the activity that causes the impact ceases, are considered less significant than irreversible impacts.

Criteria	Significance
Magnitude	The probable severity of each potential adverse impact, in the sense of degree, extensiveness or scale. Magnitude takes into account numerous factors related to the environmental resource and socio-cultural values. This is largely subjective based upon values of society. Another important factor in determining the magnitude of an impact is the degree of variation from baseline conditions.
Uncertainty	In addition, the level of confidence of impact predictions reflects the quality and quantity of available site-specific data, experience from implementation of similar projects, and the expertise of the EIA project team. Where all else is similar, assessments that are more speculative in nature for any particular project activity are generally given a higher impact rating than ones based on a higher level of confidence.
Cumulative Impacts	Whether occurring impacts will be added on existing impacts or not, which will be used to consider whether the cumulative impacts exceed the maximum acceptable level or not.
Overall Impacts	Based on the above, each impact is rated as low, medium or high. Medium or high impacts are ones that require specific mitigation and/or monitoring measures.
Residual Impact	Impacts that remain after mitigation measures have been applied.
Mitigation Measure	An action that prevents, eliminates, reduces or compensates for a negative impact.

The significance of an impact is evaluated using Scaling and Matrix methods. Each impact is assessed based on its "characteristics" and "importance".

Significance = Characteristics x Importance

Characteristic is determined using magnitude, extent, and duration of impacts. Importance of impact is determined using the values of resources and environment that are lost or decreased as a result of the project activities.

There are three stages for evaluation of impact significance level.

Stage 1: Analysis of Impact Characteristics

Analysis of impact characteristics is determined using the sum of magnitude, extent, and duration of the impact. The criteria for impact assessment are shown in

Table 1.2.

Impact Characteristics = Magnitude + Extent + Duration

Table 1.2: General Criteria and Scoring for Environmental Impact Characteristics (1)

Level	Definition	Score
Magnitude		
High	• Exceed the standard values	3

	• Major change in the original structure of environmental system, ecosystem or baseline.	
Medium	• Less than the standard values • Change some factors in environmental system, ecosystem or baseline, but does not change the structure.	2
Low	• Less than the standard values • Small change in some factors of the environmental system, ecosystem, or baseline but does not change the structure.	1
Insignificant	• Less than the standard values • No change in the environmental system, ecosystem, from baseline.	0

Extent		
High	• Area of impact is beyond the 2-km radius of associated facilities/stations. • Impact extends to regional and national level.	3
Medium	• Area of impact is beyond the project area but is in a limited area, for example the area of impact is outside a safety zone but within the 2-km radius of associated facilities.	2
Low	• Area of impact is in the immediate area of the project activity or within a safety zone	1
Insignificant	• Area of impact is not discernible	0
Duration		
High (long-term duration)	• Permanent impact • Impact will remain after well abandonment. • Impact occurs in long-term duration	3
Medium	• Impact can be reversible overtime. • Period of impact occurrence is within the project period. • Impact occurs over mid-term duration	2
Low (short-term duration)	• Impact can be quickly reversible. • Period of impact occurrence is less than the project period. • Impact occurs in short-term duration	1
Total Score for Impact Characteristics = Magnitude + Extent + Duration		

Source: Adapted from Nigel Rossouw (2003); Sippe (1999); and United Nations University (2007)

Total score for impact characteristics (Magnitude + Extent + Duration) will be compared with the criteria and scoring as shown in **Table 1.3**.

Table 1.3: Example of Criteria and Scoring for Environmental Impact Characteristics (2)

Total Score for Impact Characteristics[1]	Impact Level	Definition	Score
7-9	High	Have impact or cause large changes.	3
4-6	Medium	Have impact or cause medium changes.	2
1-3	Low	Have impact or cause small changes.	1
0	Insignificant	No impact	0

Stage 2: Analysis of Importance of Impact

Importance of impact is determined from the values of resources and environment that are lost or decreased from the project activities by comparison with criteria and scoring for importance of impact as shown in **Error! Reference source not found..**

Table 1.4: Example of Criteria and Scoring for Importance of Impact

Impact Level	Definition	Score
High	• Impact disturbs pristine area which has conservation value. • Impact damages rare/endangered species. • Impact is significant on a national or international level.	3
Medium	• Impact disturbs the area which has a value for conservation. • Impact causes a significant change in species and diversity. • Impact is important at a local or regional level.	2
Low	• Impact disturbs degraded area or causes a small disturbance in the area which has a value for conservation. • Impact causes a small change in species and diversity.	1

Stage 3: Impact Significance Evaluation

The significance of environmental impact will be evaluated by using Matrix Method as shown in **Table 1.5**. The calculation of impact significance is shown below:

Significance = Characteristics x Importance

Table 1.5: Evaluation of Significance Level of Environmental Impact

Significance Level of Environmental Impact			Characteristic		
			Low	Medium	High
			1	2	3
Importance	Low	1	Low (1)	Low (2)	Low (3)
	Medium	2	Low (2)	Medium (4)	Medium (6)
	High	3	Low (2)	Medium (6)	High (9)

The results from the evaluation of impact significance will be further used to specify mitigation measures. Examples of definition of impact significance level are shown in **Table 1.6**.

Table 1.6: Example for Definition of Impact Significance Level

Significance Level	Score	Definition
High	7-9	Impact is classified as severe and can cause other effects. Impact can not be protected and resolved by any mitigation measures or scarcely protected or resolved.
Medium	4-6	Impact causes a change that affects values of resources and environment. It needs to have mitigation measures for protecting or decreasing the impacts and include monitoring measures.
Low	1-3	Impact causes a change in resources and environment but this change does not decrease values of these resources and environment. Impact can be protected and resolved by implementation of general measures.

Source: Adapted from Nigel Rossouw (2003) and Sippe (1999)

2. Socio-eco and Health aspect

2.1Socio-economic Baseline

EQM social scientists will define socio-economic baseline conditions. The survey begins with an introductory statement providing background on the proposed project. Interviews with the stakeholders will be then carried out using a pro-forma questionnaire. The questionnaires covered the following main topics:

- Population and Demographics
- Culture, local administration, decision making and planning
- Livelihoods
- Labor and working conditions
- Employment
- Energy
- Health and nutrition
- Water, sanitation and hygiene
- Household structure and migration
- Household assets
- Land ownership
- Infrastructure, resources and services
- Transportation
- Communication
- Environmental and cultural heritage
- Experiences with previous projects
- Awareness, attitudes, and perceptions on four categories: physical resources, ecological resources, human use values, quality-of-life values and cultural heritage.

2.2 Sample Size

The social survey team used to choose a two-stage stratified random sampling for the sampling population. The first-stage unit is 'village' and the second- stage unit is 'household'. At the first stage, the sampled villages will be allocated proportionately to stratum size in each of the selected townships and the primary sampling units (PSU) will be chosen from each township. At the second stage, the households will be selected by using systematic random sampling**.**

The TARO YAMANE formula will be used to determine the correct number of households to be surveyed in the project area with rural household (Population) as shown below. The sample size will reach a standard deviation of less than 3% and confidence interval will be higher than 95% at aggregate level.

$$N = \frac{N}{(1+Ne^2)}$$

n=sample size, N=population, e=error

Socio-economic Environment Survey Method

- Secondary data
- Site Visit
- Focus group meeting (closed and open ended questionnaire)
- Key informant interview (closed and open ended questionnaire)
- Household surveys

2.3 Social Impact Assessment

The evaluation of socio-economic impacts is based on quantitative and qualitative data, and the use of professional judgment. Factors used to analyze for scale of social impacts are similar to the criteria used for environmental impact analysis such as likelihood of impact, direct/indirect impact, duration, reversibility, and magnitude of impact which also takes into consideration threats perceived as significant by the affected communities.

Additional criteria factors include consideration for changes to the assets that households depend upon for their livelihoods, manageability of the change and potential for it to lead to further changes beyond the control of the project, and whether the effects are acute or chronic.

2.1 Social Impact Significance

Significance of social impact is ranked Beneficial, Low, Medium or High using criteria below (**Table 2-1**).

Table 2-1: Social Impact Category

Impact Category	Social Impact
Beneficial	Improvement in the ability of household or settlement to maintain or improve its livelihood/store of assets Enhancement in quality or availability of resource leading to improvement in quality of life. For example: • Enhancement in physical capital including availability of infrastructure • Enhancement in social capital, including skills for future employment • Enhancement of relationship between the PTTEP MOGE-3 project developer and communities • Enhancement in health and safety of local population
Low	Possible short term decrease in availability of resource or access to infrastructure not affecting livelihood Possible short term decrease in quality of life of household or settlement not affecting long term outcomes No effect on human health No discernable long term effect of the local economy Impacts which are long lasting but to which the community is able to adapt, such as increased access to information/possible slow cultural change/changes in economic structure

Impact Category	Social Impact
Medium	Potential effect or perceived effect on ability of household to maintain livelihood/store of assets in short term Potential reduction in quality of life in short term Potential disruption to lifestyle in short term Perception of missed opportunity to improve Possible decrease or perceived decrease in access to infrastructure to which community is unable to adapt in the short term Negative effect on human health which can be contained and is therefore short term with no increased mortality Impacts which may result in high levels of complaint in the short term
High	Negative effect on safety of humans or animals Negative effect on human health which cannot be contained or results in increased mortality Effect or perceived effect on ability of household to maintain livelihood/store of assets to an extent not acceptable to affected people Permanent or perceived permanent reduction in quality of life Permanent cultural change to which the communities are unable to adapt Widespread perception of missed opportunity to improve quality of life, resulting in frustration and disappointment Result in tensions with communities which lead to sabotage by local communities, or outbreaks of violence between workers and communities

3 Health Impact Assessment

Potential impact on health is assessed for both project workers and nearby community. Factors used to analyze for scale of health impacts are similar to the criteria used for environmental and social impact analysis, such as extent, duration, reversibility, and magnitude of impact.

Additional factors unique to health aspects are considered as provided in **Table 3.1**

Table 3.1: Factors for Determining Scope and Type of Health Impact

Factor	Detail
Hazardous Chemicals or Health Threats	• Chemicals: heavy metals, toxic organic compounds. • Physical: noise and vibration • Biological: viruses, bacteria • Ergonomic: lifting of heavy material and/or inappropriate posture • Psychological: stress, annoyance, and nuisance • Social: lack of community relationship
Environment	• Change of environmental quality: water quality, air quality • Change of utilization or acquiring resources: water use • Physical: noise, dust, radiation, vibration
Factors of Exposure	• Exposure pathway: eating or skin exposure • Risk group: worker(s) or people around the project area
Health Impact	• Death rate • Injury rate from infectious diseases or non-infectious diseases, acute or chronic effects • Rate of emotional impact, stress • Injuries and accidents • Impacts on the next generation • Impacts to high-risk groups • Stimulate or enhance the severity of the disease • Cumulative impacts
Impacts on Medical Services	• Overall increase in the demand for health care • Demand for special health care • Changes to existing medical services
Impacts on Society and Human well being	• Impacts on income, employment, and socio-economics • Impacts on local income, industrial sector, and local agriculture • Impacts on migration and settlement • Impacts on environmental health • Impacts on society, culture, and lifestyle • Impacts on education • Impact on social support network • Benefits to health from project operations

Source: World Health Organization

3.1 Health Impact Significance

Method of assessing the significance of health impact is similar to a risk assessment method. The procedure involves setting criteria for analysis of probability/likelihood of health impact occurring and the severity of impact on health.

3.2 Probability of Occurrence

Likelihood is presented in the form of the probability that the impact might affect health. Considerations are based on past data, the probability of exposure or threat from the environment, and the previous data both at a domestic or international level (**Table 3.2**).

Table 3.2: Criteria for Likelihood of Causing Health Impact

Incident Potential Rating	Score	Definition
Very low	1	No evidence that the situation occurs
Low	2	Can occur by theory, but no report of occurrence in the region or abroad
Medium	3	1 time occurrence in Myanmar or abroad from the development of a similar project
High	4	Occurred more than 1 time in Myanmar or abroad from the development of a similar project
Very high	5	Have evidence of situation occurring during project operation in the same project, and occurred in Myanmar or abroad

Note: The definition might be adjusted depending on discretion of expertise and project characteristic.

Source: Adaptation from Department of Health, Philippines, available from http://doh.gov.ph/ehia.htm (2009)

3.3 Severity of Consequence

Severity of consequences is set by analysis of the severity of heath impacts, considering the worst case scenario (**Table 3-4**).

Table 3-4: Criteria for Severity of Consequences on Health

Severity of Consequences	Score	Definition
No significance	1	**No injuries or illness:** no effect on work or lifestyle and does not cause illness in the community
Low	2	**Minor injuries or illnesses**: effect on work or lifestyle: requires 2-3 days for recovery - Cause(s) of disease has a slight or short-term effect (skin irritation, food poison from bacteria)
Medium	3	**Medium injuries or illness:** effect on work or lifestyle: long-term/continued effect on the community - Causes of disease have moderate effects on health (loud noises or disturbances, hazards from environmental performance).
High/serious	4	**Permanent illness: (large of population exposure group)**

Severity of Consequences	Score	Definition
		- Causes severe disease, which can cause loss or death of workers or at-risk groups (such as cancer from some chemical).
Very high/deadly	5	**The multiplied effect** (large of population exposure group/ over local governmental organizations can handle impacts) - Cause(s) of disease(s) enhance the severity of impact (toxic chemical are cause of cancer, especially if the contaminate is in air and water, i.e. heavy metals).

Note: The definition might be adjusted depending on discretion of expertise and project characteristic.
Source: Adaptation from Department of Health, Philippines, available from http://doh.gov.ph/ehia.htm (2009)

3.4 Health Assessment Matrix

The significance level of health impact is rated by comparing the likelihood and severity of impact using a Matrix Method (from very low to very high) as shown in **Table 3.5**. The meanings of the significance levels are described in **Table 3.6**.

Table 3.5: Significance Rating of Health Impact

Health Impact Significance Matrix			**Likelihood**				
			Very low	**Low**	**Medium**	**High**	**Very high**
			1	**2**	**3**	**4**	**5**
Severity of Consequences	**Insignificant**	**1**	Low (1)	Low (2)	Low (3)	Medium (4)	Medium (5)
	Low	**2**	Low (2)	Medium (4)	Medium (6)	Medium (8)	High (10)
	Medium	**3**	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
	High/ Crisis	**4**	Medium (4)	Medium (8)	High (12)	High (16)	Very high (20)
	Very high/death	**5**	Medium (5)	High (10)	High (15)	Very high (20)	Very high (25)
			Significance Rating				

Note: 1. Significance Rating = Likelihood x Severity of Consequences
1.The definition might be adjusted depending on the discretion of expertise and project characteristics.
Source: Adaptation from the Department of Health, Philippines, available from http://doh.gov.ph/ehia.htm (2009)

Table 3.6: Health Impact Significance Levels

Risk Level	Rating	Definition
Low	1-3	Acceptable level without controlling impacts/ does not require additional management.
Medium	4-9	Acceptable level/but must be controlled to prevent increased risk to unacceptable levels.
High	10-16	Unacceptable level/ the impact must be managed/must be reduced to an acceptable level.
Very High	17-25	Unacceptable level/ the impact must be managed/ reduced to an acceptable level immediately.

Note: The definition of risk significance might be adjusted depending on the discretion of expertise and project characteristics following the HIA guideline criteria in the HIA guidelines (ONEP, 2008).

Source: Adaptation from the Department of Health, Philippines, available from http://doh.gov.ph/ehia.htm (2009)

3.5 Impacted and Vulnerable Groups

As the length of the proposed gas pipeline is substantial crossing over four divisions/states in Myanmar covering different ethnographic regions with varying economic and social conditions, any resulting impacts are expected to be non-homogenous. Therefore, it will be important to assess potential impacts and provide specific community level mitigation measures based on local conditions as well as individual household conditions.

4 Environmental and Social Risk Assessments

Environmental, social, and health risk assessment includes a qualitative and, where appropriate, a quantitative evaluation of risks to help further define the probability and potential consequences of potentially major hazardous events, and to evaluate the significance of areas that might be impacted by events. The main objective is to find the most acceptable method of undertaking the project while minimizing the risk to people and the environment.

