Deedoke Hydropower Project

Environmental and Social Impact Assessment Report

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ဒီးဒုတ်ရေအားလျှပ်စစ် စီမံကိန်းအတွက် အဓိက ကတိကဝတ်များ

ကျွန်တော်တို့သည် အရည်အချင်းသတ်မှတ်ချက်အသေးစိတ်များကို ပြည်ထောင်စုအစိုးရမှ သတ်မှတ်သဘောတူထားသော ပုံစံများ သို့မဟုတ် ပြောင်းလဲသတ်မှတ်ထားသော ပုံစံများ အတိုင်း လိုက်နာပါမည်။

ကတိကဝတ်ဖော်ပြချက်နေရာ	ကတိကဝတ်
ESIA အစီရင်ခံစာ	
အခန်း (၃) မူဝါဒ၊ ဥပဒေဆိုင်ရာနှင့် ဖွဲ့စည်းဆောင်ရွက်ပုံဆိုင်ရာ လေ့လာသုံးသပ်ချက်	
အပိုင်း ၃.၁ - ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ မူဝါဒများ ပေါင်းစပ်ခြင်း	စီမံကိန်း အကောင်အထည်ဖော်သူသည် တည်ဆောက်ဆဲကာလနှင့် လုပ်ငန်းလည် ပတ်ဆောင်ရွက်သည့်ကာလများတွင် ဖြစ်ပေါ်လာသော ပတ်ဝန်းကျင်နှင့်လူမှုရေး ဆိုင်ရာ စီမံခန့်ခွဲမှုများကို လမ်းညွှန်ရန်အတွက် ပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာ မူဝါဒများကို လိုက်နာသွားပါမည်။
အပိုင်း ၃.၂.၁ - ပတ်ဝန်းကျင် ဆိုင်ရာစီမံခန့်ခွဲမှု အခြေခံများ အတွက် ပေါ်လစီနှင့် ဥပဒေဆိုင်ရာ မူဘောင်များ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာ ပေါ်လစီ (၁၉၉၄)၊ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဥပဒေ (၂၀၁၂) နှင့် ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးနည်းဥပဒေ (၂၀၁၄)တို့ကို လိုက်နာသွားပါ မည်။
အပိုင်း ၃.၂.၂ - ပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်းနှင့် စီမံခန့်ခွဲမှုနှင့် သက်ဆိုင်သော စည်းမျဉ်းများ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ထုံးလုပ်နည်း (၂၀၁၅) လိုက်နာသွားပါမည်။
အပိုင်း ၃.၂.၃ - ပတ်ဝန်းကျင် ကာကွယ်ရေးနှင့် လူမှုရေး ထိခိုက်မှု စီမံခန့်ခွဲမှုများနှင့် သက်ဆိုင်သော ဥပဒေနှင့် စည်းမျဉ်းများ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဥပဒေ (၂၀၁၂)၊ အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန်ချက်များ (၂၀၁၅) နှင့် အောက်ဖော်ပြတို့ကို လိုက်နာသွားမည် ဖြစ်ပါသည်။ • ပြည်သူ့ကျန်းမာရေး ဥပဒေ (၁၉၇၂) • ကူးစက်ရောဂါများကာကွယ်နှိမ်နင်းရေးဥပဒေ၊ (၁၉၉၅) • ပေါက်ကွဲမှု အက်ဥပဒေ၊ (၁၈၈၇) • ပေါက်ကွဲစေတတ်သော အရာဝတ္ထု ဥပဒေ၊ (၂၀၁၂) • လူမှုဖူလုံရေး ဥပဒေ၊ (၂၀၁၂) • ဆေးလိပ်နှင့် ဆေးရွက်ကြီးထွက်ပစ္စည်းသောက်သုံးမှုထိန်းချုပ်ရေး ဥပဒေ၊ (၂၀၀၆) • အလုပ်ရုံများအက်ဥပဒေ၊ (၁၉၅၁) • မြန်မာနိုင်ငံ ရင်းနှီးမြှုပ်နှံမှု ဥပဒေ၊ (၂၀၁၆) • တိုင်းရင်းသားလူမျိုးများ၏ အခွင့်အရေးကာကွယ်စောင့်ရှောက်ရေး ဥပဒေ၊ (၂၀၁၅) • မြန်မာနိုင်ငံမီးသတ်တပ်ဖွဲ့ဥပဒေ၊ (၂၀၁၅) • မြန်မာနိုင်ငံအင်ဂျင်နီယာကောင်စီဥပဒေ၊ (၂၀၁၃)

	• မန္တလေး စည်ပင်သာယာရေးအဖွဲ့များဥပဒေ၊ (၂၀၀၂) • လျှပ်စစ်ဥပဒေ၊ (၂၀၁၄) • မော်တော်ယာဉ် နည်းဥပဒေ၊ (၁၉၈၇) • မော်တော်ယာဉ် ဥပဒေ၊ (၂၀၁၅) • ရေနံနှင့် ရေနံထွက်ပစ္စည်းဆိုင်ရာ ဥပဒေ၊ (၂၀၁၇) • ရေနံအက်ဥပဒေ၊ (၁၉၃၉) • ပို့ကုန်သွင်းကုန် ဥပဒေ၊ (၂၀၁၂) • မြေယာသိမ်းဆည်းခြင်း အက်ဥပဒေ၊ (၁၈၉၄) • မြန်မာ့အာမခံဥပဒေ၊ (၁၉၉၃) • ခွင့်နှင့် အလုပ်ပိတ်ရက်များ အက်ဥပဒေ၊ (၁၉၅၁) • အလုပ်သမား အဖွဲ့အစည်း ဥပဒေ၊ (၂၀၁၁) • အလုပ်သမား အငြင်းပွားမှု ဖြေရှင်းရေးဥပဒေ၊ (၂၀၁၂) • အနည်းဆုံးအခကြေးငွေ ဥပဒေ၊ (၂၀၁၃) • အခကြေးငွေပေးချေရေး ဥပဒေ၊ (၂၀၁၆) • အလုပ်အကိုင်နှင့် ကျွမ်းကျင်မှုဖွံ့ဖြိုးတိုးတက်ရေး ဥပဒေ (၂၀၁၃) • အလုပ်သမား လျော်ကြေး အက်ဥပဒေ၊ (၁၉၂၃) • ယဉ်ကျေးမှုအမွေအနှစ်ဒေသများ ကာကွယ်ထိန်းသိမ်းရေးဥပဒေ၊ (၁၉၉၈) • ရှေးဟောင်းဝတ္ထုပစ္စည်း ကာကွယ်ထိန်းသိမ်းရေး ဥပဒေ၊ (၂၀၁၅) • ရှေးဟောင်းအဆောက်အအုံ ကာကွယ်ထိန်းသိမ်းရေး ဥပဒေ၊ (၂၀၁၅) • မြန်မာနိုင်ငံ သစ်တော မူဝါဒ၊ (၁၉၉၅) • သစ်တောဥပဒေ၊ (၁၉၉၂) • လယ်ယာမြေဥပဒေ၊ (၂၀၁၂) • ရေချိုငါးလုပ်ငန်း ဥပဒေ၊ (၁၉၉၁) • ရေအရင်းအမြစ်နှင့် မြစ်၊ ချောင်းများ ထိန်းသိမ်းရေး ဥပဒေ၊ (၂၀၀၆)
အပိုင်း ၃.၃ - အပြည်ပြည်ဆိုင်ရာ လုပ်ထုံးလုပ်နည်းများ၊ စာချုပ်များနှင့် သဘောတူညီချက်များ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် အောက်ဖော်ပြတို့ကို လိုက်နာသွားမည် ဖြစ်ပါသည်။ • အရှေ့တောင်အာရှနှင့် ပစိဖိတ်ဒေသများအတွက် ဖါတ်အားပေးစက်ရုံ ကာကွယ်ရေး သဘောတူညီချက်၊ ရောမ၊ ၁၉၅၆ခုနှစ် • ကုလသမဂ္ဂ ရာသီဥတုပြောင်းလဲခြင်းဆိုင်ရာ ညီလာခံ (UNFCCC)၊ နယူးယောက်၊ ၁၉၉၂ခုနှစ် • ဇီဝမျိုးကွဲများဆိုင်ရာ ညီလာခံ၊ ရီယိုဒီ ဂျနေရိုး၊ ၁၉၉၂ခုနှစ် • ကမ္ဘာ့ယဉ်ကျေးမှုနှင့် သဘာဝ အမွေအနှစ်များ ကာကွယ်ခြင်းညီလာခံ၊ ပဲရစ်(စ်)၊ ၁၉၇၂ • သဘာဝပတ်ဝန်းကျင်နှင့် သဘာဝအရင်းအမြစ်များ ထိန်းသိမ်းရေး အာဆီယံ (ASEAN) သဘောတူညီမှု ၊ ကွာလာလမ်ပူ၊ ၁၉၈၅ • ကာတာဂျီနာ (Catagena) ဇီဝလုံခြုံမှု သဘောတူညီမှုစာချုပ် ကာတာဂျီနာ၊ ၂၀၀၀ ခုနှစ် • ရာသီဥတုပြောင်းလဲခြင်းဆိုင်ရာ ကျိုတိုသဘောတူညီမှု ၊ ကျိုတို၊

	၁၉၉၇ ခုနှစ် တို့ဖြစ်ပါသည်။
အပိုင်း ၃.၄.၁ - အမျိုးသားဆိုင်ရာ နှင့် ကမ္ဘာ့အဆင့်အလိုက် အစီအစဉ်များ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် သယံဇာတနှင့် သဘာဝ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန (MONREC) လက်အောက်ရှိ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန (ECD)မှ ထုတ်ပြန်ထားသော ပတ်ဝန်းကျင်ထိန်းသိမ်းစောင့်ရှောက်ရေး ကော်မတီ (ENCC) ကို လိုက်နာ ဆောင်ရွက်ပါမည်။
အပိုင်း ၃.၄.၂ - စီမံကိန်းနေရာ၏ အစီအစဉ်များ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် မြန်မာနိုင်ငံ၏ အမျိုးမျိုးသော ဝန်ကြီးဌာနများနှင့်အစိုးရအဖွဲ့အစည်းများ၏ တာဝန်ယူမှုများကို နားလည်ပါမည်။
ဇယား ၃.၅-၁ - ဆက်စပ်နေ သော ပတ်ဝန်းကျင်ဆိုင်ရာ လမ်းညွှန်ချက်များနှင့် စံနှုန်းများ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် အောက်ဖော်ပြပါတို့ကို စီမံခန့်ခွဲပြီး ထိခိုက်မှုများကို ထိန်းချုပ်သွားမည် ဖြစ်ပါသည်။ • ပတ်ဝန်းကျင်လေထု အရည်အသွေး • ပတ်ဝန်းကျင်ဆူညံသံ အဆင့်များ • တုန်ခါမှု • မြေအောက်ရေ အရည်အသွေးတို့ ဖြစ်ပါသည်။
အခန်း (၄) - စီမံကိန်းဖော်ပြချက်	
အပိုင်း ၄.၁.၁ - စီမံကိန်း အကျိုးအကြောင်းနှင့် နောက်ခံ	စီမံကိန်းကို အဝင်/အထွက်ရေ တူညီစွာ စီးဆင်းနေသော ရေအားလျှပ်စစ် စီမံကိန်းအဖြစ် ဒီဇိုင်းပြုလုပ်ထားပါသည်။
အပိုင်း ၄.၁.၃ - စီမံကိန်း အဆောက်အအုံ	<u>ရေကာတာ</u> စုစုပေါင်းအလျား မီတာ (၁၅၀) ရှိပြီး ရေမျက်နှာပြင်အမြင့် (၆၅) m.asl ရှိသော ‌လျှောစောက်ပါ လုံးဝန်သော ရေမြုပ်ရေကာတာ ပုံစံဖြစ်ပါသည်။ <u>ဂိတ်တံခါး</u> ဂိတ်တံခါးတစ်ခုလျှင် အကျယ် (၁၇) မီတာရှိသော ဂိတ်တံခါး (၇)ခုပါရှိပါသည်။ <u>ရေသေကန်</u> ရေသေကန်၏ အရှည်သည် မီတာ (၅၀) ရှိပါသည်။ <u>ဓါတ်အားရုံ</u> ရေကာတာ၏ ဘယ်ဘက်အခြမ်းတွင် တည်ရှိပါသည်။ <u>ချဉ်းကပ်လမ်း</u> စီမံကိန်းနေရာတွင်ချဉ်းကပ်လမ်း၂ခုရှိပြီးဘယ်ဘက်ကမ်းရှိ ချဉ်းကပ်လမ်းမှာ ၄၃၀မီတာရှည်လျားပြီး ညာဘက်ကမ်းရှိ ချဉ်းကပ်လမ်းအရှည်မှာ ၅၇၀ မီတာ ဖြစ်ပါသည်။ ချဉ်းကပ်လမ်း၂ခုသည် လက်ရှိလမ်းဟောင်းမှ ခွဲထွက်ဖောက်လုပ် မည်ဖြစ်ပြီး ချဉ်းကပ်လမ်း၂ခု၏ စုစုပေါင်းအရှည်မှာ မီတာ ၁၀၀၀ ဖြစ်ပါသည်။ <u>မဟာဓါတ်အားလိုင်း</u> စုစုပေါင်းအရှည် ကီလိုမီတာ (၂၀) ရှိသော (၁၃၂) kV ဆားကစ် (၂)ခု ပါဝင်သော မဟာဓါတ်အားလိုင်းကို လက်ဝဲဘက်ကမ်းမှ ဘဲလင်းပင်မ ဓါတ်အားရုံခွဲသို့ သွယ်တန်းပါမည်။ <u>ဓါတ်အားခွဲရုံ</u>

<table>
<tr><td></td><td>ဘဲလင်းပင်မဓါတ်အားရုံခွဲတွင် (၁၃၂) kV (လက်ရှိ ဓါတ်အားခွဲရုံကို တိုးချဲ့ပါမည်)</td></tr>
<tr><td>အပိုင်း ၄.၃.၂.၂ - လုပ်ငန်းစဉ် နည်းလမ်း</td><td>
<table>
<tr><td>ရေပိုက်လွှဲ</td><td>• တာတမံ
• တူးဖော်ခြင်း လုပ်ငန်းစဉ်
• ကွန်ကရစ် လုပ်ငန်းစဉ်
• ညာဘက်ကမ်းတာတမံ လုပ်ငန်းစဉ်</td></tr>
<tr><td>ဓါတ်အားရုံ</td><td>• တာတမံ
• တူးဖော်ခြင်း လုပ်ငန်းစဉ်
• ကွန်ကရစ် လုပ်ငန်းစဉ်</td></tr>
<tr><td>ဓါတ်အားပေးစခန်း</td><td>-</td></tr>
<tr><td>ယ ၁ ယီ အဆောက်အဦးများ</td><td>• ကျောက်မိုင်း
• မြေသားယူသည့်နေရာ
• မြေသားတာတမံ
• ကြိတ်ခွဲစက်
• ဘိလပ်မြေဖျော်စက်
• နောက်ကျိရေများကို သန့်စင်နေရာ
• ယာယီ ရေထောက်ပံ့ပေးမှု
• ယာယီ လျှပ်စစ်ဓါတ်အား ထောက်ပံ့ပေးမှု
• အမြဲ ချဉ်းကပ်လမ်း
• အခြေစိုက် စခန်းနှင့် ဝန်ထမ်း အိမ်ယာ
• အခြေစိုက် စခန်းနှင့် ဝန်ထမ်း အိမ်ယာတွင် ရေသန့်စင်မှု စနစ်</td></tr>
</table>
</td></tr>
<tr><td>အပိုင်း ၄.၃.၄ - ပိတ်သိမ်းခြင်း/ အပြီးသတ် ပိတ်သိမ်းခြင်း လုပ်ဆောင်မှုများ</td><td>ကန်ထရိုက်တာသည် စာချုပ်ထဲတွင်ဖော်ပြထားသည့်အတိုင်း ပတ်ဝန်းကျင်ထိန်းသိမ်းမှု ဆိုင်ရာများကို စီမံကိန်း အကောင်အထည်ဖော်သူမှ တည်ဆောက်ရေး လုပ်ငန်းများ မစတင်ခင် နဂိုမူလ အတိုင်း ပြန်လည်ဖြစ်ပေါ်စေရန် အောက်ဖော်ပြပါ လုပ်ငန်း တာဝန်များကို တာဝန်ယူ ဆောင်ရွက်ရပါမည်။
• စီမံကိန်းနေရာ ရှင်းလင်းခြင်း
• မြေပြုခြင်းနှင့် အနယ်အနှစ် ထိန်းချုပ်ခြင်း
• စီမံကိန်းမှ ကိရိယာများ ဖယ်ရှားခြင်း တို့ဖြစ်ပါသည်။</td></tr>
<tr><td colspan="2">အခန်း (၆) - ထိခိုက်သက်ရောက်မှု ဆန်းစစ်ခြင်းနှင့် လျော့ချရေးနည်းလမ်းများ</td></tr>
<tr><td>အပိုင်း ၆.၂ - ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှုများ၏ ဖော်ပြချက်</td><td>လုပ်ငန်းလည်ပတ်စဉ် ရေမျက်နှာပြင် အမြင့်သည် (၈၀) အနေဖြင့် ဒီဇိုင်း ပြုလုပ်ထားပြီး ၎င်းကြောင့် ရေမျက်နှာပြင်မြင့်တက်လာခြင်းသည် သိသာထင်ရှားစွာ တွေ့မြင်ရပါမည်။</td></tr>
<tr><td>အပိုင်း ၆.၄.၁ - အသေးစိတ် စီမံခန့်ခွဲမှုနှင့် စောင့်ကြည့်စစ်ဆေးခြင်း အစီအစဉ်</td><td>စီမံကိန်း အကောင်အထည်ဖော်သူသည် ကန်ထရိုက်တာနှင့် ပူးပေါင်း၍ အောက်ဖော်ပြပါ လျော့ချရေး နည်းလမ်းများကို လုပ်ဆောင်ရပါမည်။
<u>ပတ်ဝန်းကျင်ကို အနှောက်အယှက်ပေးသော ဖုန်မှုန့်</u></td></tr>
</table>

- စီမံကိန်းနေရာ ပြင်ဆင်ခြင်းများတွင် တည်ဆောက်ရေး ဧရိယာနှင့် လမ်းများကို ရေဖြန်းပါမည်။
- ယာဉ်များနှင့် ကုန်တင်ကားများကို တစ်နာရီလျှင် ကီလိုမီတာ (၄၀) ထက် မပိုစေရန် တင်းကြပ်စွာ တားမြစ် သတ်မှတ်ထားရပါမည်။
- ဆောက်လုပ်ရေး လုပ်ငန်းများပြီးစီးလျှင် အသုံးပြုထားသော ဧရိယာကို ပြန်လည်ထိန်းသိမ်းခြင်း၊ ပြန်လည်အသုံးပြုနိုင်ရန်ဆောင်ရွက်ခြင်းများကို ပြုလုပ်ရပါမည်။

<u>ဓါတ်ငွေ့ထုတ်လွှတ်ခြင်း</u>

ကန်ထရိုက်တာသည် ဓါတ်ငွေ့ထုတ်လွှတ်ခြင်းများ လျော့နည်းစေရန် နည်းလမ်းများကို လိုက်နာ ကျင့်သုံးရပါမည်။

<u>ဆူညံသံ</u>

- ကျယ်လောင်သော ဆူညံသံများထွက်ပေါ်စေသည့် အဓိက တည်ဆောက်ရေး လုပ်ဆောင်မှုများကို နေ့အချိန်တွင်သာ လုပ်ဆောင်စေပါမည်။ အကယ်၍ ညအချိန်တွင် လုပ်ဆောင်ရန် လိုအပ်လာပါက စီမံကိန်း အင်ဂျင်နီယာထံမှ ထောက်ခံချက်လိုအပ်ပြီး ဆူညံသံ ထိန်းချုပ်သော ကိရိယာ သို့မဟုတ် နည်းလမ်းများ အသုံးပြုရန် လိုအပ်ပါသည်။
- ကန်ထရိုက်တာသည် ပတ်ဝန်းကျင် ဆူညံသံ အဆင့်ကို အမြဲမပြတ် စောင့်ကြည့်လေ့လာသင့်ပါသည်။ အထူးသဖြင့် ဆူညံသံထွက်ပေါ်သည့် ပိုင် ရိုက်ခြင်းကာလတွင် ပြုလုပ်သင့်ပါသည်။