4.1 Determination of Risk

Risk associated with the PTTEP MOGE-3 project will be determined by assessing the probability of an event occurring and the significance of its occurrence. An "event" is identified as unplanned or accidental activity. The methodology used in risk assessment is described below.

4.2 Probability of Occurrence

The probability of a specific event occurring can be determined either in terms of historical precedence or by calculation. Probability has been categorized as shown in **Table 4.1**.

Table 4.1: Recommended Categories for Probability/Frequency Screening

Probability of Occurrence						
Likelihood	<1 in 100,000	1 in 5,000 – 100,000	1 in 100 – 5000	1 in 10 – 100	1 in 1 – 10	1 in 1
Frequency	<Once in 100 Projects	Once in 50-100 Projects	Once in 10-50 Projects	Once in 1-10 Projects	Once per Project	> Once per project
	Remote	Unlikely	Quite Likely	Likely	Very Likely	Definite
	0	1	2	3	4	5

4.3 Consequence of Occurrence

The consequence of an event occurring is determined according to a number of themes:

- Environment (physical and ecological)
- Society (including socio-economic)
- Health and Safety
- Company Reputation

Each of these has a set of pre-defined criteria associated with them which classify the level of consequence (**Table 4.2**).

Table 4.2: Categories for Consequence of Occurrence

	Issues				**Level of Consequence**
	Environment	**Society**	**Health and Safety**	**Reputation**	
Consequence	Regional scale, long-term impact	Civil unrest; closure of plant	Multiple off-site and on-site fatalities or permanent disabilities	International concerns; major ventures terminated	A+
	Large scale, long-term (decades) impact	Public protest; disruption of production; loss of livelihood to sector	Multiple on site fatalities or permanent disabilities	Persistent national concerns; long-term impact	A
	Medium scale, medium term (years) impact	Official complaints; loss of livelihood > 10 persons	Major illness/ disability	Medium term national concerns; operations curtailed	B
	Medium scale, short-term (months) impact	Long-term nuisance; loss of income > 10 persons	Illness or injury leading to lost time > 4 days	Short-term regional concerns; close scrutiny	C

	Short-term (weeks) impact	Temporary nuisance; > 5 third party complaints	Illness or injury leading to lost time < 4 days	Short-term local concern; some impact on asset	D
	Localised (immediate area), temporary impact	Temporary nuisance; < 5 third party complaints	Illness or injury requiring first aid or medication	Local mention only; freedom to operate unaffected	E
	No measurable impact	No complaints	No injury or illness	No mention	F

4.4 Risk Matrix

The level of risk can then be identified by use of a matrix comparing probability with consequence (**Table 4.3**). The matrix consists of:

Scale of Consequence (column) from A+ to F to indicate increasing severity of the consequence if such risk occurred.

Scale of Probability (row) from zero to 5 on the basis of historical evidence, or calculation.

The intersection of the chosen column and rows determine the significance, or acceptability, of the risk as being "Low", "Medium", "High" or "Severe". If the risk is determined to be "Medium" or "High", it needs to be managed to reduce the frequency of occurrence or to mitigate any consequences to achieve a risk which is "As Low As Reasonably Possible" (ALARP). If the risk is determined to be "Severe" (i.e. unacceptable), specific actions must be developed to reduce the risk to an acceptable level, which may involve a full Quantified Risk Assessment (QRA).

Based on the results, specific systems for management of risks were recommended, as appropriate. It is also important to note that existing mitigation measures used by the Client in similar projects were considered throughout the risk assessment process.

Table 4.3: Environmental Hazard Assessment Matrix

						Frequency/Likelihood					
					Likelihood	<1 in 100,000	1 in 5,000 – 100,000	1 in 100 – 5000	1 in 10 – 100	1 in 1 - 10	1 in 1
					Frequency	<Once in 100 Projects	Once in 50-100 Projects	Once in 10-50 Projects	Once in 1-10 Projects	Once per Project	> Once per project
						0	1	2	3	4	5
Consequence	**Environment**	**Society**	**Health and Safety**	**Reputation**		***Remote***	***Unlikely***	***Quite Likely***	***Likely***	***Very Likely***	***Definite***
	Regional scale, long-term impact	Civil unrest; closure of plant	Multiple off-site and on-site fatalities or permanent disabilities	International concerns; major ventures terminated	**A+**						**Severe**
	Large scale, long-term (decades) impact	Public protest; disruption of production; loss of livelihood to sector	Multiple on-site fatalities or permanent disabilities	Persistent national concerns; long-term impact	**A**						
	Medium scale, medium term (years) impact	Official complaints; loss of livelihood > 10 persons	Major illness/ disability	Medium term national concerns; operations curtailed	**B**				**High**		
	Medium scale,	Long-term nuisance; loss	Illness or injury	Short-term	**C**			**Medium**			

	short-term (months) impact	of income > 10 persons	leading to lost time > 4 days	regional concerns; close scrutiny							
	Short-term (weeks) impact	Temporary nuisance; > 5 third party complaints	Illness or injury leading to lost time < 4 days	Short-term local concern; some impact on asset	**D**						
	Localised (immediate area), temporary impact	Temporary nuisance; < 5 third party complaints	Illness or injury requiring first aid or medication	Local mention only; freedom to operate unaffected	**E**	**Low**					
	No measurable impact	No complaints	No injury or illness	No mention	**F**						

5 Mitigation of Potential Impacts

Mitigation is an integral component of the ESHIA process. Environmental Impact and Mitigation, and Social Impact and Mitigation, potentially significant impacts will be identified. For each of these impacts, mitigation measures will be defined to prevent and/or reduce the likelihood or magnitude of a negative impact and to enhance a positive impact.

The proposed mitigation measures take into account applicable guidelines, industry practices, expert judgement, design techniques and operational control. The project team, community and relevant stakeholders will be consulted to ensure that the mitigation measures are both practical and appropriate.

Examples of mitigation measures include:

- Avoiding areas of high sensitivity
- Measures in the original project design
- Engineering design solutions
- Alternative solutions to processes and methods to achieving objectives (i.e. methods of transporting materials, or recruitment of unskilled workers)
- Timing restrictions (i.e. near villages and schools)
- Operational control procedures
- Conservation management
- Management systems (i.e. reporting mechanisms for Community Liaison officers)
- Compliance and monitoring of contractors
- Development of policies and procedures (i.e. compensation plans for land/livelihoods)

Following assignment of mitigation measures, any impact that remains is termed a **residual impact**, as described below.

5.1 Residual Impacts

Any impacts remaining after mitigation measures are considered residual impacts. The significance level of the residual impact is reassessed using the same impact criteria applied to the environmental, social and health impact assessment above and re-rated (insignificant, low, medium, or high) as described in detail below.

5.2 Likelihood

To assign likelihood of residual impact, five criteria will be defined and ranked. This five-tiered likelihood ranking criteria are in line with international practices (e.g. Australian/New Zealand Risk Management Standard AS/NZS: 4360). The criteria for likelihood are shown in **Table** .

Table 5.1: Likelihood Categories and Rankings for Environmental, Social and Health Impacts

Ranking	Definition
5	The impact will occur under normal operating conditions.
4	The impact is very likely to occur under normal operational conditions.
3	The impact is likely to occur at some time under normal operating conditions.
2	The impact is unlikely to but may occur at some time under normal operating conditions.
1	The impact is very unlikely to occur under normal operating conditions but may occur in exceptional circumstances.

5.3 Residual Environmental Impact

The residual environmental impacts are assigned a level of significance based on the likelihood of the impact and the consequence of that impact. For each residual impact a consequence/severity ranking between 0 and 3 (insignificant, low, medium or high) has been assigned using the impact criteria used in environmental impact assessment above. The likelihood is assigned using **Table** . The significance level of residual environmental impact is then determined using the matrix below where L denotes a Low-level of impact, M a Medium-level and H a High-level (**Table 5.2**).

Table 5.2: Level of Residual Environmental Impact

Likelihood	0	1	2	3
5	L	M	H	H
4	L	L	M	H
3	L	L	M	M
2	L	L	L	M
1	L	L	L	L

Consequence/Severity

5.4 Residual Social and Health Impacts

As per environmental impacts, residual social and health impacts are any potential impacts remaining once mitigation measures have been implemented. However, in the case of socio-economic impacts, these may not be directly related to the aspects of the project, but may arise from unmet expectations or difficulties in communication (i.e. access to energy, or in relation to employment opportunities).

Once identified, these residual impacts will be assigned a level of significance for individuals or communities. Residual social and health impacts will be ranked, High, Medium, Low, according to the criteria used to evaluate social impact significance above in **Table 5.2.**

5.5 Addressing Residual Impacts

The following approach is applied to addressing environmental, social and health residual impacts.

High (H)

- Check that the residual impact has been subject to feasible and cost effective mitigation where possible
- Where no further reduction in impact levels can be made, it remains a High-level impact and which may therefore be subject to compensation or offsets

Medium (M)

- Check that the residual impact has been subject to feasible and cost effective mitigation and that no further measures are practicable

Low (L)

- Not mitigated further

6.7 Cumulative Impacts

The December 1998 IFC “Procedure for Environmental and Social Review of Projects” states that that an environmental assessment should also address cumulative impacts.

Cumulative Effects Assessment (CEA) is the process of assessing the incremental effects resulting from the combined influences of various actions. These actions can refer to either the

combined effects of discrete aspects of a project (e.g., effects on community health from cumulative exposure to air emissions, noise, traffic) and/or to the combined effects of other industries and developments, either existing or planned for in the future (e.g., cumulative impacts of air emissions from other activities or projects in the area). These incremental effects may be significant even though the effects of each action, when independently assessed, are considered insignificant.

The potential for cumulative impacts is of greatest concern for those aspects of the project where residual impacts are rated as medium or high.

6. Methodology for Socio-economic impact assessment

The following methodology has been applied to assess the socio-economic impacts of the project during construction, operation and decommissioning phases mainly on livelihoods, education, infrastructure, water quality, physical resources, biological resources, human use, quality of life and cultural heritage. Each source of impacts has been assessed by two parameters namely magnitude and Probability along with five scores assessment as well. Detail methodology can be seen in annex (A).

Table 6.1: Impact Assessment Parameters and its scores

Assessment	**Score**				
	1 (very low)	**2 (Low)**	**3 (Medium)**	**4 (High)**	**5 (Very High)**
Magnitude	Insignificant	Small and will have on the socio-economic environment	Moderate and will result in minor changes on community	High and will result in significant changes on community	Very high and will result permanent changes on community
Probability	Insignificant	Little socio-economic challenges	Indirect Socio-economic challenges	Direct socio-economic challenges	Direct and significance socioeconomic challenges

Then, significant rating is calculated by the following formula.
Significant point = Magnitude x Probability
Impact Significance Level: Based on the calculated significant point, impact significance can be categorized as follows;

Table 6.2: Impact Significance Levels

Risk level	Rating	Definition
Very low	1-3	No impacts occur.

Low	4-9	Acceptable level without controlling impacts/ does not require additional management.
Medium	10-16	Acceptable level/but must be controlled to prevent increased risk to unacceptable levels.
High	17-25	Unacceptable level/ the impact must be managed/must be reduced to an acceptable level.
Very High	Above 25	Unacceptable level/ the impact must be managed/ reduced to an acceptable level immediately.

Table 6.3: Analysis of Socio-economic Impact
(a) Construction phase

No.	Socio-economic impacts	Significance of potential socioeconomic impacts			Impact significance
		Magnitude	Probability	Impact significance	
The effect on Physical Resources					
1	Soil quality	3	4	12	Medium
2	Surface water quality	2	3	6	Low
3	Ground water quality	2	3	6	Low
4	Air quality	3	3	12	Medium
5	Noise	3	4	12	Medium
Effect on Biological Resources					
6	Forestry and conservation Areas	2	3	6	Low
7	Agriculture/Farming areas	3	4	9	Medium
8	Local animals	1	2	2	Very low
9	Pasture	1	2	2	Very low
10	Aquatic animals	1	2	2	Very low
Effect on human use					
11	Local fisheries	1	2	2	Very low
12	Local livestock	1	2	2	Very low
13	Local vegetation	3	3	9	Low
14	Local industry	1	2	2	Very low
15	Local transportation	3	3	9	Low
16	Local price	1	2	2	Very low
17	Recreation	1	2	2	Very low
18	Local economy	1	2	2	Very low
Effect on Quality of life					
19	Housing	1	2	2	Very low
20	Health	1	2	2	Very low
21	Education	1	2	2	Very low
22	Spiritual	1	2	2	Very low
23	Safety	3	3	9	Low
24	Crime	3	3	9	Low
25	Family Structure	1	2	2	Very low
26	Job opportunities	3	4	12	Medium
27	Income	3	3	9	Low
28	Scenery	1	2	2	Very low

29	Local culture	1	2	2	Very low
Effect on Cultural Heritage					
30	Religious building	1	2	2	Very low
31	Cemetery	1	2	2	Very low
32	Historic buildings	1	2	2	Very low

(b) Operation phase

No.	Socio-economic impacts	Significance of potential socioeconomic impacts			Impact significance
		Magnitude	Probability	Impact significance	
The effect on Physical Resources					
1	**Soil quality**	**3**	**3**	**9**	**Low**
2	**Surface water quality**	**2**	**2**	**4**	**Low**
3	**Ground water quality**	**2**	**2**	**4**	**Low**
4	**Air quality**	**3**	**4**	**12**	**Medium**
5	**Noise**	**3**	**3**	**9**	**Low**
Effect on Biological Resources					
6	**Forestry and conservation Areas**	**1**	**2**	**2**	**Very Low**
7	**Agriculture/Farming areas**	**1**	**2**	**2**	**Very Low**
8	**Local animals**	**1**	**2**	**2**	**Very low**
9	**Pasture**	**1**	**2**	**2**	**Very low**
10	**Aquatic animals**	**1**	**2**	**2**	**Very low**
Effect on human use					
11	**Local fisheries**	**1**	**2**	**2**	**Very low**
12	**Local livestock**	**1**	**2**	**2**	**Very low**
13	**Local vegetation**	**1**	**2**	**2**	**Very Low**
14	**Local industry**	**1**	**2**	**2**	**Very low**
15	**Local transportation**	**3**	**3**	**9**	**Low**
16	**Local price**	**1**	**2**	**2**	**Very low**
17	**Recreation**	**1**	**2**	**2**	**Very low**
18	**Local economy**	**1**	**2**	**2**	**Very low**
Effect on Quality of life					
19	**Housing**	**1**	**2**	**2**	**Very low**
20	**Health**	**2**	**2**	**4**	**Low**
21	**Education**	**1**	**2**	**2**	**Very low**
22	**Spiritual**	**1**	**2**	**2**	**Very low**
23	**Safety**	**3**	**3**	**9**	**Low**
24	**Crime**	**3**	**3**	**9**	**Low**
25	**Family Structure**	**1**	**2**	**2**	**Very low**
26	**Job opportunities**	**3**	**4**	**12**	**Medium**
27	**Income**	**3**	**3**	**9**	**Low**
28	**Scenery**	**1**	**2**	**2**	**Very low**
29	**Local culture**	**1**	**2**	**2**	**Very low**
Effect on Cultural Heritage					
30	**Religious building**	**1**	**2**	**2**	**Very low**
31	**Cemetery**	**1**	**2**	**2**	**Very low**
32	**Historic buildings**	**1**	**2**	**2**	**Very low**

(c) Decommission phase

No.	Socio-economic impacts	Significance of potential socioeconomic impacts			Impact significance
		Magnitude	Probability	Impact significance	
The effect on Physical Resources					
1	Soil quality	3	3	9	Low
2	Surface water quality	2	2	4	Low
3	Ground water quality	2	3	6	Low
4	Air quality	3	4	12	Medium
5	Noise	3	4	12	Medium
Effect on Biological Resources					
6	Forestry and conservation Areas	2	3	6	Low
7	Agriculture/Farming areas	3	3	9	Low
8	Local animals	1	2	2	Very low
9	Pasture	1	2	2	Very low
10	Aquatic animals	1	2	2	Very low
Effect on human use					
11	Local fisheries	1	2	2	Very low
12	Local livestock	1	2	2	Very low
13	Local vegetation	3	3	9	Low
14	Local industry	1	2	2	Very low
15	Local transportation	3	3	9	Low
16	Local price	1	2	2	Very low
17	Recreation	1	2	2	Very low
18	Local economy	1	2	2	Very low
Effect on Quality of life					
19	Housing	1	2	2	Very low
20	Health	1	2	2	Very low
21	Education	1	2	2	Very low
22	Spiritual	1	2	2	Very low
23	Safety	3	3	9	Low
24	Crime	3	3	9	Low
25	Family Structure	1	2	2	Very low
26	Job opportunities	3	4	12	Medium
27	Income	3	3	9	Low
28	Scenery	1	2	2	Very low
29	Local culture	1	2	2	Very low
Effect on Cultural Heritage					
30	Religious building	1	2	2	Very low
31	Cemetery	1	2	2	Very low
32	Historic buildings	1	2	2	Very low

ANNEX (C)

Public Consultation Questionnaires

Figure 1: Meeting with village administrative (In Jal village)

Socio-Economic, Health and Environment Household Data Baseline and Attitude Survey

မေးခွန်းများဖြေဆိုရာတွင် အဖြေများအား ဝိုင်းဝန်းဖြေကြားပေးပါ။အချို့ မေးခွန်းများအတွက်ကွက်လပ်ဖြည့်ရန် လေးထောင့်ကွက်ထားသောနေရာတွင် ဖြည့်ပေးပါ။

Introduction

Intro description

မန္တလေးမြို့ရှိ ကြာနီကန်အမှိုက်ကျင်းတွင် အမှိုက်မှ စွမ်းအင် ထုတ်လုပ်ခြင်း စီမံကိန်းအတွက် စီမံကိန်းနှင့် နီးစပ်ရာ ဒေသခံများ မှ အိမ်ထောင်စု အချက်အလက်များ၊ **စီးပွားရေးဆိုင်ရာ** အခြေအနေ၊ အိမ်ထောင်စု ကျန်းမာရေး အခြေအနေ၊ အခြေခံအဆောက်အဦး၊ သယ်ဇာတနှင့် ဝန်ဆောင်မှုများ ၊ စီမံကိန်းအပေါ် သဘောပေါက်နားလည်မှုနှင့် သဘောထားအမြင်**များ ကောက်ယူခြင်း**

The purpose of this questionnaire is to collect general socio-economic information and to obtain your perception and understanding of Proposed Project.