<u>တုန်ခါမှု</u>

- ကန်ထရိုက်တာသည် မြေကြီးတုန်ခါမှု လျော့နည်းစေရန်နှင့် လေဖိအား လက်ခံနိုင်သော အဆင့်ရစေရန် ပေါက်ကွဲမှု အစီအစဉ်ကို ပြင်ဆင်ထားပါမည်။ ပေါက်ကွဲမှု အစီအစဉ်ကို စီမံကိန်း အကောင်အထည်ဖော်သူ၏ ကြီးကြပ်ရေးမှူး အင်ဂျင်နီယာမှ စစ်ဆေးပြီး အတည်ပြုပါမည်။

<u>မြေမျက်နှာသွင်ပြင်၊ ဘူမိဗေဒနှင့် မြေလျှောင်</u>

- မြေပြိုခြင်းများကို ရှောင်ရှားရန် ဘေးအန္တရာယ်ကင်းရှင်းမှု မြင့်မားသော လျှောစောက်ဒီဇိုင်းကို အသုံးပြုပါမည်။

<u>မြေတိုက်စားခြင်းနှင့် အနယ်ကျခြင်း</u>

- မြေတိုက်စားခြင်းနှင့် အနယ်ကျခြင်းကို ထိန်းချုပ်ရန် နန်းကာနှင့် အနယ်ထိုင်ကန်များကို သင့်တော်သည့်နေရာတွင် ထည့်သွင်းပါမည်။
- မြေတိုက်စားခြင်းနှင့် အနယ်ကျခြင်းကို ထိန်းချုပ်ရန် ခြောက်သွေ့ရာသီတွင် တစ်ပတ်လျှင် တစ်ကြိမ်နှင့် မိုးရာသီတွင် (၂၄)နာရီတွင် တစ်ကြိမ် အမြဲမပြတ် စစ်ဆေးကြည့်ရှုရပါမည်။ လိုအပ်သော ပြန်လည်ပြုပြင်နိုင်သော သို့မဟုတ် အစားထိုးနိုင်သော အလုပ်များကို (၂၄)နာရီအတွင်း ရှာဖွေပါမည်။

<u>ရေကြီးရေလျှံခြင်း</u>

- ရေကြီးရေလျှံခြင်း သတိပေးစနစ်ကို တပ်ဆင်ထားပါမည်။

<u>မြေပေါ်ရေ အရည်အသွေး</u>

- ကျောက်မိုင်းနှင့် အခြား ဆောက်လုပ်ရေးများမှ စီးဆင်းလာသောရေများအတွက် အနယ်ထိုင်ကန် ထည့်သွင်းတည်ဆောက်ပါမည်။
- အနယ်အနှစ်များကို တားဆီးရန် ယာယီ အကာအရံများကို စီမံကိန်း ပတ်လည်တွင် ကာရံထားခြင်းဖြင့် စီမံကိန်း အနီးတွင် တည်ရှိသော စိုက်ပျိုးမြေများအတွင်းသို့ မိုးရွာသွန်းမှုကြောင့် တည်ဆောက်ရေး ဧရိယာမှ ထွက်ရှိလာသော ဆေးကြောရေများ ဝင်ရောက်ခြင်းကို ကန့်သတ်နိုင်ပါသည်။

<u>အဏ္ဏဝါ ဂေဟစနစ်နှင့် ရေနေသတ္တဝါ</u>

- အကောင်းဆုံး လုပ်ဆောင်မှု အနေဖြင့် မြစ်အတွင်းသို့ အနယ်အနှစ်များ စွန့်ထုတ်ခြင်းကို ရှောင်ရှားခြင်း/လျှော့နည်းစေခြင်းကို ပြုလုပ်ရပါမည်။ ဥပမာ - လျောစောက်နေရာတွင် နိုင်လိုင်ဇကာများ တပ်ဆင်အသုံးပြုခြင်းဖြင့် မြစ်အတွင်းသို့ အနယ်အနှစ်များ ဝင်ရောက်ခြင်း လျှော့နည်းနိုင်ပါသည်။
- တည်ဆောက်ရေး ဧရိယာနှင့် အလုပ်သမား စခန်းမှ ထွက်ရှိလာသော ရေဆိုးနှင့် ညစ်ညမ်းရေများကို မြစ်ငယ်မြစ်အတွင်းသို့ မစွန့်ပစ်ခင် ဦးစွာ သန့်စင်ရပါမည်။

<u>အခြေစိုက်စခန်း</u>

မြေပေါ်ရေ အရည်အသွေး

- ရေထွက်နေရာမှ မီတာ (၁၅၀) ကွာဝေးသောနေရာတွင် အလုပ်သမားများအတွက် သင့်တော်သော ယင်လုံအိမ်သာများကို ထားရှိပေးပါမည်။
- ရေထု သို့မဟုတ် ရေစုကန်အတွင်းသို့ မစွန့်ပစ်မီ ရေထုအရည်အသွေး စံနှုန်းနှင့် ကိုက်ညီစေရန် တည်ဆောက်ရေးစခန်းများအားလုံးတွင် ရေဆိုးသန့်စင်စနစ်ကို ထည့်သွင်းပါမည်။

စွန့်ပစ်ပစ္စည်း

- စွန့်ပစ်ပစ္စည်းများ စွန့်ပစ်ခြင်း အစီအစဉ်သည် စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲခြင်း စည်းမျဉ်းများအပြင် အခြား စွန့်ပစ်ခြင်း လိုအပ်ချက်များနှင့် ကိုက်ညီရပါမည်။

တစ်ကိုယ်ရည်ကျန်းမာရေး

- အခြေစိုက်စခန်းဧရိယာသည် သက်ဆိုင်ရာဥပဒေနှင့် စံနှုန်းများနှင့်အညီ လေဝင်/လေထွက်ကောင်းမွန်ရပါမည်။ အခြေစိုက်စခန်း သန့်ရှင်းမှုအတွက် ထောက်ပံ့ပေးမှုများနှင့် စစ်ဆေးမှုများ ပြုလုပ်ရပါမည်။

အပိုင်း ၆.၄.၂ - အကြောင်းအရာအလိုက် စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်	<u>လမ်းပန်းဆက်သွယ်ရေး</u> • စီမံကိန်း ဆောက်လုပ်ရေးအတွက် ပစ္စည်းများ၊ အလုပ်သမားများနှင့် ကိရိယာများ သယ်ယူပို့ဆောင်ရာတွင် ယာဉ်စည်းကမ်း၊ လမ်းစည်းကမ်းကို လိုက်နာရန် တင်းကြပ်စွာ သတိပေးပါမည်။ • ဆောက်လုပ်ရေး လုပ်ငန်းခွင်တွင် လုံလောက်သော ယာဉ်သွားလာမှု အမှတ်အသားများနှင့် အလွယ်တကူမြင်တွေ့နိုင်သော ဆိုင်းဘုတ်များကို ရှင်းလင်းစွာ ညွှန်ပြ တပ်ဆင်ပါမည်။ • အကယ်၍ မတော်တဆ ထိခိုက်မှုများ ဖြစ်ပေါ်ခဲ့လျှင် တည်ဆောက်ရေးဆိုင်ရာ အရေးပေါ် တုန့်ပြန်မှု အစီအစဉ်၏ သက်ဆိုင်ရာ ကဏ္ဍကို ချက်ချင်း လိုက်နာပါမည်။ <u>ရေအသုံးပြုမှု</u> • အလုပ်သမားများအသုံးပြုနိုင်ရန် သင့်တော် လုံလောက်သော ရေကန်များဖြင့် ရေကို စုဆောင်းပြင်ဆင်ပေးပါမည်။ • အလုပ်သမားများအတွက် လုံလောက်သော သောက်သုံးရေကို ပြင်ဆင်ပေးပါမည်။ <u>စွန့်ပစ်ပစ္စည်း</u> • အလုပ်သမား အခြေစိုက်စခန်းနှင့် စီမံကိန်း ဧရိယာတွင် အမှိုက်များ မီးရှို့ခြင်းကို တားမြစ်ပါမည်။ • အလုပ်သမားများ၏ အခြေစိုက်စခန်းနှင့် တည်ဆောက်ရေး ဧရိယာတွင် အဖုံးအကာပါသော အမှိုက်ပုံး သို့မဟုတ် အမှိုက်ကန်များကို ပြင်ဆင်ပေးပါမည်။ အမှိုက် သိမ်းဆည်းခြင်းနှင့် စွန့်ပစ်ရန်အတွက် သက်ဆိုင်ရာ ဒေသအာဏာပိုင်များ သို့မဟုတ် ကန်ထရိုက်တာခွဲကို အကြောင်းကြားပါမည်။ • စွန့်ပစ်ပစ္စည်း စွန့်ပစ်မှု အစီအစဉ်သည် စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲခြင်းဆိုင်ရာ စည်းမျဉ်းများနှင့်အညီ လုပ်ဆောင်ပါမည်။ • ရေထု သို့မဟုတ် တောရိုင်းသတ္တဝါများ၏ နေရင်းဒေသများတွင် အမှိုက်စွန့်ပစ်ခြင်းကို တားမြစ်ပါမည်။ <u>အန္တရာယ်ရှိသော ပစ္စည်းများ</u> • အန္တရာယ်ရှိဗသာ ပစ္စည်းများအတွက် လေ့ကျင့်သင်ကြားပြီး အောင်မြင်ထားသော သူသာ ၎င်းပစ္စည်းများကို ထုတ်လုပ်သူ၏ ညွှန်ကြားချက်နှင့် အစိုးရ စည်းမျဉ်းများနှင့်အညီ ကိုင်တွယ်ရပါမည်။ • အန္တရာယ်ရှိသော ပစ္စည်းများကို စွန့်ပစ်ရာတွင် သက်ဆိုင်ရာ စည်းမျဉ်းများနှင့်အညီ စွန့်ပစ်ပါမည်။ <u>ဇီဝလောက်စာရှင်းလင်းခြင်း</u> • သစ်ပင်ပန်းမန်များ နှင့် ကာကွယ်တောများဆုံးရှုံးခြင်းကို စီမံကိန်းမှ သင့်တော်အောင်ဆောင်ရွက်ပါမည်။ • သစ်ခုတ်ခြင်းနှင့် သစ်လုံးများရောင်းခြင်းကို သက်ဆိုင်ရာ