The main objective of the project is to review the community perception in **LFG, Flaring and Generators**.

The survey will be carried out in the households, which are located approximately **2** km from **Mandalay KyarNiKan Landfill Gas Recovery and Generation Project.**

The Survey will focus on gaining household member information and attitudes including:

- The structure and demographics of the household
- Household living standard, employment, income and social and economic condition
- Household and individual health
- Information on the natural environment and human use of the environment
- Attitudes on the prospective positive and negative impacts of

I. HOUSEHOLD IDENTIFICATION

	11. STATE/ DIVISION(ပြည်နယ်/တိုင်း)	| |
	1 2 3 4 5 6 7 8	| | |
	13. SURVEY/HOUSEHOLD SAMPLE NUMBER _____	
	14. NAME Of HOUSEHOLD HEAD _အိမ်ထောင်ဦးစီး အမည်	
	15. NAME OF RESPONDENT _ဖြေဆိုသူ အမည်	

I6	DATE OF VISITS:	| / | / |20
I7	ENUMERATOR: _____	SUPERVISOR _____

Enumerator's Remark: :.....

Supervisor's Remark :.....

Module A: Household Member Characteristics

အခန်း-(၁) အိမ်ထောင်စု အချက်အလက်များ

Q		Response categories	Skip to	Response
Household Member Characteristics				
A1	Relationship to household head အိမ်ထောင်ဦးစီးနှင့် တော်စပ်ပုံ	Household head ဦးစီး .... ၁ Spouse ဇနီး/ခင်ပွန်း .... ၂ Son/daughter သား/သမီး .... ၃ parents/ parents in law မိဘ/ ယောက္ခမ .... ၄ Other relatives အခြား/တော်စပ်ပုံ ၅		|__|__|
A2	Gender ကျား/မ	Male ကျား .... ၁ Female		
A3	Age (of the last birthday) အသက် (ပြည့်ပြီး)	၁၅ - ၂၀ .... ၁ ၂၀ - ၃၀ .... ၂ ၃၀ - ၄၀ .... ၃ ၄၀ - ၅၀ .... ၄ ၅၀ - ၆၀ .... ၅ ၆၀ - ၇၀ .... ၆		|__|__|
A4	Race လူမျိုး	Kachin ကချင် .... ၁ kayah ကယား .... ၂ kayin ကရင် .... ၃ Chin ချင်း .... ၄ Mon မွန် .... ၅ Rakhine ရခိုင် .... ၆ Shan ရှမ်း .... ၇ Burma ဗမာ .... ၈ Indigenous		|__|__|
A5	Religion ဘာသာ	Buddhist ဗုဒ္ဓဘာသာ................ ၁ Hindu ဟိန္ဒူဘာသာ........... ၂ Christian ခရစ်ယာန်ဘာသာ...... ၃ Muslim အစ္စလာမ်ဘာသာ.......... ၄		|__|__|
A6	How many family members do you have in your household including you? စုစုပေါင်း မိသားစုဝင် အရေအတွက်	☐ ဦး		

Vulnerable Persons in Family			
A7	Anybody over the age of 65 years? အိမ်တွင် အသက်၆၅ နှစ်အထက် လူကြီး ရှိပါသလား။	i. Yes ရှိပါသည်။	ii. No မရှိပါ။
A8	Any Disabled in the Household? (Adult) အိမ်တွင် မသန်စွမ်းသူ ရှိပါသလား။ (၁၆ နှစ်အထက်)	**(a)** i. Yes ရှိပါသည်။ ii. No မရှိပါ။	**(b) Type of Disability** Mobility/walking လမ်းမလျှောက်နိုင် .... ၁ Loss of limb ခြေလက်အင်္ဂါ မစုံ .... ၂ Blindness မျက်စိမမြင် ၃

			Loss of hearing နားမကြား .... ၄ Other အခြား (*Please Specify*) ၅
A9	Any child who needs special care in the Household? အိမ်တွင် မသန်စွမ်းသူ ရှိပါသလား။ (၁၆ နှစ်အောက်)	**(a)** i. Yes ရှိပါသည်။ ii. No မရှိပါ။	**(b) Type of Disability** Mobility/walking လမ်းမလျှောက်နိုင် .... ၁ Loss of limb ခြေလက်အင်္ဂါ မစုံ .... ၂ Blindness မျက်စိမမြင် .... ၃ Loss of hearing နားမကြား .... ၄ Other အခြား (*Please Specify*) ၅

Occupation and Education				
A10	What is your primary occupation? အဓိကလုပ်ငန်းအမည်နှင့်တကွ ဖော်ပြပါ။	Farmer လယ်သမား...၁ Livestock worker မွေးမြူရေး သမား..........................၂ Fisherman ငါးဖမ်းသမား.............................. ၃ Forestry worker သစ်တော လုပ်ငန်း.................. ၄ Sale worker အရောင်းဝန်ထမ်း....................... ၅ Service worker ဝန်ဆောင်မှု လုပ်ငန်း .... ၆ Skilled worker ကျွမ်းကျင် အလုပ်သမား.................... ၇ Casual worker ကျပန်း အလုပ်သမား .... ၈ Unpaid family worker [illegible]		
A11	How much income do you earn per year? (kyats) သင်၏ တစ်နှစ်ဝင်ငွေ (ကျပ်)	Below 500,000 ငါးသိန်းအောက် ....၁ 500,001 - 1,000,000 ငါးသိန်းမှ ဆယ်သိန်း ....၂ 1,000,001 - 2,000,000 ဆယ်သိန်း မှ သိန်းနှစ်ဆယ် ....၃ 2,000,001 - 3,000,000 သိန်းနှစ်ဆယ် မှ သိန်းသုံးဆယ် ....၄ 3,000,001 - 5,000,000 သိန်းသုံးဆယ် မှ သိန်းငါးဆယ် ....၅ Above 5,000,000 သိန်းငါးဆယ် အထက် ၆		
A12	What education have you completed? ဖြေဆိုသူ၏ပြီးဆုံးခဲ့သော ပညာရေး	KG သူငယ်တန်း .... ၀ မူလတန်း .... ၁ အလယ်တန်း .... ၂ အထက်တန်း .... ၃ 10th std. passed ဆယ်တန်းအောင် .... ၄ Graduate (ဘွဲ့ရ) ....၅ Post Graduate ဘွဲ့ လွန် ....၆ Under grad.Diploma ဒီပလိုမာ ....၁၃ Vocational certificate သင်တန်းဆင်းလက်မှတ်..........၁၄ Monastery ဘုန်းကြီးကျောင်းသင် ၁၅		

A13	What is the highest level of education achieved in your household? မိသာစုအတွင်း အမြင့်မားဆုံး ပညာရေး	KG သူငယ်တန်း ..... ၀ မူလတန်း ..... ၁ အလယ်တန်း ..... ၂ အထက်တန်း ..... ၃ 10th std. passed ဆယ်တန်းအောင် ..... ၄ Graduate (ဘွဲ့ရ) .....၅ Post Graduate ဘွဲ့လွန် .....၆ Under grad.Diploma ဒီပလိုမာ .....၁၃ Vocational certificate သင်တန်းဆင်းလက်မှတ်.....၁၄ Monastery ဘုန်းကြီးကျောင်းသင် ၁၅		| |__|

Module B: Agriculture and Livestock

Land and Agriculture		
B1	Total land holding size of Household လယ်ဧက မည်မျှပိုင်ဆိုင်ပါသနည်း။	
B2	What kind of agricultural land do you have? ပိုင်ဆိုင်သောလယ်ဧက အမျိုးအစား	Pasture Land စားကျက်မြေ ..... ၁ Fallow Land ဖုန်းဆိုးမြေ ..... ၂ Perennial Plantation နှစ်ရှည်ပင်စိုက်ပျိုးသော မြေ ..... ၃ Crop Land သီးနှံပင်စိုက်ပျိုးသော မြေ ..... ၄ Forest Land သစ်တောမြေ..... ၅ Other(Specify) အခြား (ဖော်ပြပေးပါ)..... ၆
B3	What is the main crop you grow? လွန်ခဲ့သောနှစ်က အဓိကသီးနှံ ထုတ်လုပ်မှု ဖော်ပြပေးပါ။	Rice: စပါးပင်..... ၁ Beans/Pulses: ပဲပင်..... ၂ Corn: ပြောင်းဖူးပင်..... ၃ Sesame: နှမ်းပင်..... ၄ Vegetables:ဟင်းသီးဟင်းရွက်ပင် ..... ၅ Other: အခြား (ဖော်ပြပေးပါ) ၆
B4	Is any plot of land affected because of the project? စီမံကိန်းကြောင့် ပိုင်ဆိုင်သော လယ်ဧက မည်မျှ ထိခိုက်နိုင်ပါ သနည်း။	☐ ဧက

Previous Land Acquisition (If applicable)			
B5	Any previous instances of land acquisition (in which you lost lands) လယ်ဧကဆုံးရှုံး ဖူးပါသလား။	i. Yes ဆုံးရှုံးဖူးပါသည်။	ii. No မဆုံးရှုံးဖူးပါ။ In case of the answer is "No", skip to the next section

		မဆုံးရှုံးဖူးပါက **တိရိစ္ဆာန်မွေးမြူရေး** မေးခွန်းဆီမှ စဖြေပါ။	
B7	Tentative year of acquisition မြေယာဆုံးရှုံးခဲ့သောနှစ်		
B11	Are you satisfied with the compensation for the affected land/assess ? If "No", could you please state the reason? လျော်ကြေးကိစ္စ နှင့်ပတ်သက်၍ ကျေနပ်မှုရှိပါသလား။ အကယ်၍ ကျေနပ်မှုမရှိပါက အဘယ့်ကြောင့်နည်း။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။	အဘယ့်ကြောင့်နည်း။

Livestock တိရိစ္ဆာန်မွေးမြူရေး				
B12	Does Household own any livestock? တိရိစ္ဆာန်မွေးမြူ ပါသလား။		(a) Yes မွေးမြူ ပါသည်။	(b) No မမွေးမြူ ပါ။
	Type အမျိုးအစား	How many? အရေအတွက်	(a) For self-consumption ကိုယ်တိုင်စားသုံးရန် (b) For selling ရောင်းရန် (c) For rent ငှားရန် i. Agriculture စိုက်ပျိုးရေးအတွက်ငှားရန် ii. Ceremonies ပွဲတော်များအတွက်ငှားရန်	
i	Cow နွား			
ii	Buffalo ကျွဲ			
iii	Goats ဆိတ်			
iv	Poultry ကြက် ဘဲ ငန်း မန်ဒါလီ			
v	Pigs ဝက်			
vi	Horse မြင်း			
vii	Other **(Please specify)** အခြား (ဖော်ပြပေးပါ)			

	Expenditure Items သုံးစွဲမှု အမျိုးအစားများ	(a)expenditure(kyats) (က)အသုံးစရိတ်(ကျပ်)	(b)unit (week/month/year) (တစ်ပတ် သို့မဟုတ် တစ်လ သို့မဟုတ် တစ်နှစ်လျှင်)	တစ်နှစ်အတွင်း ပုံမှန်မရှိသော အသုံးစရိတ်
C1	Tax အခွန်			
C2	Cooking Fuel ထင်း၊မီးသွေး၊လောင်စာ			
C3	Education ပညာရေး			
C4	Diesel/Petrol ဒီဇယ်၊ ဓာတ်ဆီ			
C5	Transport (when public transport) သယ်ယူပို့ဆောင်ရေး			
C6	Telephone/Mobile phone တယ်လီဖုန်း/မိုဘိုင်းဖုန်း			
C7	Entertainment ဖျော်ဖြေရေး			
C8	Healthcare/Medical Expenditure ကျန်းမာရေးစောင့်ရှောက်မှု၊ ဆေးဝါးကုန်ကျစရိတ်			
C9	Input Investment သွင်းအားစု/အရင်းအနှီး			
C10	Annual maintenance of house နှစ်စဉ် အိမ်ပြင်ဆင်ထိန်းသိမ်းခြင်း			
C11	Loan repayment ချေးငွေ၊အတိုး			
C12	Cultural /religious expenses ယဉ်ကျေးမှု၊ဘာသာရေးဆိုင်ရာများ			

C13	Food ရိက္ခာ(စားစရိတ်)			
C14	Other (specify) အခြား			
C15	Total (system generated) စုစုပေါင်း			

Module C: Household Expenditures အခန်း-(၂) အိမ်ထောင်စု အသုံးစရိတ်များ

	Q	Response categories	Skip to	Response
Household Health Condition မိသားစု ကျန်းမာရေး အခြေအနေ				
D1	In any day of the last month, did anyone in the family get diarrhea at least 3 times per day? လွန်ခဲ့သောလ က မိသာစု အတွင်း ဒု ကြိမ်နှင့် အထက် ပမ်းလျောမ	i. Yes ရှိပါသည်။ ii. No မရှိပါ။		___ | ___ ___ ___
D2	In the last month, did anyone in your household get sick or ill? လွန်ခဲ့သော လ က မိသာစု အတွင်း နေမကောင်း	i. Yes ရှိပါသည်။ ii. No မရှိပါ။		|
D3	What types of sickness are most common in your family? သင် မိသားစုအတွင်း အဖြစ်များဆုံး ရောဂါများအား အမည်နှင့်တကွ ဖော်ပြပါ	None မရှိပါ ... . **1** Malaria ငှက်ဖျား .... **2** Flu တုပ်ကွေး ..... **3** Diseases of digestive system အစာအိမ် ... **4** Muscle pain ကြွက်သားနာကျင် ..... **5** Diseases of the skin အရေပြားရောဂါ ..... **6** Hypertension သွေးတိုး .... **7** Ear, eye ,tooth disease မျက်စိ၊နား၊နှာခေါင်း ..... **8** Heeart Disease) နှလုံးရောဂါများ 9		| |

		Cancer ကင်ဆာ ..... **10** Catch a cold အအေးမိ ..... **11** Sexually Transmitted Diseases Dengue Fever သွေးလွန်တုပ်ကွေး ရောဂါ		
D4	Who did you see for the treatment/health services? ကျန်းမားရေး စောင့်ရှောက်မှု မည်သူနှင့် ခံယူပါသလဲ။	Government Hospital အစိုးရဆေးရုံ ..... **1** Private Hospital ပုဂ္ဂလိက ဆေးရုံ ..... **2** Private clinic (Doctor) ဆေးခန်း (ဆရာဝန် ထိုင်သော) ..... **3** Doctor (from other village) တခြားရွာမှ ဆရာဝန် ..... **4** Health Assistant ကျန်းမာရေးမှူး ....**5** Midwife/ LHV သားဖွား ..... **6** Traditional healer ရိုးရာကုသမှု ..... **9** Quack အပ်ပုန်း/ရမ်းကု .... **10** Self medication ကိုယ်တိုင်ကုသ ... **11** Other (Specify) အခြား **12**		| |__|

D5 No	Health Impacts	No. of affected persons in your family မိသားစုတွင်ဖြစ်ပွားသော လူအရည်အတွက်	Treatment (ကုသမှု ခံယူခြင်း) 1. Yes ခံယူပါသည်။ 2. No မခံယူပါ။	Condition (ရောဂါ အခြေအနေ) 1. Mild (အခြေအနေ သိပ်မဆိုး) 2.Moderate (အခြေအနေ အတော်အသင့်) 3. Severe (အခြေအနေ ဆိုးရွား)
Pregnancy and Birth Defects				
1	Miscarriage ကိုယ်ဝန်ပျက်ကျခြင်း			
2	Infertility ကလေးမရခြင်း			
3	Premature Birth လမစေ့ခင် ကလေးမွေးခြင်း			
4	Still Birth ကလေးအသေမွေးဖွားခြင်း			
5	Perinatal Death မွေးကင်းစကလေးသေဆုံးခြင်း			
6	Low Birth Weight ပေါင်ချိန်မပြည့်ဘဲမွေးဖွားခြင်း			

7	Complications after Birth မွေးဖွားပြီး နောက်ဆက်တွဲ ရောဂါများဖြစ်ပွားခြင်း			
8	Heart Defects of newborn မွေးကင်းစကလေးတွင် နှလုံးရောဂါ ပါလာခြင်း			
9	Oral Cleft နှုတ်ခမ်းကွဲ အာခေါင်ကွဲ ဖြစ်ခြင်း			
10	Chromosomal Abnormality (e.g., Down Syndrome) မျိုးရိုးဗီဇဆိုင်ရာ ရောဂါများ ဖြစ်ပွားခြင်း			
11	Disability (Deaf, Inability to speech, Blindness .. etc) မသန်စွမ်းဖြစ်ခြင်း			
Malignancy ကင်ဆာရောဂါများ				
12	Lung Cancer အဆုတ် ကင်ဆာ			
13	Liver Cancer အသည်း ကင်ဆာ			
14	Bladder Cancer ဆီးအိမ် ကင်ဆာ			
15	Gastrointestinal Cancer အစာအိမ်နှင့် အူလမ်းကြောင်း ကင်ဆာ			
16	Leukemia သွေး ကင်ဆာ			
17	Non- Hodgkin Lymphoma ခွဲန်ကိုယ်တွင် အကျိတ် အဖုများထွက်သော ကင်ဆာ			
18	Others (***Please Specify***) အခြား (ဖော်ပြပေးပါ)			
Neurological Problems အာရုံကြောဆိုင်ရာ ပြဿနာများ				
19	Loss of Coordination ရွေ့လျားမှုကိုင်တွယ်မှု ပုံမှန်မဟုတ်ခြင်း			
20	Nausea ပျို့ခြင်း			
21	Vomiting အန်ခြင်း			
22	Memory Disturbance မှတ်ဉာဏ်ချို့ယွင်းခြင်း			

23	Sleep Disorders အနားယူ အိပ်စက်မှု ပုံမှန်မဟုတ်ခြင်း			
24	Anger ဒေါသထွက်လွယ်လာခြင်း			
25	Fatigue မောပန်း လွယ်ခြင်း			
26	Head Tremors ဦးခေါင်း တုန်လှုပ်ခြင်း			
27	Blurred Vision အမြင်အာရုံဝေဝါးခြင်း			
28	Slurred Speech ဗလုံးဗထွေး စကားပြောတတ်ခြင်း			
29	Seizures တက်ခြင်း			
30	Sleepiness အမြဲ အိပ်ချင်နေခြင်း			
31	Ataxia ခြေလှမ်း ပုံမှန်မဟုတ်ခြင်း			
32	Paralysis အကြောဆွဲခြင်း			
33	Psychological Disorders စိတ်ပိုင်းဆိုင်ရာရောဂါများ			
Respiratory System, Digestive System, Musculoskeletal System and Immunity အသက်ရှူလမ်းကြောင်း၊ အစာအိမ် ၊ အရိုးနှင့် ကြွက်သား၊ ကိုယ်ခံအား စနစ်				
34	Cough ချောင်းဆိုးခြင်း			
35	Lung Infection အဆုတ်ရောဂါများ			
36	Breathlessness အသက်ရှူမဝခြင်း			
37	Asthma ရင်ကျပ်ခြင်း			
38	Recurrent Flu တုတ်ကွေးဖြစ်လွယ်ခြင်း			
39	Diarrhea ဝမ်းလျှောခြင်း			
40	Cholera ကာလ ဝမ်းရောဂါ ဖြစ်ခြင်း ဆန်ဆေးရည်ကဲ့သို့ ဝမ်းသွားခြင်း			
41	Weakness of body အားမရှိခြင်း အားပျော့ခြင်း			
42	Back Pain ကျောနာခြင်း			

Vascular System သွေးကြောဆိုင်ရာ ရောဂါများ				
43	Anemia သွေးအားနည်းခြင်း			
44	Heart Diseases (Angina, Myocardial Infarction, etc.,) နှလုံးရောဂါများ			
45	Hypertension သွေးတိုးခြင်း			
Irritations ယားယံခြင်း				
47	Eyes မျက်လုံး			
48	Nose နှာခေါင်း			
49	Throat လည်ချောင်း			
50	Skin အရည်ပြား			
Nutrition အဟာရ ပြည့်ဝမှု				
51	Malnutrition အရိုးပေါ် နေအောင် ပိန်လွန်းခြင်း (သို့) ဖောနေခြင်း			
Communicable Diseases ကူးစက်တတ်သောရောဂါများ				
52	Malaria ငှက်ဖျား			
53	Tuberculosis တီဘီ			
54	Sexually Transmitted Diseases လိင်မှ တစ်ဆင့်ကူးစက်တတ်သောရောဂါများ (ဥပမာ .. အေအိုင်ဒီအက်စ်၊ ဆီးပူညောင်းကျ၊)			

Module E: Household structure, migration and Population Influx

အခန်း-(၅) အိမ်ထောင်စု ဖွဲ့စည်းပုံ နှင့် ပြောင်းရွှေ့နေထိုင်ခြင်း

	Question	Response categories	Skip to	Response
House Structure				
E1	What type of house do you have? သင်နေထိုင်သောအဆောက်အအုံအမျိုးအစား	Two storey and above နှစ်ထပ်နှင့်အထက် ..... ၁ One storey house တစ်ထပ်အိမ် ..... ၂ Hut တဲ ..... ၃ Other (Specify) အခြား		| | |
E2	What is the primary construction material of the roof of the dwelling? အိမ် အမိုးကို မည်သည့် ပစ္စည်းဖြင့် တည်ဆောက်ထားသနည်း။	Thatch/ large leaves/ Palm သက်ကယ်..... ၁ Bamboo ဝါး ..... ၂ CGI သွပ် .....၃ Tarpaulin မိုးကာဖျင် .....၄ Other (Specify) အခြား ၅		
Migration ရွှေ့ပြောင်းနေထိုင်မှုပုံစံ				
E3	How long has your family lived in this place? သင့်၏ မိသားစု ဒီနေရာမှာနေတာ ဘယ်လောက်ကြာပြီလဲ။	Less than one year တစ်နှစ်အောက် .....၀ One to three years ၁ နှစ်မှ- ၃ နှစ် ..... ၂ Three to ten years ၃ နှစ်မှ - ၁၀ နှစ် ..... ၃ More than ten year ၁၀ နှစ် အထက် ၄		
E4	Has any household member migrated for work due to job scarcity in the past 12 months? Who are they? လွန်ခဲ့သော (၁၂)လအတွင်းက အလုပ်ရှားပါးမှုကြောင့် အခြားဒေသသို့ သွားရောက်အလုပ်လုပ်သူရှိပါသလား။ (အမည်ဖြင့် တကွ ဖော်ပြပေးပါ)	မရှိပါ ..... ၀ အိမ်ထောင်ဦးစီး ..... ၁ အရွယ်ရောက် ကျား (၁၅ နှစ် အထက်)..... ၂ အရွယ်ရောက် မ (၁၅ နှစ် အထက်) ..... ၃ ကျား (၁၅ နှစ် အောက်) ၄		| | |
E7	For what reason did he/she migrate? မည်သည့်အတွက် ကြောင့် သွားရောက်ခဲ့သလဲ။	Work အလုပ် ..... ၁ Education ပညာရေး ....., ... ၂ Marriage/ or live with other family အိမ်ထောင်ပြုခြင်း(သို့)မိသားစုနှင့်နေထိုင်ရန် ၃		| | |
Population Influx (Labor and Working condition) အလုပ်သမားနှင် လုပ်ငန်းအခြေအနေ				
	Do you employ laborers as a part of your business or	i. Yes ရနိုင်ပါသည်။		

E10	Farming activities? ကူညီလုပ်ကိုင်ပေးမည့်လုပ်သားများလွယ်ကူစွာရနိုင်ပါသလား။ (မိသားစုဝင်မဟုတ်သည့်အခြားအလုပ်သမား)	ii. No မရနိုင်ပါ။		| | |
E11	Where do laborers come from? မည်သည့်နေရာမှလာရောက်လုပ်ကိုင်ပါသနည်း။	By hiring from other village အခြားကျေးရွာများမှငှားရမ်းခြင်း ၁ Substitute with machine စက်မှု အစားထိုး ၂ Other(Specify)		| ||
Impact on Local Business ဒေသခံ အလုပ်အကိုင်များ အပေါ် သက်ရောက်မှု				
E12	Have the activities of larger projects affected labor availability for traditional business? စီမံကိန်းကြီးများ၏ လုပ်ငန်းဆောင်ရွက်မှုများကြောင့် ဒေသတွင်းရှိရင်းစွဲလုပ်ငန်းငယ်များအတွက် လုပ်သားရရှိနိုင်မှုကို သက်ရောက်မှုရှိဖူးပါသလား။	i. Yes ရှိဖူးပါသည်။ ii. No မရှိဖူးပါ။		— —

Module F: Land Ownership

အခန်း-(၆) **မြေပိုင်ဆိုင်မှု**

Question		Response categories	Skip	Response
Land Ownership				
F1	Does your household own land? မြေပိုင်ဆိုင်မှု / နေထိုင်မြေ ပိုင်ဆိုင်မှုရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No		|—+ |
F2	How does your household show ownership or user rights of this land? ပိုင်ဆိုင်မှု အထောက်အထား ရှိပါသလား။	With document အထောက်အထား နှင့် နေထိုင် ..... ၁ No document With permission အထောက်အထားမရှိသော်လည်းနေထိုင်ရန်ခွင့်ပြုချက်ရှိ ..... ၂ No Document No permission အထောက်အထားမရှိသည့်အပြင် နေထိုင်ရန်ခွင့်ပြုချက်လည်းရရှိမထားပါ ... ၃		| | |

Module G: Infrastructure, Resource and Services

အခန်း-(၇) အခြေခံအဆောက်အဦ၊ သယ်ဇာတနှင့် ဝန်ဆောင်မှုများ

Question		Response categories	Skip	Response
Health and Education (ကျန်းမာရေး နှင့် ပညာရေး)				
G1	Is Health care available for members of your household? ကျန်းမာရေးစောင့်ရှောက်ရန်ဆေးရုံဆေးခန်း ၊ ဆေးပေးခန်း ရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။		| |__|
G3	Do you have access to education for members of your household? အိမ်ထောင်စုအတွင်း ကျောင်းတက်နိုင်သူ ရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။		
G 4	If the answer is "No", why he/she does not attend school? အကယ်၍ ကျောင်းမတက်နိုင်သူရှိပါက အခက်အခဲအား ဖော်ပြပေးပါ။			

Energy (စွမ်းအင်)				
G5	What source of lighting does your household primarily use? လျှပ်စစ် (အလင်းစွမ်းအင်) ဘယ်ကရရှိပါသလဲ။	Public electricity အများသုံးလျှပ်စစ် ..... ၁ Community hydro power အစုအဖွဲ့ ရေအားလျှပ်စစ် ..... ၂ Battery ဘက်ထရီ ..... ၃ Kerosene ရေနံဆီ ..... ၄ Candle ဖယောင်းတိုင် ..... ၅ Solar ဆိုလာ ..... ၆ Generator မီးစက် ..... ၇ Other အခြား ၈		| |__|
G6	What is the main fuel source used by your household for cooking? ဟင်းချက်ရာတွင်မည်သည့်(အဓိက)လောင်စာကအသုံး	Electricity လျှပ်စစ် ..... ၁ Gas/kerosene/diesel ဂက်စ်၊ရေနံဆီ၊ဒီဇယ် ..... ၂ Charcoal/fuelwood substitute မီးသွေး၊ထင်းအစားထိုး..... ၃ Firewood ထင်း ..... ၄ Other အခြား ၅		| |__|
G7	If **firewood** is used, please mention number of sources with direction from the village အကယ်၍ ထင်းအသုံးပြု ပါက မည်သည့်နေရာများမှ			

	ထင်းခုတ်ယူပါသနည်း။ (မိမိဒေသ၏ အရှေ့အနောက်တောင်မြောက် လမ်းညွှန်မှုနှင့် အကွာအဝေး အားဖော်ပြပေးပါ။)			
Question		***Response categories***	***Skip***	***Response***
Water, Sanitation and Hygiene (ရေ၊ ရေဆိုးနှတ်စနစ်၊ တစ်ကိုယ်ရေ နှင့် ပတ်ဝန်းကျင် သန့်ရှင်းရေး)				
G8	Availability of Water for Drinking Purpose သောက်သုံးရေ ရရှိနိုင်မှု အခြေအနေ	i. Perennial တစ်နှစ်ပတ်လုံးရရှိ .... ၁ ii. Seasonal တစ်နှစ်ပတ်လုံးမရရှိ ၂		
G9	Availability of Household Water Consumption သုံးရေ ချိုးရေ ရရှိနိုင်မှု အခြေအနေ	i. Perennial တစ်နှစ်ပတ်လုံးရရှိ .... ၁ ii. Seasonal တစ်နှစ်ပတ်လုံးမရရှိ ၂		
G10	If, the answer is "Perennial", What is the source of drinking water used by your household for in the past 12 months? သောက်ရေ တစ်နှစ်ပတ်လုံးရရှိပါက မည်သည့် အရင်းအမြစ်မှ ရရှိပါသနည်း။	Public piped water အများသုံးရေပိုက် ..... ၁ Deep well အဂိစိရေတွင်း ..... ၂ Tube well အဂိစိ မဟုတ်သောရေတွင်း ..... ၃ Protected dug well/pond/spring/rainwater ကာကွယ်ထားသော ရေတွင်း၊ရေကန်၊မိုးရေ ..... ၄ Unprotected dug well/pond/spring/rainwater ကာကွယ်မထားသော ရေတွင်း၊ရေကန်၊မိုးရေ ..... ၅ River/stream မြစ်၊ချောင်း ၆		
G11	If, the answer is "Seasonal", What is the source of drinking water used by your household for in the past 12 months? သောက်ရေ တစ်နှစ်ပတ်လုံး **မရရှိပါက** မည်သည့် အရင်းအမြစ်မှ ရရှိပါသနည်း။	Public piped water အများသုံးရေပိုက် ..... ၁ အဂိစိရေတွင်း ..... ၂ Tube well အဂိစိ မဟုတ်သောရေတွင်း ..... ၃ Protected dug well/pond/spring/rainwater ကာကွယ်ထားသော ရေတွင်း၊ရေကန်၊မိုးရေ ..... ၄ Unprotected dug well/pond/spring/rainwater ကာကွယ်မထားသော ရေတွင်း၊ရေကန်၊မိုးရေ ..... ၅ River/stream မြစ်၊ချောင်း ၆	a) Summer နွေရာသီတွင်ရရှိသောနေရာ ☐ b) Rainy မိုးရာသီတွင်ရရှိသောနေရာ ☐ c) Winter ဆောင်းရာသီတွင်ရရှိသောနေရာ ☐	
G12	What is the distance to this source of drinking water? ရေရရှိဖို့အတွက် အကွာအဝေး မည်မျှ ရှိပါသနည်း။	Household Level ..... ၁ ¼ mile ၀.၂၅ မိုင် ..... ၂ 1 mile ၁ မိုင် ..... ၃ More than one mile ၁ မိုင်ထက်ပို ၄	Remarks:	