	အာဏာပိုင်များ၏ သက်ဆိုင်ရာ ဥပဒေများနှင့် စည်းမျဉ်းများနှင့်အညီ ဆောင်ရွက်ပါမည်။ <u>သစ်ပင်မျိုးစိတ်များ ရွှေ့ပြောင်းစိုက်ပျိုးခြင်း</u> • မျိုးသုဉ်းအန္တရာယ်ကျရောက်နေသော သင့်တော်သော အရွယ်အစားရှိသော သစ်ပင်မျိုးစိတ်များကို စစ်တမ်းကောက်ယူပါမည်။ <u>လုပ်ငန်းခွင်ကျန်းမာရေး</u> • လုပ်ငန်းခွင် မတော်တဆထိခိုက်မှုများ လျော့နည်းစေရန် ဘေးအန္တရာယ်ကင်းရှင်းရေး လေ့ကျင့်သင်ကြားမှုများနှင့် အကြိုလေ့ကျင့်ခြင်းများကို ပြုလုပ်ပါမည်။ • အခြေစိုက်စခန်း သန့်ရှင်းရေး လုပ်ဆောင်မှုများကို ထောက်ပံ့ပေးခြင်းနှင့် ပုံမှန် စစ်ဆေးခြင်းများပြုလုပ်ပါမည်။ • ဘေးအန္တရာယ်ကာကွယ်ရေး ပစ္စည်း သို့မဟုတ် ကိရိယာများအသုံးပြုခြင်းအားဖြင့် မတော်တဆထိခိုက်မှုကို ကာကွယ်နိုင်ခြင်း သို့မဟုတ် လျော့နည်းစေနိုင်သောကြောင့် ၎င်းတို့ကို အသုံးပြုရန် ပြင်ဆင် တိုက်တွန်းရပါမည်။ ဥပမာ - မျက်စိအကာအကွယ်၊ လုံခြုံရေးဖိနပ်၊ နားအကာအကွယ်များ၊ အသက်ကယ်ခါးပတ်များ၊ ကာကွယ်ရေး အဝတ်အစားများနှင့် ဦးထုပ်များကို အမြဲစစ်ဆေးရပါမည်။ <u>လူထုကျန်းမာရေး</u> • ဒီးဒုတ် ရေအားလျှပ်စစ်စီမံကိန်း၏ EMP အခန်း (၆) တွင် လူထုကျန်းမာရေး စီမံခန့်ခွဲမှု အစီအစဉ်ကို ဖော်ပြထားပါသည်။ <u>တည်ဆောက်ရေး ထောက်ပံ့မှု ဖွဲ့စည်းပုံများ ဖျက်သိမ်းခြင်း</u> • ဒီးဒုတ် ရေအားလျှပ်စစ်စီမံကိန်း၏ EMP အခန်း (၆) တွင် တည်ဆောက်ရေး ထောက်ပံ့မှု ဖွဲ့စည်းပုံများ ဖျက်သိမ်းခြင်းအတွက် စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်ကို ဖော်ပြထားပါသည်။ <u>အလုပ်သမားများအတွက် လေ့ကျင့်သင်ကြားရေး အစီအစဉ်</u> • ဒီးဒုတ် ရေအားလျှပ်စစ်စီမံကိန်း၏ EMP အခန်း (၆) တွင် အလုပ်သမားများအတွက် လေ့ကျင့်သင်ကြားရေး အစီအစဉ်ကို ဖော်ပြထားပါသည်။
အပိုင်း ၆.၅.၁ - လူမှုရေးဆိုင်ရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည် ည့်လေ့လာရေး အစီအစဉ်	***စီမံကိန်းနေရာ အသေးစိတ် စီမံခန့်ခွဲမှု အစီအစဉ်*** <u>တူးဖော်ရာဖွေ တွေ့ရှိမှု</u> • တူးဖော်ရာဖွေတွေ့ရှိမှု စီမံခန့်ခွဲမှု အစီအစဉ်နှင့်အညီ တူးဖော်ရာဖွေတွေ့ရှိမှု အစီအစဉ်ကို အကောင်အထည်ဖော်ပါမည်။ ***အကြောင်းအရာအလိုက် စီမံခန့်ခွဲမှု အစီအစဉ်*** <u>ပေးလျော်ခြင်း</u> • စီမံကိန်းကြောင့် ထိခိုက်ခံရသော မြေများကို RAP

	တွင် ဖော်ပြထားချက်များနှင့်အညီ ပေးလျော်ပါမည်။ အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်ရေး • အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်ရေး အစီအစဉ်ကို RAP တွင် ဖော်ပြထားချက်များနှင့်အညီ အကောင်အထည်ဖော်ပါမည်။ ဒေသဖွံ့ဖြိုးရေး • ဒေသဖွံ့ဖြိုးရေး အစီအစဉ်များကို RAP တွင် ဖော်ပြထားချက်များနှင့်အညီ အကောင်အထည်ဖော်ပါမည်။
အပိုင်း ၆.၆ - ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု စနစ် (EMS)	စီမံကိန်းအကောင်အထည်ဖော်သူနှင့် ကန်ထရိုက်တာသည် စီမံကိန်း ဆောက်လုပ်ရေးအတွက် ၎င်းတို့၏ ကိုယ်ပိုင် ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု စနစ် (EMS) ကို အကောင်အထည်ဖော် လု လုပ်ဆောင်ပါမည်။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ EMSသည် စီမံကိန်းအဆင့်အလိုက် ပတ်ဝန်းကျင်ဆိုင်ရာ လိုက်နာမှုများအတွက် စောင့်ကြည့်လေ့လာခြင်းနှင့် သုံးသပ်ခြင်းများကို စီမံကိန်း၏ စီမံခန့်ခွဲမှုအစိတ်အပိုင်းအနေဖြင့် လုပ်ဆောင်ပါမည်။ ကန်ထရိုက်တာ EMSသည် ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်း လုပ်ငန်းအဆင့်များကို အလေးပေးပြီး ဆောက်လုပ်ရေး စီမံခန့်ခွဲမှုအစိတ်အပိုင်းအနေဖြင့် လုပ်ဆောင်ပါမည်။
အပိုင်း ၆.၇ - အရေးပေါ် တုန့်ပြန်မှု အစီအစဉ် (ERP)	ဆောက်လုပ်ရေး ကန်ထရိုက်တာကို အရေးပေါ်တုန့်ပြန်မှု အစီအစဉ် အကောင်အထည်ဖော်ရန် ညွှန်ကြားသွားပါမည်။
အပိုင်း ၆.၉ - လူထုတွေ့ဆုံဆွေးနွေးခြင်းနှင့် ထုတ်ဖော်ချက်	လူထုတွေ့ဆုံဆွေးနွေးခြင်းနှင့် ထုတ်ဖော်ချက်များ ဆောင်ရွက်မှုကို ESIA အစီရင်ခံစာတွင် ဖော်ပြထားပါသည်။
အခန်း (၇) - ဆက်စပ်သက်ရောက်မှုများ ဆန်းစစ်ခြင်း	
မြစ်ငယ်မြစ်ပေါ်တွင် အကောင်အထည်ဖော်သည့် ရေအားလျှပ်စစ် စီမံကိန်းများအားလုံး ပါဝင်သော CIA ဆန်းစစ်ချက် ပြီးမြောက် အကောင်အထည်ဖော်မှုတွင် ပါဝင် ဆောင်ရွက်ပါမည်။ CIA တွင် အခြားအစိတ်အပိုင်းများ ဖြစ်သော သစ်တော၊ လမ်းနှင့် လမ်းပန်းဆက်သွယ်ရေး၊ စိုက်ပျိုးရေးနှင့် မိုင်းလုပ်ငန်းတို့ပါဝင်နေပါသည်။ ထို့ကြောင့် CIA နှင့် ထိခိုက်မှု စီမံခန့်ခွဲခြင်းပေါင်းစပ်မှုများအတွက် DEPP မှ စတင် အကောင်အထည်ဖော်မည့် မြစ်ငယ်မြစ် ပေါ်တွင် တည်ရှိနေသော ရေအားလျှပ်စစ် အကောင်အထည်ဖော်သူများနှင့် လက်ရှိ ရေအားလျှပ်စစ် စီမံကိန်းများ ပေါင်းစပ်ပါဝင်မှုတွင် ဒီးဒုတ် စီမံကိန်းသည်လည်း ပါဝင်ပါမည်ဟု ကတိကဝတ်ပြုပါသည်။	
အခန်း (၈) - ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှု အစီအစဉ်များ	
အပိုင်း ၈.၃ - တည်ဆောက်ရေးကာလအတွက် စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်များ	
ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့် ည့်လေ့လာရေး အစီအစဉ်များ	စီမံကိန်းနေရာ သို့မဟုတ် ဧရိယာ၏ အသေးစိတ် လုပ်ငန်းစဉ်များနှင့် လုပ်ထုံးလုပ်နည်းများ • လေထုအရည်အသွေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ဆူညံသံ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • တုန်ခါမှု စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်

	• မြေမျက်နှာသွင်ပြင်၊ ဘူမိဗေဒနှင့် မြေငလျင်ပညာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • တိုက်စားခြင်းနှင့် အနယ်ထိုင်ခြင်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ရေကြီးရေလျှံခြင်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • မြေမျက်နှာပြင်ရေ အရည်အသွေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • အဏ္ဏဝါ ဂေဟာဗေဒနှင့် ရေနေသတ္တဝါ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ပစ္စည်း သိုလှောင်ခြင်း ဧရိယာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • တူးဖော်ထားသော မြေကြီးများ စုပုံရာနေရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ကျောက်ပုံသည့် ဧရိယာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • မြေသားယူသည့်နေရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • စီမံကိန်း စခန်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်
	အကြောင်းအရာအလိုက် လုပ်ငန်းစဉ်များနှင့် လုပ်ထုံးလုပ်နည်းများ • သယ်ယူပို့ဆောင်ရေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ရေအသုံးပြုမှု စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • စွန့်ပစ်အမှိုက် စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • အန္တရာယ်ရှိသော စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ဇီဝလောင်စာ ရှင်းလင်းခြင်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • သစ်ပင်အစိတ်အပိုင်းများ ရွှေ့ပြောင်းစိုက်ခြင်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • လုပ်ငန်းခွင် ကျန်းမာရေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ဒေသခံလူထု ကျန်းမာရေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • တည်ဆောက်ရေး အထောက်အပံ့ ဖွဲ့စည်းပုံများ ဖျက်သိမ်းခြင်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • အလုပ်သမားများအတွက် လေ့ကျင့်သင်ကြားပေးရေး အစီအစဉ်များ • တည်ဆောက်ရေး အရေးပေါ်တုန့်ပြန်မည့် အစီအစဉ် (CERP)
လူမှုရေးဆိုင်ရာ	စီမံကိန်းနေရာ သို့မဟုတ် ဧရိယာ၏ အသေးစိတ် လုပ်ငန်းစဉ်များနှင့်

စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်	လုပ်ထုံးလုပ်နည်းများ • အခွင့်အလမ်းများ ရှာဖွေခြင်းဆိုင်ရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်
	အကြောင်းအရာအလိုက် လုပ်ငန်းစဉ်များနှင့် လုပ်ထုံးလုပ်နည်းများ • ပေးလျော်မှု စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်ရေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ဒေသခံလူထု ဖွံ့ဖြိုးတိုးတက်မှု စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်
အပိုင်း ၈.၄ - လုပ်ငန်းလည်ပတ်စဉ်ကာလအတွက် စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်များ	
ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်များ	စီမံကိန်းနေရာ သို့မဟုတ် ဧရိယာ၏ အသေးစိတ် လုပ်ငန်းစဉ်များနှင့် လုပ်ထုံးလုပ်နည်းများ • ဆူညံသံ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • တုန်ခါမှု စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • ရေကြီးရေလျှံခြင်း စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • မြေမျက်နှာပြင်ရေ အရည်အသွေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • အဏ္ဏဝါ ဂေဟဗေဒနှင့် ရေနေသတ္တဝါ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ် • စွန့်ပစ်အမှိုက် စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်
လူမှုရေးဆိုင်ရာ စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်	စီမံကိန်းနေရာ သို့မဟုတ် ဧရိယာ၏ အသေးစိတ် လုပ်ငန်းစဉ်များနှင့် လုပ်ထုံးလုပ်နည်းများ • အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်ရေး စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့် လေ့လာရေး အစီအစဉ် • ဒေသခံလူထု ဖွံ့ဖြိုးတိုးတက်မှု စီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်
စောင့်ကြည့်လေ့လာရေး နေရာများနှင့် အကြိမ်နှုန်းများ	ကာလအားလုံး၏ ပတ်ဝန်းကျင်ဆိုင်ရာ အစိတ်အပိုင်းအားလုံး အတွက် စောင့်ကြည့်လေ့လာရေး နေရာများနှင့် အကြိမ်နှုန်းများကို EMP တွင် ဖော်ပြထားပြီး စီမံကိန်း အကောင်အထည်ဖော်သူသည်
ရံပုံငွေ	စီမံကိန်းအကောင်အထည်ဖော်သူသည် ကာလအားလုံး၏ လုပ်ငန်းစဉ်များနှင့် လုပ်ထုံးလုပ်နည်းများကို ရန်ပုံငွေအလုံအလောက်ဖြင့် လုပ်ဆောင်သွားပါမည်ဟု ကတိပြုပါသည်။
အခန်း (၉) - အများပြည်သူတိုင်ပင်ဆွေးနွေးခြင်းနှင့် ထုတ်ဖော်ကြေညာခြင်း	
အပိုင်း ၉.၁ - နိဒါန်း	စီမံကိန်းအကောင်အထည်ဖော်သူသည် ဒေသခံများနှင့် သက်ဆိုင်နေသော ထိခိုက်မှု များ ဆန်းစစ်ခြင်း၊ လျော့ချရေးနည်းလမ်း အစီအစဉ်များနှင့် စောင့်ကြည့်လေ့လာရေး အစီအစဉ်များရွေးချယ်ခြင်း စသည်တို့ကို ပတ်ဝန်းကျင် ဆိုင်ရာ လုပ်ထုံးလုပ်နည်းများ နှင့်အညီ လိုက်နာဆောင်ရွက်သွားပါမည်။

<table>
<tr>
<td>အပိုင်း ၉.၂ - နည်းလမ်းနှင့် ချဉ်းကပ်ခြင်း</td>
<td>

စီမံကိန်းအကောင်အထည်ဖော်သူသည် အများပြည်သူ ပါဝင်မှုနှင့်သက်ဆိုင် သော အခြေခံစည်းမျဉ်းများနှင့် လုပ်နည်းများကို လိုက်နာဆောင်ရွက် သွားပါမည်။
စီမံကိန်းအကောင်အထည်ဖော်သူသည် စီမံကိန်းနှင့် ပတ်သက်သည့် ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ပြဿနာများကို ဒေသခံများအား တင်ပြသွား ပါမည်။

</td>
</tr>
<tr>
<td>အပိုင်း ၉.၃.၂ - စီမံကိန်း နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း ပြင်ဆင်ခြင်း ကာလ၏
လူထုတွေ့ဆုံ ဆွေးနွေးခြင်း</td>
<td>
စီမံကိန်းအကောင်အထည်ဖော်သူနှင့် အကြံပေးများ၏ တုန့်ပြန်ဖြေကြားချက်များကို အခန်း (၉)၊ အပိုင်း ၉.၄.၁ တွင် ဖော်ပြထားပြီး အောက်ဖော်ပြပါ ဇယားတွင် ဖော်ပြထားပါသည်။
<table>
<tr><th>အဓိကပြဿနာများ</th><th>စီမံကိန်း အကြံပေးမှ ရှင်းလင်းချက်များ</th></tr>
<tr><td colspan="2">အစိုးရ အာဏာပိုင်များ</td></tr>
<tr>
<td>- ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများ ဖြစ်သော ဖုန်မှုန့်၊ ဆူညံသံနှင့် မြစ်ရေ အရည်အသွေး</td>
<td>- EIA လေ့လာမှုတွင် လေထု၊ ဆူညံသံ၊ ရေအရည်အသွေးနှင့် အဏ္ဏဝါ ဂေဟစနစ်တို့ ပါဝင်ပါသည်။ စီမံကိန်း အကောင်အထည်ဖော်မှုအတွက် အခြေခံ သတင်းအချက်အလက်များ ရရှိရန် ပတ်ဝန်းကျင်ဆိုင်ရာ နမူနာကောက်ယူခြင်းကို နှစ်ရာသီတွင် ပြုလုပ်ခဲ့ပါသည်။ ထို့ပြင် အကြံပေးအဖွဲ့မှ ဖြစ်ပေါ်လာနိုင်သော ထိခိုက်မှုများအတွက် လျော့ချရေး နည်းလမ်းများကို အကြံပြုထားပါသည်။</td>
</tr>
<tr>
<td>- မြစ်ငယ်မြစ်ရေ၏
၏
လက်ရှိတွင် အမြင့်ဆုံး
ဆုံး pH
အဆင့်နှင့် စီ
စီမံကိန်း လ
လည်ပတ်သည့် ကာ
ာလတွင် တိုးပွားလာန
နိုင်ခြင်း ရှိ/မရှိ သ
သိရှိလိုပါသည်။</td>
<td>- ရေအရည်အသွေး လေ့လာရာတွင် pH အဆင့်တိုင်းတာခြင်းလဲ ပါဝင်ပါသည်။ ဒုတိယအကြိမ် လူထုတွေ့ဆုံပွဲတွင် ၎င်း pH အဆင့် ရလဒ်ကို တင်ပြသွားပါမည်။ အကယ်၍ pH အဆင့်သည် မြင့်တက်ခဲ့ပြီး ထိခိုက်မှုများ ဖြစ်ပေါ်ခဲ့ပါက အကြံပေး အဖွဲ့အစည်းသည် ဖြစ်ပေါ်လာနိုင်သော ထိခိုက်မှုများအတွက် လျော့ချရေး နည်းလမ်းများကို ပြင်ဆင်ပေးသွားမည် ဖြစ်ပါသည်။</td>
</tr>
<tr>
<td>- ကျေးရွာနေလူထု၏ ကျန်းမာရေးဆိုင်ရာ</td>
<td>- စီမံကိန်း အကောင်အထည်ဖော်မှုအတွက်</td>
</tr>
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		ထိခိုက်မှု	EIA လေ့လာမှုတွင် ကျန်းမာရေးဆိုင်ရာ ထိခိုက်မှုများပါဝင်ပါသည်။	
		- စီမံကိန်း တည်ဆောက်ခြင်း ဧရိယာအတွက် မြေယာ ရယူခြင်း	- စီမံကိန်း တည်ဆောက်မှုများ မစတင်ခင် စီမံကိန်းမှ မြေပိုင်ရှင်များအား အကြောင်းကြားကာ ဆွေးနွေးမှုများ ပြုလုပ်သွားပါမည်။	
		- ရေကာတာ ပျက်စီးမှု အတွက် စိုးရိမ်ပူပန်ခြင်း	- EIA လေ့လာမှုတွင် ငလျင် ပြဿနာအတွက်ပါဝင်ပြီး စီမံကိန်း ဒီဇိုင်းသည် အပြည်ပြည်ဆိုင်ရာ စံနှုန်းများနှင့်အညီ လိုက်နာသွားမည် ဖြစ်ပါသည်။	
		- ရေမျက်နှာပြင် မြင့်တက်လာပြီး ကွန်ကရစ်လမ်းကို ရေလွှမ်းမှု ဖြစ်လာနိုင်ပါသလား။	- ရေမျက်နှာပြင်သည် (၈) မီတာမြင့်တက်လာပြီး ၄င်း ရေအမြင့်သည် မြစ်အတွင်းမှာသာ တည်ရှိနေမည် ဖြစ်ပါသည်။ သို့သော် အကယ်၍ စီမံကိန်းနေရာသည် ၄၄ (ဂ) နေရာ (သရက်ပင်ကျေးရွာ) တွင် တည်ရှိခဲ့ပါက တည်ဆောက်ရေး လုပ်ငန်းအတွက် အချို့သော ကွန်ကရစ်လမ်းများကို ပြန်လည် နေရာချထားပေးရမည် ဖြစ်ပါသည်။	
		- ပေးလျော်ခြင်း အစီအစဉ် သည် မည်သို့ရှိသနည်း။	- စီမံကိန်း အကောင်အထည်ဖော်သူ၊ အစိုးရ အာဏာပိုင်များနှင့် မြေပိုင်ရှင်များပါဝင်သော ပေးလျော်ခြင်း ကော်မတီကို ဖွဲ့စည်းမည် ဖြစ်ပြီး ပေးလျော်ခြင်း နှုန်းထားအတွက် ဆွေးနွေးသွားကြကြမည် ဖြစ်ပါသည်။ - ပေးလျော်ခြင်း အစီအစဉ်သည် ထိခိုက်ခံရသူများအတွက် မြန်မာနိုင်ငံ၏ ဥပဒေများနှင့်အညီ ညီတူညီမျှဖြစ်ပြီး ပွင့်လင်းမြင်သာမှုရှိရပါမည်။	
		- စီမံကိန်းနေရာ ၅၄တွင် စီမံကိန်းကြောင့် ထိခိုက်မှု ဧရိယာများ	- စီမံကိန်း ထိခိုက်မှု ဧရိယာ စုစုပေါင်း (၅) ဟက်တာရှိပြီး လယ်ယာမြေ (၂) ဟက်တာနှင့် မစိုက်ပျိုးသောမြေ (၃)	