G13	Quality ရေ အရည်အသွေး	**(a)** Good **ကောင်း** **(b)** Bad **ဆိုး** (ဆိုးပါက အောက်ဖော်ပြပါနေရာများအား ဝိုင်းပေးပါ) i. Color အရောင် ii. Smelly အနံ့ iii. Taste အရသာ iv. Turbid ရေနောက် v. Hard ရေသွေက်	Remarks:
G14	Water treatment for water is "Yes", what do you usually do to make it safe to drink? ရေသောက်သုံး ရာတွင် သန့်ရှင်းစေရန် မည်ကဲ့သို့ ဆောင်ရွက်ပါသနည်း ။	Let it stand (sedimentation)အနည်ချ .....၁ Filtration (ceramic, sand)သဲဖြင့်စစ်ခြင်း ..... ၂ Boil ကျိုချက်ခြင်း ....၃ Chlorineကလိုရင်းဖြင့်သန့်စင်.....၄	Remarks:
G15	Does the capacity of water used change in current? အချိန်နှင့်အမျှ ရေ၏အရည်အသွေး ပြောင်းလဲမှုရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။	| | |
G16	Time period in which you face scarcity of drinking water? လအလိုက် **သောက်ရေ** ရှားပါးသော အချိန်များအားဖော်ပြပေးပါ။	**a.** Months လ ၁ ၂ ၃ ၄ ၅ ၆ ၇ ၈ ၉ ၁၀ ၁၁ ၁၂	**b.** From to (မည်သည့်လ **မှ** မည်သည့်လ **သို့**) ---------- **မှ** ---------- **သို့**
G17	Time period in which you face scarcity of water for Household Consumption? လအလိုက် **သုံးရေ ရိုးရေ** ရှားပါးသော အချိန်များအားဖော်ပြပေးပါ။	**a.** Months လ ၁ ၂ ၃ ၄ ၅ ၆ ၇ ၈ ၉ ၁၀ ၁၁ ၁၂	**b.** From to (မည်သည့်လ **မှ** မည်သည့်လ **သို့**) ---------- **မှ** ---------- **သို့**
G18	Has water availability changed over time? **သောက်ရေ ရရှိနိုင်မှု အခြေအနေ သည် တစ်နှစ်ထက် တစ်နှစ်**	**Improved** **ပိုမိုကောင်းမွန်လာပါသည်**	**Declined** **ပိုမိုဆိုးဝါးလာပါသည်**	**Not changed** **မပြောင်းလဲပါ။**
G19	*If water **quality** is changed, please state the cause of change.* ရေ **အရည်အသွေး** ပြောင်းလဲပါက အဘယ်ကြောင့်နည်း။			

G20	*If water **quantity** is changed, please state the cause of change.* ရေ **ပမာဏ** ပြောင်းလဲပါက အဘယ်ကြောင့်နည်း။	
G21	Are you concerned about water quantity change and water quality change? ရေ **အရည်အသွေး နှင့်** ရေ **ပမာဏ** ပြောင်းလဲမှုအပေါ် စိုးရိမ်ပူပန်ပါသလား။	
G22	Is there sanitation nearby household? ရေဆိုးမြောင်း အိမ်အနီးတွင်းရှိသလား။?	i. Yes ရှိပါသည်။
G23	Type of Latrine အိမ်သာ အမျိုးအစား	a. Dry pit latrine ကျင်းတူးထားသော **ရေ မသုံးသော** အိမ်သာ b. Pour flush latrine ကျင်းတူးထား၍ **ရေ သုံးသော** အိမ်သာ **(ရေခွက်ဖြင့်သုံး)** c. Flush latrine ကျင်းတူးထား၍ **ရေ သုံးသော** အိမ်သာ **(ခလုတ်နှိပ်၍ ရေဆွဲချရသော)** d. Open latrine **ဧရိ တိုးခြင်း**
Communication ဆက်သွယ်မှု		
G24	Is any phone in your Household connected to Internet? အိမ်တွင် အင်တာနက်ဖြင့် ချိတ်ဆက်နိုင်သော ဖုန်းရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။
G25	Which application is installed? အောက်ဖော်ပြပါများနှင့် ချိတ်ဆက်ထားပါသလား။ 1. Facebook ဖေ့စ်ဘုတ် 2. Viber ဗိုင်ဘာ 3. Whatsapps ဝှက်စ်အပ် 4. Other (***Please Specify***) အခြား (ဖော်ပြပေးပါ)	
G26	Can any household member use internet very well? အတူနေမိသားစုတွင် အင်တာနက် ကောင်းကောင်းအသုံးပြု တတ်သူရှိပါသလား။	i. Very Well အလွန်ကျွမ်းကျင်စွာ ii. Well ကောင်းမွန်စွာ iii. Just a little အနည်းငယ်မျှသာ
G27	Is Communication via Facebook available?	i. Yes ရပါသည်။

	သင့်အား စီမံကိန်းနှင့် ပတ်သက်၍ Facebook မှ တစ်ဆင့် ဆက်သွယ်နိုင်ပါသလား။ (ဗီဒီယို ဖြင့် ဖုန်းခေါ် ဆက်သွယ်ခြင်း ၊ စီမံကိန်း အကြောင်းအရာများအား အဖွဲ့ ဖွဲ့၍ မျေးခြင်း စသည်ဖြင့် ...)	ii. No လုံးဝ ရနိုင်ပါ။ iii. Can communicate if the technology will be explained by a family member. အတူနေမိသားစုဝင် မှ နည်းစနစ်အား ရှင်းပြပေးပါက ရနိုင်ပါသည်။

Module H: Cultural Aspect

အခန်း-(၈) ယဉ်ကျေးမှုဆိုင်ရာရှုထောင့်

Question		Response categories	Skip	Response
Cultural Heritage (ယဉ်ကျေးမှု အမွေအနှစ်)				
H1	Who makes decisions in the community? အရေးပါသော ဆုံဖြတ်ချက်များအား မည်သူကချမှတ်ပါသနည်း။	Village Leader အုပ်ချုပ်ရေးမှူး .....၁ ReligiousLeader ဘာသာရေးခေါင်းဆောင် ..... ၂ Elder People အကြီးအကဲ၊နာယက.... ၃ SmallGroupLeaderအသင်းအဖွဲ့ခေါင်းဆောင် ၄		| | |
H2	Do you know the important cultural, historic or religious sites around your community? ရေးဟောင်းအမွေအနှစ်နယ်မြေ များရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။		| |__|
H3	Are those cultural, historic or religious sites adequately protected? ၄င်းနေရာ ကိုလုံလောက်သော ကာကွယ် စောင့်ရှောက်မှုပြုပြင်မှုမ်းမံမှုများရှိပါသလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။		| |__|

Module I: Air and Climate

အခန်း-(၉) လေ၊ ရာသီဥတု

Question		Response categories	Skip	Response
Air, Water and Soil (လေ၊ ရေ နှင့် ရာသီဥတု)				
I1	Have you noticed any changes to Air Quality as long as you have been in the household?	Improved: ကောင်းမွန်..... 1 Declined ကျဆင်း..... 2 No Change ပြောင်းလဲမှုမရှိ 3		|

I2	လေအရည်အသွေးပြောင်းလဲမှုရှိပါသလား။ Cause of change in air quality:	Industry စက်ရုံ ..... 1 Livestock Industry မွေးမြူရေး ..... 2 Brush-burning/ Forest fire		|
I3	Has the climate changed since you have been living in this area? အရင်ကနှင့်ယှဉ်ရင် ရာသီဥတု ပြောင်းလဲခဲ့မှု ရှိပါသလား။	Warmerပူနွေးလာ .....1 Cooler အေးလာ .....2 Unchanged... ပြောင်းလဲမှုမရှိ		
I4	Is the local climate changed to be	Wetter... စိုစွတ်လာ..... 4 Drier...ခြောက်သွေ့လာ..... 5		

Module J: Fishing

Question		Response categories	Skip to	Response
J1	Are you or your family a fisherman? သင်သို့မဟုတ်သင့်မိသားစုသည် ရေလုပ်ငန်းလုပ်ကိုင်ပါသလား။	i. Yes လုပ်ကိုင်ပါ။ ii. No မလုပ်ကိုင်ပါ။		|__|__|

Module K: **Disasters** သဘာဝဘေးအွန္တရာယ်များ

Landslide မြေပြို ခြင်း		
K1	Have you experienced landslide before? ဤဒေသတွင် မြေပြို ခြင်း များရှိဖူးပါသလား။	i. Yes ရှိဖူးပါသည်။ ii. No မရှိဖူးပါ။
K2	When did it happen? ဖြစ်ပွားခဲ့သောနှစ် ၊ ရာသီ	**1. Year** နှစ် ၁.( ) ၂.( ) ၃.( ) **2. Season** ရာသီ ၁.( ) ၂. ( ) ၃. ( ) ***Code*** (ရာသီတွင်_နွေ၊ မိုး ၊ ဆောင်း ဖြည့်ပေးပါ။) i. Summer နွေ ii. Rainy မိုး iii. Winter ဆောင်း
K4	In your view, what is the cause of landslide?	၁။ Deforestation သစ်တောပြုန်းတီးခြင်း

	အဘယ်ကြောင့် မြေပြို မှုများဖြစ်ပွားသနည်း။ သင်၏သဘောထား ထင်မြင်ချက်အား ဖော်ပြပေးပါ။	၂။ Road Construction လမ်းများဖောက်ခြင်း ၃။ Mining သတ္တုတွင်းများ တူးဖော်ခြင်း
K5	Do you know if there is anyone who is affected by landslide? မြေပြိုမှုကြောင့် ထိခိုက်မှု ၊ သေဆုံးမှုများရှိပါလား။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။
K6	If yes, how many times have you heard of such cases? မြေပြိုမှုကြောင် ထိခိုက်မှု ၊ သေဆုံးမှုများရှိပါက သင်ကြားခဲ့ဖူးသော အကြိမ်များအား ဖော်ပြပေးပါ။	

Module L: Social Groups အခန်း(၁၂) လူမှုရေးအဖွဲ့များ

Social Support Group (လူမှုရေးကူညီမှုအဖွဲ့)					
Membership to any Group? မည်သည့်တို့တွင် အဖွဲ့ဝင်ထားပါသလဲ။				1. Yes (ရှိ)	2. No (မရှိ)
L1	a) Social Groups က) **လူမှုရေးအဖွဲ့များ**	b) i. Active(အဖွဲ့ရှိပါသေးသလား) ii.Not Active (အဖွဲ့မရှိတော့ပါ)	c) Total Strength အဖွဲ့ဝင်စုစုပေါင်း	d) Major Activity အဓိကလုပ်ဆောင်ချက်	e) Nature of Support received from Group မည်သည်တို့ကို ထောက်ပံ့ပေးသနည်း။
1	Saving and Loan Association ငွေစုငွေချေးအဖွဲ့				
2	Youth Group ပရဟိတလူငယ်အသင်း				
3	Fishing Group ငါးဖမ်းလုပ်ငန်းအုပ်စု				
4	Farming Group တောင်သူလယ်သမားအုပ်စု				
5	Community Group လူမှုအဖွဲ့အစည်း				
6	Religious Group ဘာသာရေးအဖွဲ့				
7	Low interest Microcredit အသေးစားချေးငွေလုပ်ငန်း				
8	Others (***Please Specify***) အခြားအဖွဲ့များ				
Non-governmental Organizations Operational in the community အစိုးရမဟုတ်သောအဖွဲ့အစည်းများရှိပါသလား။ အဖွဲ့အစည်း အမည်၊ လုပ်ငန်းသဘာ နှင့် အကျိုးပြုလုပ်ငန်းများအားဖော်ပြပေးပါ။					
NGO Name (အဖွဲ့အစည်း အမည်) ၁။		၂။		၃။	၄။

	Nature of Work (လုပ်ငန်းသဘာဝ)	Benefits Received (အကျိုးပြုလုပ်ငန်းများ)
	1. Health (ကျန်းမာရေး) 2. Sanitation (သန့်ရှင်းမှု) 3. Education (ပညာရေး) 4. Livelihood (အသက်မွေးဝမ်းကြောင်း) 5. Water Supply (ရေပေးဝေရေး) 6. Micro-credit (ချေးငွေ) 7. Others (အခြား) (***Please Specify***)	1. Technical Training (နည်းပညာသင်တန်း) 2. Medical Supplies (ဆေးဘက်ဆိုင်ရာအထောက်အပံ့များ) 3. Other Capacity Building(အခြား စွမ်းရည်ဖွံ့ဖြိုးမှုသင်တန်း) 4. Credit Group Formation(ချေးငွေဖွဲ့သင်တန်း) 5. Other (အခြား) ((***Please Specify***)

Module M: Habit of Waste Collection and Disposal အိမ်ထောင်စုတွင် အမှိုက်သိမ်းဆည်းခြင်း၊ အမှိုက်စွန့်ပစ်ခြင်း အလေ့အကျင့်

How do you collect the Household Waste? (Can select multiple answers) သင့်အိမ်မှ ထွက်သော အမှိုက်များကို သင် ဘယ်လို သိမ်းဆည်းပါသလဲ။ (အဖြေ တစ်ခုထက်မက ဖြစ်နိုင်ပါသည်)

q21001	q21002	q21003	q21004	q21005	q21006	q21007
Dust Bin with Cover အဖုံးပါသော အမှိုက်ပုံး သုံးပါသည် .....၁ မသုံးပါ ၂	Dust Bin without Cover အဖုံးမပါသော အမှိုက်ပုံး သုံးပါသည် .....၁ မသုံးပါ ၂	Plastic Bag, Woven PP Bag ပလပ်စတစ် အိတ်၊ ပိန်အိတ် သုံးပါသည် .....၁ မသုံးပါ ၂	Basket တောင်း သုံးပါသည် .....၁ မသုံးပါ ၂	Dump on the ground မြေကွက်လပ်တွင် စုပုံထားခြင်း လုပ်ဆောင်ပါသည် .....၁ မလုပ်ဆောင်ပါ ၂	Others (***Please Specify***) အခြားသိမ်းနည်း (ဖော်ပြပါ)	No Collection of Waste အမှိုက်သိမ်းဆည်းခြင်းမပြုလုပ်ပါ။
Code	Code	Code	Code	Code	Code	Code

How do you dispose the Household Waste? (Can select multiple answers) သင့်အိမ်က ထွက်တဲ့ အမှိုက်တွေကို ဘယ်နေရာမှာ သင် ပစ်ပါသလဲ။ (အဖြေ တစ်ခုထက်မက ဖြစ်နိုင်ပါသည်)

q21008	q21009	q21010	q21011	q21012	q21013	q21014
Burning မီးရှို့သည် မီးရှို့ပါသည် .....၁ မီးမရှို့ပါ ၂	Burying မြေမြှုပ်သည် မြေမြှုပ်ပါသည် .....၁ မြေမမြှုပ်ပါ ၂	Throw Garbage into River မြစ်ထဲသို့ ပစ်ပါသည် .....၁ မပစ်ပါ ၂	Waste Dumping သွားပုံသည်			
			Stream, Drainage area, Pond, Bank of river ချောင်း/မြောင်းကန် ကမ်းနဘေး ပစ်ပါသည် ၁	Empty Compound ခြံဝင်းကွက်လပ် ပစ်ပါသည် .....၁ မပစ်ပါ ၂	Beside the street, open space area လမ်းဘေး/မြေကွက်လပ်ရှိရာ ပစ်ပါသည် .....၁ မပစ်ပါ ၂	MCDC dumping area or MCDC garbage container စည်ပင်အမှိုက်ပုံအမှိုက်ကန် ပစ်ပါသည် ၁

			မပစ်ပါ ၂			မပစ်ပါ ၂
Code	Code	Code	Code	Code	Code	Code

q21015	q21016	q21017	q21018	q21019
Send garbage to MCDC Truck စည်ပင်အမှိုက်ကားသို့ ပို့သည်	Send garbage to Private waste collectors ပုဂ္ဂလိက အမှိုက်သိမ်းသို့ ပေးသည်	Sell garbage to Recycle shop ရီဆိုက်ကယ်သမားသို့ ရောင်းချသည်	Decomposing for fertilizer မြေဆွေးလုပ်သည်	Others (***Please Specify***) အခြား (ဖော်ပြပါ)
ပို့ပါသည် .....၁ မပို့ ပါ ၂	ပို့ပါသည် .....၁ မပို့ ပါ ၂	ရောင်းပါသည် .....၁ မရောင်း ပါ ၂	လုပ်ပါသည် .....၁ မလုပ်ပါ ၂	
Code	Code	Code	Code	Code

Module N: Awareness and Attitudes about the project

အခန်း-(၁၄) (စီမံကိန်းအပေါ် သဘောပေါက်နားလည်မှုနှင့် သဘောထားအမြင်)

Question		Response categories	Ski	Response
N1	How much do you know about this project? ယခုစက်ရုံ အကြောင်းကို သင်မည်မျှသိပါသနည်း။	Nothing at all လုံးဝမသိပါ ..... ၁ A little အနည်းငယ်သိ ..... ၂ Some အချို့သိ ..... ၃ A lot ကောင်းကောင်းများများသိ ၄	**>>j3**	| | |
N2	How did you know about this project? ယခုစက်ရုံ ကို မည်သူဆီမှ သင်သိရှိပါသနည်း။	Government agencies အစိုးရဌာနများ ..... ၁ Community leaders အစုအဖွဲ့ခေါင်းဆောင်များ .... ၂ Media သတင်းမီဒီယာ ..... ၃ Family members/friends မိသားစုဝင်များ၊ မိတ်ဆွေများ .....၄ Surveyors/Interviewers မေးမြန်းစုံစမ်းသူ ၅		| | |
N3	How important will this project be to this	Not extremely important (အလွန်အလွန်အရေးမကြီးပါ).....၁ Not very important (အလွန်အရေးမကြီးပါ).....၂		

	ယခုစက်ရုံ သည် လူမှု ပတ်ဝန်းကျင် အတွက် မည်မျှအရေးကြီးပါသနည်း။	Not important (အရေးမကြီးပါ).....၃ Normal(သာမာန်).....၄ Important (အရေးကြီးပါသည်).....၅ Very important(အလွန်အရေးကြီးပါသည်).....၆ Extremely important(အလွန်အလွန်အရေးကြီးပါသည်).....၇ Unaware(မသိပါ).....၈		၂ ၂ ၂
N4	What other projects did you experience before? ယခင်က မည်ကဲ့သို့သော စီမံကိန်းများ တွေ့ကြုံဖူးပါသနည်း။	Road/ railways (လမ်း၊မီးရထား).....၁ Bridge(တံတား).....၂ Dam(ရေကာတာ).....၃ Industrial project(စက်မှုစီမံကိန်း)..၄ Oil/Gas/Pipeline project (ရေနံ၊ဓါတ်ငွေ့၊ပိုက်လိုင်းစီမံကိန်း).....၅ Other(အခြား)(Specify).....၆		
N5	How did it affect your community? ထို စက်ရုံ(သို့)စီမံကိန်း ကြောင့်လူမှုပတ်ဝန်းကျင်တွင်	Positive ကောင်း .....၁ Negative ဆိုး .....၂ No effect သက်ရောက်မှုမရှိပါ ၃		၂ ၂ ၂
N6	Have you been discuss about compensation from project? ထို စက်ရုံ (သို့)စီမံကိန်း များမှနစ်နာကြေးနှင့်ပတ်သက်ပြီးဆွေးနွေးဖူး	ဆွေးနွေးဖူးပါသည်.....၁ မဆွေးနွေးဖူးပါ.....၂		၂ ၂ ၂
N7	What are the most positive impacts of the project that you anticipate? ယခုစက်ရုံ၏ကောင်းသော အကျိုးသက်ရောက်မှုများကြောင့် သင်တို့အပေါ်မည်သည့်အရာများ စွမ်းဆောင်ပေး နိုင်မည်ဟု ထင်ပါသနည်း။ (အရေးကြီးဆုံးအချက်)	Unware မသိပါ.....၁ Increase employment အလုပ်အကိုင် တိုးတက်လာခြင်း..... ၂ Increase annual income ဝင်ငွေ တိုးတက်လာခြင်း.....၃ Improve living condition လူနေမှုအဆင့်အတန်းမြင့်မားလာခြင်း.....၄ Improved transport/infrastructureအခြေခံအဆောက်အဦများ တိုး ၅ Compensation for land used မြေယာ လျော်ကြေးများရခြင်း...၆ Improved environment ပတ်ဝန်းကျင်တိုးတက်ကောင်းမွန်လာခြင်း....၇		

N8	What are the most negative impacts of the project that you are concerned about? စီမံကိန်း၏ ဆိုးသော အကျိုးသက်ရောက်မှုကြောင့်သင်တို့ အပေါ်မည်သည့်အရာသက်ရောက်နိုင်မည်ဟု ထင်ပါသနည်း။	Unaware မသိ ..... ၁ Transport and infrastructure သယ်ယူပို့ဆောင်/အခြေခံအဆောက်အဦများ ....၂ Negative social environment ဆိုးသောလူမှုပတ်ဝန်းကျင် .....၃ House damaged အိုးအိမ် ပျက်စီးခြင်း .....၄ Increased costs စရိတ်မြင့်တက်ခြင်း ..... ၅ Environmental pollution ပတ်ဝန်းကျင် ညစ်ညမ်းခြင်း ... ၆ Safety လုံခြုံမှု .....၇ Damaged environment ပတ်ဝန်းကျင်ပျက်စီးခြင်း .....၈ Employment/income disruption အလုပ်အကိုင်၊ဝင်ငွေနည်းပါးခြင်း....၉ Crime ပြစ်မှုများ ၁၀ Health ကျန်းမာရေး ၁၁ Discrimination ခွဲခြားဆက်ဆံခြင်း ၁၂		
N9	Are you concerned about outside people coming to your community to work on the construction and maintenance of the project? လုပ်ငန်းခွင်သို့ အခြားဒေသမှ	Very worried အလွန်စိုးရိမ်ပါသည် .... ၁ A little worried အနည်းငယ်စိုးရိမ်ပါသည် .....၂ Not worried မစိုးရိမ်ပါ ၃		
N 10	What is the development priority for your community? မိမိတို့ ဒေသတွင် မည်သည့်အရာများ လိုအပ်ပါသနည်း။ (အရေးကြီးဆုံး ဦးစားပေး)	Road transport (လမ်းပန်းဆက်သွယ်မှု).....၁ Electricity(လျှပ်စစ်) .....၂ Telecommunication (ဖုန်းဆက်သွယ်မှု).....၃ Water/Sanitation/Hygiene ရေ၊သန့်ရှင်းမှု၊တကိုယ်ရေကျန်းမာရေး)...၄ Access to credit(ချေးငွေရရှိမှု).....၅ Education(ပညာရေး).....၆ Health(ကျန်းမာရေး) ၇		| | |
N 11	Which three groups or categories are likely to be most negatively affected from the project? မည်သည့်. အုပ်စု အမျိုးအစားသောသူတို့.တွင်	Women(အမျိုးသမီး) ....၁ Children(ကလေး)....၂ Unskilled workers(ကျပန်းအလုပ်သမား)....၃ Religious minorities (ကိုးကွယ်မှုဆိုင်ရာ လူနည်းစု)...၄ Ethnic minorities (လူမျိုးဆိုင်ရာ လူနည်းစု)...၅ Other (အခြား) ...၆		| | |
N 12	Do you agree with the proposed project? ယခုစက်ရုံ၏တိုးတက်ဖွံ့ဖြိုးမှုအတွက် သဘောတူညီမှု ရှိပါသလား။	Yes (သဘောတူညီပါသည်)... ၁ No(သဘောမတူညီပါ)... .....၂ Not sure (မသေချာပါ).....၃		

N13 Priority Development Initiative (s) in the Community (ဒေသဖွံ့ဖြိုးစေရေးအတွက်ဦးစားပေးအရာများ)						
	Services (အထောက်အပံ့)	Priority(ဦးစားပေး)		Services(အထောက်အပံ့)	Priority(ဦးစားပေး)	
a.	Education Services/ Facilities (ပညာရေး အထောက်အပံ့)		b.	Drinking Water (သောက်သုံးရေရရှိမှု)		1. First Priority (ပထမဦးစားပေး) 2. Second Priority (ဒုတိယဦးစားပေး) 3. Third Priority (တတိယဦးစားပေး) 4. Not Required (မလိုအပ်ပါ)
c.	Medical Services/ Facilities (ကျန်းမာရေးအထောက်အပံ့)		d.	Sanitation (Toilets) သန့်ရှင်းမှု(အိမ်သာများ)		
e.	Road/ Transport (လမ်းပန်းဆက်သွယ်မှု)		f.	Solid Waste Disposals (အမှိုက်ကျင်းများ)		
g.	Electricity (လျှပ်စစ်မီးရရှိမှု)		h.	Law and Order (ဥပဒေနှင့်အမိန့်)		
i.	Telecommunication (ဖုန်းဆက်သွယ်မှု)		j.	Employment (အလုပ်အကိုင်ရရှိမှု)		

Module O: Perceptions on Impacts of the Project

စီမံကိန်း သက်ရောက်မှုအပေါ် သိမြင်နားလည်မှုများ

		Very negative အလွန်ဆိုး	Negative ဆိုး	Slightly negative အနည်းငယ်ဆိုး	No effect ပြောင်းလဲမှု မရှိ	Slightly positive အလွန်ကောင်း	Positive ကောင်း	Very positive အလွန်ကောင်း	
The effect on Physical Resources (ရုပ်ပိုင်းဆိုင်ရာ သယံဇာတများအပေါ် သက်ရောက်မှု)									
1	Soil quality (မြေအရည်အသွေး)	1	2	3	4	5	6	7	
2	Surface water quality (မြေပေါ်ရေ) မြစ် ချောင်း	1	2	3	4	5	6	7	
3	Ground water quality (မြေအောက်ရေ) အဂိစိတ္တင်း	1	2	3	4	5	6	7	
4	Air quality (လေအရည်အသွေး)	1	2	3	4	5	6	7	
5	Noise (ဆူညံမှု)	1	2	3	4	5	6	7	
Effect on Biological Resource(ဇီဝသယံဇာတများအပေါ် သက်ရောက်မှု)									
6	Forestry and conservation areas (သစ်တောနှင်ထိန်းသိမ်းရေး နေရာများ)	1	2	3	4	5	6	7	
7	Agriculture/ Farming areas (စိုက်ပျိုးရေးနှင့် လယ်ယာနေရာများ)	1	2	3	4	5	6	7	
8	Local animals (ဒေသဆိုင်ရာတိရိစ္ဆာန်များ)	1	2	3	4	5	6	7	
9	Pasture (စားကျက်နေရာများ)	1	2	3	4	5	6	7	

10	Aquatic animals (ရေနေသတ္တဝါများ)	1	2	3	4	5	6	7	
									Effect on Human Use(လူသားတို့အသုံးပြုမှုအပေါ် သက်ရောက်မှု)
11	Local Fisheries (ဒေသခံငါးဖမ်းလုပ်ငန်းများ)	1	2	3	4	5	6	7	
12	Local Livestock(ဒေသခံမွေးမြူရေးလုပ်ငန်း)	1	2	3	4	5	6	7	
13	Local Vegetation(ဒေသဆိုင်ရာပေါက်ပင်)	1	2	3	4	5	6	7	
14	Local Industry(ဒေသဆိုင်ရာစက်ရုံလုပ်ငန်း)	1	2	3	4	5	6	7	
15	Local Transportation (ဒေသဆိုင်ရာဆက်သွယ်ရေး)	1	2	3	4	5	6	7	
16	Local Price (ဒေသဆိုင်ရာကုန်ဈေးနှုန်း)	1	2	3	4	5	6	7	
17	Recreation (အပန်းဖြေမှု)	1	2	3	4	5	6	7	
18	Local Economy(ဒေသဆိုင်ရာစီးပွားရေး)	1	2	3	4	5	6	7	
									Effect on Quality of Life(လူနေမှုဘဝ အရေအနေအပေါ် သက်ရောက်မှု)
19	Housing (အိမ်ရာ)	1	2	3	4	5	6	7	
20	Health (ကျန်းမာရေး)	1	2	3	4	5	6	7	
21	Education (ပညာရေး)	1	2	3	4	5	6	7	
22	Spiritual (စိတ်ခံစားမှု)	1	2	3	4	5	6	7	
23	Safety (ဘေးကင်းလုံခြုံမှု)	1	2	3	4	5	6	7	
23	Crime (ပြစ်မှု)	1	2	3	4	5	6	7	
23	Family Structure(မိသားစုပုံစံ)	1	2	3	4	5	6	7	
24	Job opportunities(အလုပ်အကိုင်အခွင့်ရေး)	1	2	3	4	5	6	7	
25	Income (ဝင်ငွေ)	1	2	3	4	5	6	7	
26	Scenery (မျက်စိပသာဒ ဖြစ်မှု)	1	2	3	4	5	6	7	
27	Local Culture (ဒေသဆိုင်ရာ ဓလေ့ထုံးတမ်း)	1	2	3	4	5	6	7	
									Effect on Cultural Heritage(ယဉ်ကျေးမှုဆိုင်ရာ အမွေအနှစ်များအပေါ် သက်ရောက်မှု)
28	ReligiousBuilding(ဘာသာရေးအဆောက်ဦ)	1	2	3	4	5	6	7	
29	Cemetery (သုတ်ခုန်)	1	2	3	4	5	6	7	
30	Historic buildings/sites (သမိုင်းဝင်နေရာ)	1	2	3	4	5	6	7	

"CHECK the whole questionnaire AGAIN, THANK the respondent and FINISH interview."