မည်သို့ရှိသနည်း။	ဟက်တာတို့ ပါဝင်ပါသည်။ ၎င်း ဧရိယာများသည် စီမံကိန်း တည်ဆောက်ရေး ဧရိယာနှင့် လုပ်ငန်းလည်ပတ်သည့် ကာလတွင် ဖြစ်ပေါ်လာမည့် ရေလွှမ်းခံရမည့် ဧရိယာများ ဖြစ်ပါသည်။
- စီမံကိန်းဧရိယာအတွင် ဒေသခံများကို ဖြတ်သန်းခွင့် ပြုမ မည်လား။	- စီမံကိန်း တည်ဆောက်ဆဲကာလတွင် လုံခြုံမှုအရ စီမံကိန်း ဧရိယာအတွင်း ဒေသခံများအား ဖြတ်သန်းသွားလာခွင့်ပြုမည် မဟုတ်ပါ။ စီမံကိန်း လည်ပတ်မှုကာလအတွက် ၎င်းပြဿနာကို နောက်ပိုင်းတွင် ဖြေရှင်းတုန့်ပြန်ပေးသွားမည် ဖြစ်ပါသည်။
- ကိရိယာများနှင့် ပစ္စည်းများသယ်ယူ ပို့ဆောင်မှုကြောင့် လမ်းပျက်စီးမှု ဖြစ်ပေါ်လာလျှင် စီမံကိန်းမှ မည်သို့ တာဝန်ယူ ပေးမည်န နည်း။	- စီမံကိန်းသည် ပျက်စီးသွားသော လမ်းကို ချက်ချင်း ပြန်လည် ပြင်ဆင်ပေးပါမည်။
ဒေသခံလူထုများ	
- ပေးလျော်ခြင်း အစီအစဉ် မည်သို့ ရှိသနည်း၊	- စီမံကိန်း အကောင်အထည်ဖော်သူ၊ အစိုးရ အာဏာပိုင်များနှင့် မြေပိုင်ရှင်များပါဝင်သော ပေးလျော်ခြင်း ကော်မတီကို ဖွဲ့စည်းမည် ဖြစ်ပြီး ပေးလျော်ခြင်း နှုန်းထားအတွက် ဆွေးနွေးသွားကြမည် ဖြစ်ပါသည်။ - ပေးလျော်ခြင်း အစီအစဉ်သည် ထိခိုက်ခံရသူများအတွက် မြန်မာနိုင်ငံ၏ ဥပဒေများနှင့်အညီ ညီတူညီမျှဖြစ်ပြီး ပွင့်လင်းမြင်သာမှုရှိရပါမည်။
- စီမံကိန်း ဧရိယာအနီးရှိ ဒေသခံများအတွက် အလုပ်အကိုင် ရရှိမှု	- အကြံပေးတို့သည် EIA အစီရင်ခံစာတွင် လူမှုရေးဆိုင်ရာ ထိခိုက်မှု လျော့ချရေး

		အခွင့်အလမ်း မည်သို့ ရှိသနည်း။	နည်းလမ်းများအဖြစ် ဒေသခံအလုပ်သမားများကို ခန့်ထားပေးရန် အကြံပြုထားပါသည်။	
		- ဆောက်လုပ်ရေးလုပ်ငန် န်း လုပ်ဆောင်မှုများကြော ကာင့် ဖြစ်ပေါ်လာနိုင်သော တုန်ခါမှုနှင့် ဆူညံသံများ၏ ထိခိုက်မှုများ မည်သို့ရှိသနည်း။	- EIA လေ့လာမှုများပြုလုပ်ရာတွင် ဆူညံသံ၊ တုန်ခါမှုအဆင့် တိုင်းတာခြင်းများ ပြုလုပ်ခဲ့ပါသည်။ စီမံကိန်း အကောင်အထည်ဖော်မှုအတွက် ထိခိုက်မှုများ ဆန်းစစ်ခြင်း၏ အခြေခံ သတင်းအချက်အလက်များအနေဖြင့် လက်ရှိ ဆူညံသံနှင့် တုန်ခါမှုတို့ကို တိုင်းတာပါမည်။ ထို့အပြင် ဖြစ်ပေါ်လာနိုင်သော ထိခိုက်မှုများအတွက် အကြံပေးသူမှ လျော့ချရေးနည်းလမ် မ်းများကို ပြင်ဆင်ပေးသွားမည် ဖြစ်ပါသည်။	
		- ဒေသဖွံ့ဖြိုးရေးအတွ တွက် စီမံကိန်းမှ မည်သို့ ထောက်ပံ့ပေး ပးသွား မည်နည်း။ ဥပမာ - လျှပ်စစ်မီးနှင့် ရေပေး းဝေမှုစနစ်	- EIA အစီရင်ခံစာတွင် ၄င်းပြဿနာများကို အကြံပေးအဖွဲ့မှ အကြံပြုပေးပါမည်။	
		- မြစ်ငယ်မြစ်၏ ကမ်းနစ်ဖက်လုံးသို့ ဖြတ်သန်းမှုအတွက် ရေကာတာကို အသုံးပြုနိုင်မှု ဖြစ်နိုင်ချေရှိ/မရှိ	- အကြံပေးအဖွဲ့သည် ၄င်းပြဿနာအတွက် ဖြေရှင်းချက်ကို အသေးစိတ် ဖြစ်နိုင်ချေ လေ့လာမှု ပြီးဆုံးသွားသည သည့်အခါ ဒုတိယအကြိမ် လူထုတွေ့ဆုံပွဲတွင် ပြန်လည်ဖြေကြားပေးသွားမည် ဖြစ်ပါသည်။	
		- စီမံကိန်း သတင်းအချက် အလက်များကို ရှင်းရှင်းလင်းလင်း ဖြန့်ဝေစေချင်ပါသည်။	- နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်းအဆင့်တွင် အသေးစိတ် ဖြစ်နိုင်ချေ လေ့လာမှုသည် မပြီးဆုံးသေးပါ။ ထို့ကြောင့် တိကျသော စီမံကိန်း သတင်းအချက်အလက်များနှင့်	

	အဓိက ထိခိုက်မှုများနှင့် လျော့ချရေးနည်းလမ်းများကို ဒုတိယအကြိမ် လူထုတွေ့ဆုံပွဲတွင် တင်ပြသွားမည် ဖြစ်ပါသည်။
အပိုင်း ၉.၅ - EIA အစီရင်ခံစာ ပြင်ဆင်ခြင်းအတွက် လူထုတွေ့ဆုံခြင်း ရလဒ်	စီမံကိန်းအကောင်အထည်ဖော်သူနှင့် အကြံပေးများ၏ တုန့်ပြန်ဖြေကြားချက်များကို **အခန်း (၉)၊ အပိုင်း ၉.၅.၁** တွင် ဖော်ပြထားပြီး အောက်ဖော်ပြပါ ဇယားတွင် ဖော်ပြထားပါသည်။

အဓိကပြဿနာများ	စီမံကိန်း အကြံပေးမှ ရှင်းလင်းချက်များ
အစိုးရ အာဏာပိုင်များ	
- ထိခိုက်ခံရသူများအတွက် ပေးလျော်မှု နှုန်းထား - ပေးလျော်ခြင်း ပြဿနာအတွက် အစိုးရ အုပ်ချုပ်ရေးရုံး၊ အကောင်အထည်ဖော်သူနှင့် ဒေသခံများအကြားတွင် ဆွေးနွေးညှိနှိုင်းခြင်းများ ပြုလုပ်သင့်ပါသည်။	- စီမံကိန်း အကောင်အထည်ဖော်သူ၊ အစိုးရ အာဏာပိုင်များနှင့် မြေပိုင်ရှင်များပါဝင်သော ပေးလျော်ခြင်း ကော်မတီကို ဖွဲ့စည်းမည် ဖြစ်ပြီး ပေးလျော်ခြင်း နှုန်းထားအတွက် ဆွေးနွေးသွားကြမည် ဖြစ်ပါသည်။ - ပေးလျော်ခြင်း အစီအစဉ်သည် ထိခိုက်ခံရသူများအတွက် မြန်မာနိုင်ငံ၏ ဥပဒေများနှင့်အညီ ညီတူညီမျှဖြစ်ပြီး ပွင့်လင်းမြင်သာမှုရှိရပါမည်။
- စီမံကိန်းကြောင့် သက်ရောက်မှုရှိသော မြေနှင့် ပိုင်ဆိုင်မှုများကို အသေးစိတ် လေ့လာမှုများ ပြုလုပ်သင့်ပါသည်။	- စီမံကိန်း တည်ဆောက်မှု မစတင်ခင်တွင် အသေးစိတ်လေ့လာမှုများကို လုပ်ဆောင်သွားမည် ဖြစ်ပါသည်။
- မြစ်အောက်ပိုင်း ဧရိယာတွင် ရေအရည်အသွေး ထိခိုက်မှု	- ၎င်းလေ့လာမှုတွင် ရေအရည်အသွေးလေ့လာမှု၊ pH အဆင့်၊ နောက်ကျိမှု၊ BOD၊ COD နှင့် ဆားဓါတ်ပါဝင်မှုတို့ပါဝင်ပါသည်။ EIA အစီရင်ခံစာတွင် မြစ်ရေ၏ ရေအရည်သွေး ရလဒ်များကို ဖော်ပြထားပါသည်။ စီမံကိန်း တည်ဆောက်ရေးလုပ်ငန်းနှင့် စီမံကိန်း လည်ပတ်ရေး လုပ်ငန်းများကြောင့် ရေအရည်သွေး
- မြစ်ရေတွင် ဆားဓါတ်ပါဝင်မှုကို မည်သို့ ထိန်းချုပ်မည်နည်း။	
- ဒေသခံများ၏ ရေအသုံးပြုမှုအပေါ် ထိခိုက်မှု	

		ထိခိုက်မှုများ ဖြစ်ပေါ်လာလျှင် အကြံပေးမှ အကြံပြုထားသည့် ရေထောက်ပံ့ပေးပေးခြင်း ကဲ့သို့သော လျော့ချရေး နည်းလမ်းများပါရှိပါသည်။	
	- စီမံကိန်းအကောင်အထည် ဖော်မှုကြောင့် ရေလွှမ်းခံရနိုင်သည့် ဧရိယာ အတိအကျ	- ရေမျက်နှာပြင်သည် (၈) မီတာမြင့်တက်လာပြီး ၄င်း ရေအမြင့်သည် မြစ်အတွင်းမှာသာ တည်ရှိနေမည် ဖြစ်ပါသည်။	
	- ဆောက်လုပ်ရေး ကန်ထရိုက်တာသည် လျော့ချရေးနည်းလမ်းများကို တင်းကြပ်စွာ လုပ်ဆောင်ရပါမည်။	- အကြံပေးအဖွဲ့သည် EIA အစီရင်ခံစာတွင် ဒေသခံများ၏ အကြံပေးချက်များ ထည့်သွင်း ဖော်ပြပေးပါမည်။	
	- ဆောက်လုပ်ရေး ကန်ထရိုက်တာသည် ဒေသခံများနှင့် နီးကပ်စွာ ဆက်ဆံရပါမည်။	- အကြံပေးအဖွဲ့သည် EIA အစီရင်ခံစာတွင် ဒေသခံများ၏ အကြံပေးချက်များ ထည့်သွင်း ဖော်ပြပေးပါမည်။	
	- လုပ်ငန်းလည်ပတ်စဉ်ကာလတွင် လျော့ချရေးနည်းလမ်းများမှာ ရေရှည် ဖြစ်သင့်ပါသည်။	- EIA အစီရင်ခံစာတွင် တည်ဆောက်ရေး ကာလနှင့် လုပ်ငန်းလည်ပတ်စဉ် ကာလများအတွက် လျော့ချရေး နည်းလမ်းများကို အကြံပေးအဖွဲ့မှ တင်ပြသွားမည် ဖြစ်ပါသည်။	
	ဒေသခံလူထုများ		
	- စီမံကိန်း သက်ရောက်မှု ဧရိယာနှင့် ပိုင်ဆိုင်မှုများအတွက် ပေးလျော်ခြင်းနှုန်းထားမည်သို့ရှိသနည်း။ - မြစ်ငယ်မြစ်ကမ်း (၂) ဘက်လုံးတွင် ပေးလျော်ခြင်းနှုန်းထား တူညီသင့်ပါသည်။	- စီမံကိန်း အကောင်အထည်ဖော်သူ၊ အစိုးရ အာဏာပိုင်များနှင့် မြေပိုင်ရှင်များပါဝင်သော ပေးလျော်ခြင်း ကော်မတီကို ဖွဲ့စည်းမည် ဖြစ်ပြီး ပေးလျော်ခြင်း နှုန်းထားအတွက် ဆွေးနွေးသွားကြမည် ဖြစ်ပါသည်။ - ပေးလျော်ခြင်း အစီအစဉ်သည် ထိခိုက်ခံရသူများအတွက် မြန်မာနိုင်ငံ၏ ဥပဒေများနှင့်အညီ ညီတူညီမျှဖြစ်ပြီး ပွင့်လင်းမြင်သာမှုရှိရပါမည်။	
	- စီမံကိန်း	- ရေမျက်နှာပြင်သည် (၈)	

	အကောင်အထည်ဖော ်စဉ်တွင် ရေလွှမ်းမှု အဆင့် မည်သို့ရှိသနည်း။	မီတာမြင့်တက်လာပြီး ၄င်း ရေအမြင့်သည် မြစ်အတွင်းမှာသာ တည်ရှိနေမည် ဖြစ်ပါသည်။
	- ရေလွှမ်းခံရမည့် ဧရိယာကို ပိုင်းခြား သတ်မှတ်သင့်ပါသည်။ - မြစ်ငယ်မြစ် (၂) ဘက်ကမ်း တစ်လျှောက်တွင် ရေလွှမ်း ဧရိယာကို စိုးရိမ် ပူပန်ကြပါသည်။	- စီမံကိန်းသည် ရေလွှမ်းခံမည့် ဧရိယာကို ပိုင်းခြားသတ်မှတ်ခြင်းနှင့် အသေးစိတ် လေ့လာခြင်းကို စီမံကိန်း တည်ဆောက်ရေး မစတင်ခင်တွင် ပြုလုပ်သွားမည် ဖြစ်ပါသည်။
	- မြစ်ဖြတ် တံတားအဖြစ် အသုံးပြုလိုကြပါသည်။	- အကြံပေးအဖွဲ့သည် EIA အစီရင်ခံစာတွင် ဒေသခံများ၏ အကြံပေးချက်များ ထည့်သွင်း ဖော်ပြပေးပြီး ဖြစ်နိုင်ချေလေ့လာသည့် အဖွဲ့နှင့် ပူးပေါင်းဆောင်ရွက်ပေးပါမည်။
	- စီမံကိန်းအကောင်အထ ထည် ဖော်သူသည် အခြေခံအဆောက်အ အဦးများကို ထောက်ပံ့ေ ပးသင့်ပါသည်။ ဥပမာ - စာကြည့်တိုက်၊ ဆရာ/ဆရာမများနှင့် ဆရာဝန်များအတွက် နေရာထိုင်ခင်းများ ဆော ဂက်လုပ်ပေးခြင်း - စီမံကိန်း တည်ဆောက်ရေး လုပ်ငန်းများတွင် ဒေသခံများအတွက် အလုပ်အကိုင် အခွင့်အလမ်းများနှင့် ဒေသခံ ယာဉ်များအား အသုံးပြုစေခြင်း	- EIA အစီရင်ခံစာတွင် လူမှုရေးဆိုင်ရာ ထိခိုက်မှု လျော့ချရေးနည်းလမ်းများ အဖြစ် ဒေသခံ အလုပ်သမားများ ခန့်အပ်ရန် အကြံပေးအဖွဲ့မှ အကြံပြုပေး သွားမည် ဖြစ်ပါသည်။
အပိုင်း ၉.၆ - EIA သုံးသပ်နေသည့်ကာလတွင် တေ ွ့ဆုံဆွေးနွေးခဲ့သည့် ရလဒ်များ	EIA ကိုသုံးသပ်နေသည့်ကာလတွင် စီမံကိန်း အကောင်အထည်ဖော်သူမှ လူထုတွေ့ဆုံ ဆွေးနွေးပွဲကို ၂၀၁၈ခုနှစ်၊ ဧပြီလ ၂၃ရက်နေ့တွင် ဧပြီလတွင် ပြုလုပ်ခဲ့သော ဒေသခံလူထု တွေ့ဆုံပွဲ	

	အခမ်းအနားတွင် အောက်ဖော်ပြပါ မေးခွန်းများကို မေးကြားခဲ့ပါသည်။ • မြေယာ ရယူခြင်းဆိုင်ရာ ထိခိုက်မှုများ၊ • ရဲရွာ ရေကာတာ၏ ဆက်စပ်သက်ရောက်မှုများပါဝင်သော ရေ အရည်အသွေး ထိခိုက်မှုများ၊ • အကျိုးသက်ရောက်မှုများ ခွဲဝေခြင်းဆိုင်ရာ အစီအစဉ်များ ပါဝင်ခြင်း၊ • ဘေးအန္တရာယ် စီမံခန့်ခွဲခြင်း အစီအစဉ်/ ရေကာတာ ဘေးကင်းရေး အစီအစဉ် • တည်ဆောက်ရေးကြောင့် ဖြစ်ပေါ်လာသော လူမှုရေးနှင့် ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများ (ဖုန်မှုန့်၊ ကျန်းမာရေး၊ ဆူညံသံ စသည်) • ကျန်းမာရေးဆိုင်ရာ စစ်တမ်းကောက်ယူခြင်းနှင့် ဖြစ်ပေါ်လာနိုင်သော ကျန်းမာရေး ထိခိုက်မှုများ၊ • အလုပ်သမားများ ဝင်ရောက်လာမှုကြောင့် ထိခိုက်မှု တို့ဖြစ်ပါသည်။
အပိုင်း ၉.၇ - ဆက်လက် လုပ်ဆောင်နေသော တွေ့ဆုံဆေ ဆွေးနွေးမှုများ အတွက် အကြံပြုချက်များ	ထိခိုက်ခံစားရသူများ (PAPs)၊ ဒေသခံများနှင့် စိတ်ပါဝင်စားသော အဖွဲ့အစည်းများသည် စီမံကိန်း အကောင်အထည်ဖော်မှုကို သေချာစွာ နားလည်စေရန် ၄င်းတို့သည် စီမံကိန်း ဖွံ့ဖြိုးတိုးတက်ရန်အတွက် လုပ်ဆောင်မှုများအားလုံးကို ကနဦးထဲမှ ပါဝင်ရပါမည်။ ၄င်း အစီအစဉ် လုပ်ဆောင်မှုများတွင် - **(၁) သတင်းအချက်အလက်များ ဖြန့်ဝေခြင်း** ထိခိုက်ခံစားရသူများ (PAPs) အတွက် အောက်ဖော်ပြပါ သတင်းအချက်အလက်များကို ဖြန့်ဝေခဲ့ပါသည်။ • စီမံကိန်း အစိတ်အပိုင်းများ၊ • စီမံကိန်း စတင်မည့် အချိန်ဇယား၊ • စီမံကိန်း မူဝါဒအတွက် အသေးစိတ် သတင်းအချက်အလက်များ နှင့် အစီအစဉ်များ အကောင်အထည်ဖော်ခြင်း • ပေးလျော်ခြင်း အစီအစဉ်နှင့် ရပိုင်ခွင့်များ • ဆုံးရှုံးနစ်နာမှုအတွက် ပြင်ဆင်ရန် ဖြေလျော့ခြင်းနှင့် အယူခံဝင်ခြင်း လုပ်ငန်းစဉ် • ပါဝင်မှု နှင့် ဆွေးနွေးမှု အခွင့်အရေးများ • လူမှုဘဝ အရည်အသွေး တိုးတက်မှု အစီအစဉ်နှင့် လူမှုရေးဆိုင်ရာ ဖွံ့ဖြိုးတိုးတက်မှု အစီအစဉ် • အဖွဲ့အစည်း၏ တာဝန်ယူမှုများ တို့ဖြစ်ပါသည်။ **(၂) ထိခိုက်ခံစားရသူများ (PAPs)နှင့် တွေ့ဆုံဆွေးနွေးခြင်း** (က) ထိခိုက်ခံစားရသူများ (PAPs)ကို ပေးလျော်ခြင်းအတွက် ပေးချေမှုကို သတိပေးစာနှင့်အတူ အကြောင်းကြားခြင်း ပြုလုပ်ပါမည်။ ထိခိုက်ခံစားရသူများ (PAPs) သည် ပေးလျော်ခြင်းအတွက် လိုအပ်သော သက်ဆိုင်ရာ စာရွက်စာတမ်းများ (မှတ်ပုံတင်၊ မြေအမျိုးအစား၊ စသည်) နှင့်အတူ ကြိုတင် အကြောင်းကြားခြင်း၊ (ခ) ပြန်လည်ထူထောင်ရေး ကူညီဆောင်ရွက်မှုများ၏ ဦးစားပေး