"ကျေးဇူးတင်ပါသည်"

Social survey questionnaire for village community near Kyar Ni Kan Landfill area (In Gel village)

Impacts on Agriculture due to Landfill Site

အမှိုက်ကျင်းကြောင့် စိုက်ပျိုးရေး အပေါ် သက်ရောက်မှု

If you Household grow rice and other plants,

အကယ်၍ မိသားစု အတွင်း စပါးနှင့် အခြားသီးနှံစိုက်ပျိုးရေး ပြုလုပ်ပါက

Q1	Do you grow rice and plants on farmland of your own or owned by other people? စပါးနှင့် အခြားသီးနှံစိုက်ပျိုးရေး အားမည်သည့်မြေပေါ်တွင်စိုက်ပျိုးပါသနည်း။	1. Own Farmland ကိုယ်ပိုင်မြေ 2. Owned by others သူတစ်ပါး ပိုင်ဆိုင်သောမြေ 3. Both အထက်ပါ နှစ်မျိုးလုံး	
Q2	Please sate the productivity before and after establishing landfill site. အမှိုက်ကျင်းမရှိခင်ကနှင့်ယှဉ်လျှင် စပါးနှင့် အခြားသီးနှံ **အထွက်နှုန်းပြောင်းလဲမှု** ရှိပါသလား။	1. Increased အထွက်နှုန်းတိုးလာပါသည်။ 2. Decreased အထွက်နှုန်းကျဆင်းလာပါသည်။ 3.Same အထွက်နှုန်းပြောင်းလဲမှု မရှိပါ။	
Q3	Please sate the quality of rice and plants before and after establishing landfill site. အမှိုက်ကျင်းမရှိခင်ကနှင့်ယှဉ်လျှင် စပါးနှင့် အခြားသီးနှံ **အရည်အသွေး ပြောင်းလဲမှု** ရှိပါသလား။	1. Increased အရည်အသွေး ကောင်းမွန်လာပါသည်။ 2. Decreased အရည်အသွေး ကျဆင်းလာပါသည်။ 3.Same အရည်အသွေး ပြောင်းလဲမှု မရှိပါ။	
Q4	Are there any problems and impacts on agriculture due to landfill? အမှိုက်ကျင်းကြောင့် စိုက်ပျိုးရေးလုပ်ငန်း အပေါ် အခြားသက်ရောက်မှု များရှိပါသလား၊ i. Yes **ရှိပါသည်။** ii. No **မရှိပါ။**	If "Yes". Please mention about those issues. အမှိုက်ကျင်းကြောင့် စိုက်ပျိုးရေးလုပ်ငန်း အပေါ် သက်ရောက်မှု များရှိပါက ဖော်ပြပေးပါ။ --- ---	

Q5	Compared to last 25 years ago, your farmland acres လွန်ခဲ့သော ၂၅ နှစ်ကနှင့်ယှဉ်လျှင် သင်ပိုင်ဆိုင်သော လယ်ယာမြေများမှာ	1. Increased ၁. လယ်ဧက ပမာဏ **ပိုမိုများပြားလာသည်။** 2. Decreased ၂. လယ်ဧက ပမာဏ**လျော့နည်း** သွားပါသည်။ 3. Same ၃. လယ်ဧက ပမာဏ မပြောင်းလဲပါ။	If decreased, how many acres? လယ်ဧက ပမာဏ**လျော့နည်း** သွားပါက ယခင်နှင့် ယခုလက်ရှိ ဧက အရည်အတွက်အား ဖော်ပြပေးပါ။ **Before** ယခင် **After** ယခု
Q7	Please state the reason of decreased farmland. (You can answer more than one.) လယ်ဧက ပမာဏ**လျော့နည်း** သွားပါက အဘယ်ကြောင့်နည်း။	1. Reduced quality of rice and plants ၁. စပါးနှင့် သီးနှံ **အရည်အသွေး ကျဆင်း**သွားသောကြောင့် 2. Give farmland to family members/relatives or others ၂.လယ်ယာအား မိသားစု၊ ဆွေမျိုး နှင့် အခြားသူများအား **ပေးလိုက်သော**ကြောင့် 3. Sell to others ၃. **ရောင်းချလို**က်သောကြောင့်	

Social survey questionnaire for
nearest community at the Kyar Ni Kan Landfill area (Waste Pickers)

Questionnaire for Nearest Community at the landfill site

စီမံကိန်းနှင့် အနီးစပ်ဆုံး ဒေသခံများ မှ အိမ်ထောင်စု အချက်အလက်များ

U1	U2	U3	U4	U6	U7	U8	U9	U10	U11	U12
No. **အမှတ်စဉ်**	Name **အမည်**	Age **အသက် (ပြည့်ပြီး)**	Sex **ကျား/မ**	Duration of Residence **ယခုနေရာတွင် နေထိုင်သည်မှာ မည်မျှကြာသနည်း (ဖော်ပြပေးပါ။)**	Education **ပညာရေး** **(ဖော်ပြပေးပါ)**	Occupation **အဓိကလုပ်ငန်း** Farmer လယ်သမား.....၁ Livestock worker မွေးမြူရေးသမား.....၂ Fisherman ငါးဖမ်းသမား... ၃ Forestry worker သစ်တောလုပ်ငန်း..... ၄ Sale worker အရောင်းဝန်ထမ်း..၅ Service worker ဝန်ဆောင်မှု လုပ်ငန်း..... ၆ Skilled worker ကျွမ်းကျင်အလုပ်သမား... ၇ Casual worker ကျပန်း အလုပ်သမား..... ၈ Unpaid family worker မိသားစုအလုပ်သမား ... ၉ Other (Specify) အခြား (ဖော်ပြပေးပါ) ...၁၀	Average Income per day **တစ်နေ့ ပျမ်းမျှ ဝင်ငွေ (ကျပ်)**	Smoking **ဆေးလိပ် သောက်ပါသလား** i. Yes **သောက်ပါသည်။** ii. No **မသောက်ပါ။**	Drinking Alcohol **အရက် သောက်ပါသလား** i. Yes **သောက်ပါသည်။** ii. No **မသောက်ပါ။**	Betal Chewing **ကွမ်းစား ပါသလား** i. Yes **စားပါသည်။** ii. No **မစားပါ။**

Vulnerable Household members

U13	Is there any pregnant mother in your household? မိသားစု အတွင်း ကိုယ်ဝန်ဆောင်မိခင်လောင်း ရှိပါသလား။	
U14	Is there any infant in your household? မိသားစု အတွင်း မွေးကင်းစကလေး ရှိပါသလား။	
U15	Is there any children under 5 years old in your household? မိသားစု အတွင်း အသက်ငါးနှစ်အောက်ကလေး ရှိပါသလား။	
U16	Have you experienced before any death of child under 5 years old?ူ့နျူယ If "Yes". Please mention the cause of death,ကူနေ **ယခု နေထိုင်ရာဒေသတွင်** မိသားစု အတွင်း အသက်ငါးနှစ်အောက်ကလေး သေဆုံးမှု ရှိခဲ့ပါသလား။ အကယ်၍ ရှိခဲ့ပါက သေဆုံး ရသော **အကြောင်းအရင်း**ကို ဖော်ပြပေးပါ။	

Wastes

V1	Where do you pick up wastes at landfill area? အမှိုက်ကျင်းတွင် အမှိုက်များအား မည်သည့်နေရာမှကောက်ယူပါသနည်း	1. Old place **၁.ယခင်နေရာဟောင်း** 2. New place **၂.လက်ရှိအမှိုက်ချနေသောနေရာ**	
V2	Please mention the type of wastes you pick up? ကောက်ယူသော အမှိုက် အမျိုး အစားများကို ဖော်ပြပေးပါ။ (တစ်ခုထက်မက ဖြေဆိုနိုင်ပါသည်။)	1. Kitchen Garbage **၁. မီးဖိုချောင်ထွက်အမှိုက်နှင့် အစားအသောက်များ** 2. Paper, Books, Paper Board **၂. စက္ကူ၊ စာအုပ်၊ ဂျပ်** 3. Plastic bag and other Plastic stuffs **၃. ပလပ်စတစ်၊ ထုပ်ပိုး ပလပ်စတစ်အမျိုးမျိုး**	

		4. Glassware, Glass Bottles and Broken glass pieces ၄. ဖန်၊ မှန် ပုလင်းများ၊ ဘူးများနှင့် အကွဲအစများ 5. Metal, Empty Metal bottles and containers ၅. သတ္တု၊ သတ္တုဗူးခွံ/ခွက်ခွံ 6. Clothes/ Fabrics ၆. အဝတ်အထည်/အစများ 7. Construction Wastes ၇. ဆောက်လုပ်ရေးအမှိုက်များ 8. Hazardous Wastes (Chemical wastes, medical wastes, etc..) ၈. ဘေးအန္တရာယ်ရှိ အမှိုက် (ဓာတုဗေဒ အမှိုက်များ၊ ဆေးရုံဆေးခန်းမှ အမှိုက်များ၊ အစရှိသည် ....)	

Negative Impact of Landfill Site (အမှိုက်ကျင်းဓါး ဆိုးကျိုးသက်ရောက်မှုများ)

W1	W2	W3
Odour အနံ့အသက်များ	Rodents ကြွက်များ	Flies ယင်ကောင်များ
i. Yes ရှိပါသည်။ ii. No မရှိပါ။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။	i. Yes ရှိပါသည်။ ii. No မရှိပါ။

Plantation and Fish-Consumption around landfill area အမှိုက်ကျင်း အနီး အပင်စိုက်ပျိုးခြင်းနှင့် ငါးစားသုံးမှု

X1	Do you plant vegetables around landfill area? အမှိုက်ကျင်း အနီး အပင်စိုက်ပျိုးပါသလား။	i. Yes **စိုက်ပါသည်။** ii. No **မစိုက်ပါ။**	If Yes, Type of Vegetable စိုက်ပျိုးပါက အပင်အမျိုးအစားအား ဖော်ပြပေးပါ **၁။** **၂။** **၃။**	1. Eat **၁။စားသုံးရန်** 2. Sell **၂။ရောင်းချရန်** 3. Both **၃။ အထက်ပါနှစ်မျိုးလုံး**	
X4	Do you catch fish around landfill area? အမှိုက်ကျင်း အနီး ငါးဖမ်းပါသလား။	i. Yes **ငါးဖမ်းပါသည်။** ii. No **ငါးမဖမ်းပါ။**		If Yes, **ငါးဖမ်းပါက** 1. Eat **၁။စားသုံးရန်** 2. Sell **၂။ရောင်းချရန်** 3. Both **၃။ အထက်ပါနှစ်မျိုးလုံး**	1. Daily **နေ့ စဉ်** 2. Once a week **တစ်ပတ်တစ်ခါ** 3.Twice a week **တစ်ပတ်နှစ်ခါ** 4. Once a month **တစ်လတစ်ခါ** 5. Twice a month **တစ်လနှစ်ခါ** 6. Once in three months **သုံးလတစ်ခါ** 7. Once in six months **ခြောက်လတစ်ခါ** 8. Once a year **တစ်နှစ်တစ်ခါ**
7	Do you breed any animal/s around project area? အမှိုက်ကျင်း အနီး တိရိစ္ဆာန်မွေးမြူပါသလား။	i. Yes **မွေးမြူပါသည်။** ii. No **မမွေးမြူပါ။**	If Yes, Type of animal/s မွေးမြူပါက တိရိစ္ဆာန်အမျိုးအစားအား ဖော်ပြပေးပါ **၁။** **၂။** **၃။**	1. Eat **၁။စားသုံးရန်** 2. Sell **၂။ရောင်းချရန်** 3. Both **၃။ အထက်ပါနှစ်မျိုးလုံး**	

Impacts of the Project

Y1	Will this waste to energy project affect your job and income? အမှိုက်မှ စွမ်းအင်ထုတ်သည့် ယခုစီမံကိန်းကြောင့် သင်၏ **အလုပ်အကိုင်နှင့် ဝင်ငွေရရှိမှု** အပေါ် သက်ရောက်မှု ရှိနိုင်ပါသလား။	i. Yes **ရှိနိုင်ပါသည်။** ii. No **မရှိနိုင်ပါ။**	If Yes, **ရှိနိုင်ပါက** 1. Positively (ကောင်းကျိုးသက်ရောက်မည်။) 2. Negatively (ဆိုးကျိုးသက်ရောက်မည်။)

Y2	Will this waste to energy project affect your lifestyle and quality of life? အမှိုက်မှ စွမ်းအင်ထုတ်သည့် ယခုစီမံကိန်းကြောင့် သင်၏ **လူနေမှုပုံစံနှင့် ဘဝအရည်အသွေး** အပေါ် သက်ရောက်မှု ရှိနိုင်ပါသလား။	i. Yes **ရှိနိုင်ပါသည်။** ii. No **မရှိနိုင်ပါ။**	If Yes, **ရှိနိုင်ပါက** 1. Positively (ကောင်းကျိုးသက်ရောက်မည်။) 2. Negatively (ဆိုးကျိုးသက်ရောက်မည်။)
Y3	Will this waste to energy project affect health status of your household? အမှိုက်မှ စွမ်းအင်ထုတ်သည့် ယခုစီမံကိန်းကြောင့် သင်၏ **ကျန်းမာရေး** အပေါ် သက်ရောက်မှု ရှိနိုင်ပါသလား။	i. Yes **ရှိနိုင်ပါသည်။** ii. No **မရှိနိုင်ပါ။**	If Yes, **ရှိနိုင်ပါက** 1. Positively (ကောင်းကျိုးသက်ရောက်မည်။) 2. Negatively (ဆိုးကျိုးသက်ရောက်မည်။)

Survey questionnaire for Biodiversity

Biodiversity Questionnaire

	Questions	Response
1.Crops	a. What **crops** do you plant? မည့်သည့်ကောက်ပဲသီးနှံများစိုက်ပျိုးပါသနည်း။	List Crops 1.rice ဆန် 2.sugar cane ကြံ 3.beans ပဲ 4.sesame နှမ်း 5.ground nut မြေပဲ
	b. Which is the most valuable **crop** that you grow? မည့်သည့်သီးနှံက ဈေးကောင်းအရဆုံး ဖြစ်သနည်း။	List Crops 1.rice ဆန် 2.sugar cane ကြံ 3.beans ပဲ 4.sesame နှမ်း 5.ground nut မြေပဲ
	c. Do you use **fertilizer**? အသီးအပင် အားတိုးဆေး သုံးပါသလား။	Yes No
	d. Do you use **pesticide**? ပိုးသတ်ဆေး သုံးပါသလား။	Yes No
	e. Over the last 10 years has **crops** yield? ၁၀ နှစ်အတွင်း အထွက်နှုန်း မည့်သို့ရှိ သနည်း။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained stable နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	f. What is the cause of change? အဘယ့်ကြောင့် ထိုသို့ ပြောင်းလဲမှု ရှိသနည်း။	List Causes of possible change 1 not enough water ရေမလုံလောက်ခြင်း 2 too much water ရေများလွန်းခြင်း 3 too hot ပူလွန်းခြင်း

		4 Change in ecosystem ဂေဟစနစ် ပြောင်းလဲမှု ဖြစ်ပေါ်ခြင်း
	g. Are you crops an important food source? i.e. or are they sold စိုက်ပျိုးထားသော ကောက်ပဲသီးနှံများကို ရောင်းချပါသလား။	Yes No
2. Honey	a. Is honey produced in this area? ပျားရည် ဤဒေသတွင် ရပါသလား။	Yes No
	b. Has honey production in the past 10 years? ပျားရည် အထွက်နှုန်း ၁၀ နှစ်အတွင်း မည်သို့ရှိသနည်း။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained stable နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	c. What in your opinion is the reason for the change in honey production? ပျားရည် အထွက်နှုန်း ပြောင်းလဲခြင်း အတွက် မည်သို့ထင်မြင် ပါသနည်း။	List Causes of possible change 1. Less Harvesting မွေးမြူခြင်း လျော့နည်းလာခြင်း 2. More Harvesting ပို မွေးမြူခြင်း 3. Change in ecosystem ဂေဟစနစ် ပြောင်းလဲလာခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	d. Is honey an important source of **food/medicine** ပျားရည်က အစာနဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
3. Palm Sugar/Sap(Jackeri)	a. Over the past 10 years has **palm sugar/sap(Jackeri)** Production ၁၀ နှစ်အတွင်း ထန်းလျက်/ထန်းရည် အထွက်နှုန်း မည်သို့ရှိသနည်း။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained stable နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	b. What is the reason for any observed change in **palm sugar/sap?** ထန်းလျက်/ထန်းရည် အထွက်နှုန်း ပြောင်းလဲခြင်း အတွက်	List Reasons for observed change 1. Less Harvesting စိုက်ပျိုးခြင်း လျော့နည်းလာခြင်း 2. More Harvesting ပို စိုက်ပျိုး ခြင်း

	သိသာသော အကြောင်းပြချက်ကို ပြောပြပါ။	3. Change in ecosystem ဂေဟစနစ် ပြောင်းလဲလာခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	c. Is palm sugar/sap and important source of **food/medicine?** ထန်းလျက်/ထန်းရည် သည် အစာနဲ့ဆေး အတွက် အရေးပါပါသလား။	Yes No
4. Wild Plants **တောရိုင်းပင်များ**	a. Over the past 10 years has the abundance or distribution of **wild plants**? ၁၀ နှစ်အတွင်း အပင်ရိုင်း များ ပေါများမှုမှာ မည့်သို့ရှိသနည်း။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained stable နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	b. Over the past 10 years has the diversity/type of **wild plants**? လွန်ခဲ့သော ၁၀ နှစ်အတွင်း တောရိုင်းအပင် အမျိုးအစားများ မည်သို့ ပြောင်းလဲသနည်း။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	c. If there has been a change in number and or diversity of **wild plants**, why do you think this change has occurred? တောရိုင်းအပင်၏ အရေအတွက်/အမျိုးအစား ပြောင်းလဲလျှင် မည့်သည့်အချက် ကြောင့်ပြောင်းလဲသနည်း။	1. Less Harvesting စိုက်ပျိုးခြင်း လျော့နည်းလာခြင်း 2. More Harvesting ပိုစိုက်ပျိုးခြင်း 3. Change in habits/ecosystem ဂေဟစနစ် ပြောင်းလဲလာခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	d. Over the past 10 years has the timing of **flowering** changed in any plants ၁၀ နှစ်အတွင်း အပင်များ၏ ပန်းပွင့်သော အချိန် ပြောင်းလဲပါသလား	Yes No
	e. Are these **wild plants an important source of food/medicine**?	Yes No

	တောရိုင်းပင်များသည် အစာနဲ့ဆေး အတွက် အရေးပါပါသလား။	
5. Birds General **ဌက်**	a. Over the past 10 years has the number of wild **birds**? ၁၀ နှစ်အတွင်း ဌက်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	b. Over the past 10 years has the diversity/type of wild **birds**? ၁၀ နှစ်အတွင်း ဌက်မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	c. If there has been a change in number and or diversity of wild **birds**, why do you think this change has occurred? ဌက်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits/ecosystem ဂေဟစနစ် ပြောင်းလဲလာခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	d. Are wild birds and important source **food/medicine**? ဌက်များသည် အစာနဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
6. **Hawks** **သိမ်းဌက်**	a. Have you ever seen a **hawk/bird of prey in this area**? ဤဒေသတွင် သိမ်းဌက် ကို မြင်ဖူးပါ သလား။	Yes No
	b. Are hawks common? ဤဒေသတွင် သိမ်းဌက် ပေါများပါသလား။	Yes No
	c. Has the number of **hawks** increased, decreased or	A. Increased, တက်သလား

	remain stable over the past 10 years? ၁၀ နှစ်အတွင်း သိမ်းဌက် အရေအတွက် ပြောင်းလဲပါသလား။	B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **hawks** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း သိမ်းဌက် မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of **hawks**, why do you think this change has occurred? သိမ်းဌက်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are hawks a source of foods? သိမ်းဌက် ကိုစားပါသလား။	Yes No
7. Vultures **လင်းတ**	a. Have you ever seen a **vultures in this area**? ဤဒေသတွင် လင်းတကို မြင်ဖူးပါ သလား။	Yes No
	b. Are vultures common? ဤဒေသတွင် လင်းတ ပေါများပါသလား။	Yes No
	c. Has the number of **vultures** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ဌက်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d.If there has been a change in number and or diversity of wild **vultures**, why do you think this change has occurred? လင်းတ အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း

	e. Are vultures a source of foods/medicine? လင်းတများသည် အစာနဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
8. Owls **ဇီးကွက်**	a. Have you ever seen a **owls in this area**? ဤဒေသတွင် ဇီးကွက်ကို မြင်ဖူးပါ သလား။	Yes No
	b. Are owls common? ဤဒေသတွင် ဇီးကွက် ပေါများပါသလား။	Yes No
	c. Has the number of **owls** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ဇီးကွက် အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **owls** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ဇီးကွက် မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **owls**, why do you think this change has occurred? ဇီးကွက် အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are owls a source of foods/medicine? ဇီးကွက်များသည် အစာနဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
9. Wild Cats **တောကြောင်**	a. Have you ever seen a **wild (non-domestic) cats in this area**? ဤဒေသတွင် တောကြောင်ကို မြင်ဖူးပါ သလား။	Yes No

	b. Are wild cats common? ဤဒေသတွင် တောကြောင် ပေါများပါသလား။	Yes No
	c. Has the number of **wild cats** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း တောကြောင်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **wild cats** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း တောကြောင်မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of **wild cats**, why do you think this change has occurred? တောကြောင်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are wild cats a source of foods/medicine? တောကြောင်များသည် အစာနဲ့ဆေး အတွက် အရေးပါပါသလား။	Yes No
10. Bats **လင်းနို**	a. Have you ever seen a **bats in this area**? ဤဒေသတွင် လင်းနိုကို မြင်ဖူးပါ သလား။	Yes No
	b. Are bats common? ဤဒေသတွင် လင်းနို ပေါများပါသလား။	Yes No
	c. Has the number of **bats** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း လင်းနိုအရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား

	d. Has the diversity/type of **bats** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း လင်းနို့မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, B. Decreased or C. Remained the same	တက်သလား ကျသွားသလား နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **bats**, why do you think this change has occurred? လင်းနို့အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည့်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting 2. More Hunting 3. Change in habits 4. Climate change	အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း ပို အမဲလိုက်ခြင်း ကျက်စားရာဒေသ ပြောင်းလဲခြင်း ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are bats a source of foods/medicine? လင်းနို့များသည် အစာနဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No	
11. Rats and Mice ကြွက်	a. Have you ever seen a **Rats and Mice in this area**? ဤဒေသတွင် ကြွက်ကို မြင်ဖူးပါ သလား။	Yes No	
	b. Are **Rats and Mice** common? ဤဒေသတွင် ကြွက် ပေါများပါသလား။	Yes No	
	c. Has the number of **Rats and Mice** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ကြွက် အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, B. Decreased or C. Remained the same	တက်သလား ကျသွားသလား နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Rats and Mice** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ကြွက်မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, B. Decreased or C. Remained the same	တက်သလား ကျသွားသလား နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **Rats and Mice**, why do you think this change has occurred? ကြွက်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်	1. Less Hunting 2. More Hunting 3. Change in habits	အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း ပို အမဲလိုက်ခြင်း ကျက်စားရာဒေသ ပြောင်းလဲခြင်း

	ပေါ်ပါလျှင် မည့်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Rats and Mice** a source of foods/medicine? ကြွက်များသည် အစာနှဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
12. Frogs and Toads ဖားနှင့်ဖားပြုတ်	a. Have you ever seen a **Frogs and Toads in this area**? ဤဒေသတွင် ဖားနှင့်ဖားပြုတ်ကို မြင်ဖူးပါ သလား။	Yes No
	b. Are **Frogs and Toads** common? ဤဒေသတွင် ဖားနှင့်ဖားပြုတ် ပေါများပါသလား။	Yes No
	c. Has the number of **Frogs and Toads** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ဖား/ဖားပြုတ်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Frogs and Toads** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ဖား/ဖားပြုတ်မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **Frogs and Toads**, why do you think this change has occurred? ဖား/ဖားပြုတ်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည့်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Frogs and Toads** a source of foods/medicine? ဖား/ဖားပြုတ်များသည် အစာနှဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No

13. Scorpions **ကင်းမြီးကောက်**	a. Have you ever seen a **Scorpions in this area**? ဤဒေသတွင် ကင်းမြီးကောက် မြင်ဖူးပါ သလား။	Yes No
	b. Are **Scorpions** common? ဤဒေသတွင် ကင်းမြီးကောက် ပေါများပါသလား။	Yes No
	c. Has the number of **Scorpions** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ကင်းမြီးကောက်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Scorpions** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ကင်းမြီးကောက်မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **Scorpions**, why do you think this change has occurred? ကင်းမြီးကောက်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည့်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Scorpions** a source of foods/medicine? ကင်းမြီးကောက်များသည် အစာနဲ့ဆေး အတွက် အရေးပါပါသလား။	Yes No
14. Turtles & Tortoise **ရေလိပ်/ကုန်းလိပ်**	a. Have you ever seen a **Turtles &Tortoise in this area**? ဤဒေသတွင် ရေလိပ်/ကုန်းလိပ် မြင်ဖူးပါ သလား။	Yes No
	b. Are **Turtles & Tortoise** common? ဤဒေသတွင် ရေလိပ်/ကုန်းလိပ် ပေါများပါသလား။	Yes No

	c. Has the number of **Turtles &Tortoise** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ရေလိပ်/ကုန်းလိပ်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Turtles &Tortoise** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ရေလိပ်/ကုန်းလိပ် မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e. If there has been a change in number and or diversity of wild **Turtles &Tortoise**, why do you think this change has occurred? ရေလိပ်/ကုန်းလိပ်အမျိုးအစားနှင့်အရေအတွက်ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည့်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Over the past 5 years have you ever seen a **Star Tortoise**/jai lek? လွန်ခဲ့သော ၅နှစ်ခန့်က ကြယ်လိပ်ကိုတွေ့ဖူးပါသလား။	Yes No
	g. Are **Turtles &Tortoise** a source of foods/medicine? ရေလိပ်/ကုန်းလိပ်များသည် အစာနဲ့ဆေး အတွက် အရေးပါပါသလား။	Yes No
15. Bees **ပျား**	a. Have you ever seen a **Bees in this area**? ဤဒေသတွင် ပျားများကို မြင်ဖူးပါ သလား။	Yes No
	b. Are **Bees** common? ဤဒေသတွင် ပျားများ ပေါများပါသလား။	Yes No

	c. Has the number of **Bees** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ပျားအရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Bees** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ပျားမျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **Bees**, why do you think this change has occurred? ပျားအမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Bees** a source of foods/medicine? ပျားများသည် အစာနှံ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
16. Butterflies **လိပ်ပြာ**	a. Have you ever seen a **Butterflies in this area**? ဤဒေသတွင် လိပ်ပြာများကို မြင်ဖူးပါ သလား။	Yes No
	b. Are **Butterflies** common? ဤဒေသတွင် လိပ်ပြာများ ပေါများပါသလား။	Yes No
	c. Has the number of **Butterflies** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း လိပ်ပြာအရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Butterflies** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း လိပ်ပြာမျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း

	diversity of wild **Butterflies**, why do you think this change has occurred? လိပ်ပြာအမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Butterflies** a source of foods/medicine? လိပ်ပြာများသည် အစာနှံ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
17. Mosquitoes ခြင်	a. Have you ever seen a **Mosquitoes in this area**? ဤဒေသတွင် ခြင်များကို မြင်ဖူးပါ သလား။	Yes No
	b. Are **Mosquitoes** common? ဤဒေသတွင် ခြင်များ ပေါများပါသလား။	Yes No
	c. Has the number of **Mosquitoes** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ခြင်အရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Mosquitoes** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း ခြင်မျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **Mosquitoes**, why do you think this change has occurred? ခြင်အမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Mosquitoes** a source of foods/medicine? ခြင်များသည် အစာနှံ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No

18. Snakes **မြွေ**	a. Have you ever seen a **Snakes in this area**? ဤဒေသတွင် မြွေများကို မြင်ဖူးပါ သလား။	Yes No
	b. Are **Snakes** common? ဤဒေသတွင် မြွေများ ပေါများပါသလား။	Yes No
	c. Has the number of **Snakes** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း မြွေအရေအတွက် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	d. Has the diversity/type of **Snakes** increased, decreased or remain stable over the past 10 years? ၁၀ နှစ်အတွင်း မြွေမျိုးစိတ် ပြောင်းလဲပါသလား။	A. Increased, တက်သလား B. Decreased or ကျသွားသလား C. Remained the same နဂိုအတိုင်းမပြောင်းမလဲရှိသလား
	e.If there has been a change in number and or diversity of wild **Snakes**, why do you think this change has occurred? မြွေအမျိုးအစားနှင့်အရေအတွက် ပြောင်းလဲမှုဖြစ်ပေါ်ပါလျှင် မည်သည့်အချက်ကြောင့် ပြောင်းလဲပါသနည်း။	1. Less Hunting အမဲလိုက်ခြင်း လျော့နည်းလာခြင်း 2. More Hunting ပို အမဲလိုက်ခြင်း 3. Change in habits ကျက်စားရာဒေသ ပြောင်းလဲခြင်း 4. Climate change ရာသီဥတု ပြောင်းလဲခြင်း
	f. Are **Snakes** a source of foods/medicine? မြွေများသည် အစာနှံ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
19. General Environment	a. Over the past 10 years has natural habitat decreased by over25% ၁၀ နှစ်အတွင်း ကျက်စားရာ ဒေသ ၂၅% ထက်ပို၍ လျော့ကျပါသလား။	Yes No
	b. Over the past 10 years has the amount of wildlife decreased significantly? ၁၀နှစ်အတွင်း တောရိုင်းတိရစ္ဆာန်များ သိသိသာသာ	Yes No

	လျော့နည်းပါသလား။	
	c. Over the past 10 years are there significantly more people in this area? ဝဂနှစ်အတွင်း ဤဒေသတွင် သိသိသာသာ လူပိုများလာပါသလား။	Yes No
	d. Over the past 10 years has the weather changed significantly? ဝဂနှစ်အတွင်း ရာသီဥတု သိသိသာသာ ပြောင်းလဲလာပါသလား။	Yes No
	e. Are the wild plant and animals in this local environment a significant important source of food or medicine? တောရိုင်းအပင် နှင့် တိရစ္ဆာန်များ သည်ဤဒေသတွင် အစာနဲ့ဆေး အတွက် အရေးပါ ပါသလား။	Yes No
	f. Are the wild plant and animals in this local environment a significant important source of income? တောရိုင်းအပင် နှင့် တိရစ္ဆာန်များ သည်ဤဒေသတွင် အရေးပါသော ဝင်ငွေရနိုင်သည့် အလုပ်ဖြစ်ပါသလား။	Yes No

Survey questionnaire for Cultural heritage

Cultural Heritage

	Cultural Heritage	Response
1	Name အမည်၊	
2	Age အသက်၊	
3	Ethnic လူမျိုး၊	
4	Religion ဘာသာ၊	
5	Education ပညာရေး၊	
6	Job အလုပ်၊	
7	Address လိပ်စာ၊	
8	Marital Status အိမ်ထောင်ရှိ/မရှိ	
9	Respect in god အခြား (နတ်/ တန်ခိုးရှင်)ကိုးကွယ်ပါသလား	
10	Respect in Guardian Spirit တော၊ တောင်၊ ရေ၊ မြေ၊ ရွာစောင့်နတ်များယုံကြည်ကိုးကွယ်ပါသလား	
11	Location of Pagodas/ Monasteries and the histories ဘုရား/ ဘုန်းကြီးကျောင်းတို့ ၏ တည်နေရာနှင့် သမိုင်းကြောင်းများ	
12	Cultural Heritage places in your village/ township area ရွာ/ မြို့ အနီးပတ်ဝန်းကျင်တွင် ရှေးဟောင်းသမိုင်းဝင်နေရာများရှိ/ မရှိ	

13	If there is cultural heritage areas in your places, please mention the villagers view about them ရှိလျှင် ထိုနေရာများအပေါ်ဒေသခံများ၏ သဘောထား	
14	School location and type in your village/township စာသင်ကျောင်း တည်နေရာ/ အမျိုးအစား:	
15	Fairy Tale ပုံပြင်ဒဏ္ဍာရီများ	
16	Any Believe in your job လုပ်ကိုင်နေသော အလုပ်အကိုင်နှင့်ဆိုင်သော ယုံကြည်မှု	

17	Dos and Don'ts in your village/ township သင့်ရွာ/မြို့တွင် ဒေသခံများကျင့်သုံးသော ရှောင်ဓလေ့နှင့် ဆောင်ဓလေ့များ	
18	History of your village/ township ရွာ/မြို့ ၏ ရာဇဝင်-သမိုင်းကြောင်း	
19	Location of cemetery ရွာသံ်ချိုင်း၏ တည်နေရာ	
20	Any idea/view for the proposed project အသစ်တည်ဆောက်မည့် ရေနံနှင့်သဘာဝဓာတ်ငွေ့ တူးဖော်မှုလုပ်ငန်းအပေါ် ထင်မြင်ချက်	