	အတည်ပြုချက်များ အတွက် ထိခိုက်ခံစားရသူများ (PAPs)နှင့်အတူ တွေ့ဆုံဆွေးနွေးမှုများ ပြုလုပ်ခြင်း၊ (ဂ) တည်ဆောက်ရေးလုပ်ငန်းစတင်ရန် စီမံကိန်းနေရာရှင်းလင်းခြင်းများ မစတင်ခင်တွင် ထိခိုက်ခံစားရသူများ (PAPs)ကို ကြိုတင် အကြောင်းကြားခြင်း၊ (ဃ) ရုပ်ပိုင်းဆိုင်ရာ လုပ်ငန်းများ စတင်လုပ်ဆောင်ခြင်းနှင့် လုပ်ငန်း လုပ်ကိုင်နေစဉ် ကာလတစ်လျှောက်၏ အချိန်ဇယားများကို ထိခိုက်ခံစားရသူများ (PAPs) ကိုအကြောင်းကြားခြင်း၊ (င) ဝင်ငွေ ပြန်လည်ထူထောင်ရေး ဆောင်ရွက်မှုများအတွက် ထိခိုက်ခံစားရသူများ (PAPs)နှင့် တွေ့ဆုံဆွေးနွေးခြင်းနှင့် ၄င်းတို့ပါဝင်မှုအတွက် အတည်ပြုခြင်း၊ (စ) ဒေသတွင်း/လူမှုရေးဆိုင်ရာ ဖွံ့ဖြိုးတိုးတက်မှု အစီအစဉ်အတွက် ထိခိုက်ခံစားရသူများ (PAPs)နှင့် တွေ့ဆုံဆွေးနွေးခြင်း၊ (ဆ) စီမံကိန်း အကောင်အထည်ဖော်စဉ်ကာလတွင် စောင့်ကြည့်လေ့လာခြင်းနှင့် ကြီးကြပ်ကြည့်ရှုခြင်း လုပ်ဆောင်မှုများအတွက် ထိခိုက်ခံစားရသူများ (PAPs)ကို အကြောင်းကြားခြင်းတို့ကို ပြုလုပ်ပါမည်။

မှ

စီမံကိန်းအကောင်အထည်ဖော်သူနှင့် ကန်ထရိုက်တာများ

PROJECT KEY TECHNICAL COMMITMENT FOR DEEDOKE HYDROPOWER PROJECT

We commit to implementing the technical specifications as per the government-approved design, or to any government-approved changes thereto.

Commitment Source	Commitment
ESIA Report	
Chapter 3 Overview of the Policy, Legal and Institutional Framework	
Section 3.1: Corporate Environmental and Social Policies	Project proponent will formulate an environmental and social management policy to guide its environmental and social management during the construction phase and the operation phase.
Section 3.2.1: Policy and legal framework which provide the foundation for environmental management	Project proponent will follow National Environmental Policy (1994), the Environmental Conservation Law (2012), and Environmental Conservation Rules (2014).
Section 3.2.2: Regulations Related to Environmental Impact Assessment and Management	Project proponent will comply the Environmental Impact Assessment Procedure (EIA Procedure 2015)
Section 3.2.3: Laws and Regulations Related to Environmental Protection and Social Impact Management	Environmental Conservation Law (2012), National Environmental Quality (Emission) Guidelines, Myanmar (2015) and project proponent will follow: • Public Health Law (1972) • The Prevention and Control of Communicable Disease Law (1995) • The Explosive Act (1887); section 5 and 6 • Explosive Substance Law (2012) • Social Security Law (2012); section 11(a),15(a), 18(b), 48, 49 and 75(a) (b) • The Control of Smoking and Consumption of Tobacco Product Law (2006) • Factories Act (1951); section 23, 25, 26, 28, 33(1) and 40 • Myanmar Investment Law (2016); section 50(a) (d), 51(b) (c) (d), 65(g) (I) (j) (k) (l) (m) (o) (p) (q) • Protection of National Races Law (2015); section 5 • Myanmar Fire Bridge Law (2015); section 25 • Myanmar Engineering Council Law (2013); section 31(a), (b) and 37 • The City of Mandalay Development Law (2002) • Electricity Law (2014); section 18, 21(a), 22(a), 26(a), (b), 27, 40, and 68 • Motor Vehicle Rules (1987) • Motor Vehicle Law (2015) • The Petroleum and Petroleum Product Law (2007) • Petroleum Rules (1937) • Export and Import Law (2012) • The Land Acquisition Act (1894) • Leave and Holiday Act, 1951 (No.58) • Labour Organization Law (2011); section 17,18, 19,

Commitment Source	Commitment
	20, 21 and 22 • Settlement of Labour Disputes Law (2012); section 38, 39, 40 and 51 • Minimum Wages Law (2013); section 12 and 13 (a), (b), (c), (d), (e), (f) and (g) • Payment of Wages Act (2016); section 3(a), (b), 4, 5, 14 • Employment and Skill Development Law (2013); section 5, 14, 30 • The Workmen's Compensation Act (1923); section 3(1), 12(1) and 14(1) • The Protection and Preservation of Cultural Heritage Regions Law (1998), Amended by Law No.1/2009 • The Protection and Preservation of Antique Objects Law (2015); section 12 • The Protection and Preservation of Ancient Monuments Law (2015); section 12, 15(h) and 20(f) • Myanmar Forest Policy (1995) • The Forest Law (1992); section 12 • The Farmland Law (2012); section 30(a) and (b) • The Freshwater Fisheries Law (1991); section 36, 40 and 41 • The Conservation of Water Resources and Rivers Law (2006)
Section 3.3: International Conventions, Treaties and Agreements	Project proponent will follow: • Plant Protection Agreement for the South-East Asia and the Pacific Region, Rome (1956) • United Nations Framework Convention on Climate Change, New York (1992) (UNFCCC) • Convention on Biological Diversity, Rio de Janeiro (1992) • The Convention for the Protection of the World Culture and Natural Heritage, Paris (1972) • ASEAN Agreement on the Conservation of Nature and Nature Resources, Kuala Lumpur (1985) • Catagena Protocol on Biosafety, Cartagena (2000) • Kyoto Protocol to the Convention on Climate Change, Kyoto (1997)
Section 3.4.1: Arrangement at the National and Sector Level	Project proponent shall comply the Environmental Conservation Committee (ENCC) by MONREC through ECD.
Section 3.4.2: Sectoral Framework/Mechanism	Project proponent has to understand the responsibility of different ministries and government organizations.
Table 3.5-1: Relevant Environmental Guidelines and Standards	Project proponent will manage and control impacts as follows: • Ambient Air Quality • Ambient Noise Levels • Vibration • Groundwater Quality
Chapter 4 Project Description	
Section 4.1.1: Project Rationale and Background	The Project will be designed as a run-of-river hydropower project.
Section 4.1.3: Project	<u>Dam</u>

<table>
<tr><th>Commitment Source</th><th>Commitment</th></tr>
<tr><td>Infrastructure</td><td>Submerge rounded crest weir with a slope on both side, spillway crest elevation 68.5 m. asl, dam top elevation 84 m asl, total length 150 m
<u>Gates</u>
Seven tainter (radial) gates, each 17 m width
<u>Stilling basin</u>
Length about 50 m
<u>Power house</u>
Location on the left side of the dam
<u>Access Road</u>
The project will construct two access roads to the project site, one on the left bank about 430 m and another on the right bank about 570 m, both branching out from the existing roads, total length 1,000 m.
<u>Transmission lines</u>
There is 132 kV line with double circuits on the left bank with total length of 20 km from Deedoke HPP to Belin Substation.
<u>Substations</u>
Belin Substation 132 kV 2 bays (extension in the substation compound)</td></tr>
<tr><td>Section 4.3.2.2: Method of Work</td><td><table>
<tr><td>Spillway</td><td>• Coffer dam
• Excavation work
• Concrete work
• Right Bank Embankment work</td></tr>
<tr><td>Power House</td><td>• Coffer dam
• Excavation work
• Concrete work</td></tr>
<tr><td>Switchyard</td><td>• Excavation work
• Concrete work</td></tr>
<tr><td>Temporary Facilities</td><td>• Quarry
• Borrow Pit
• Spoil bank
• Crushing plant
• Batching plant
• Turbid water treatment facilities
• Temporary water supply
• Temporary power supply
• Permanent access roads
• Base camp and worker camp
• Water treatment system in base camp and worker camp</td></tr>
</table></td></tr>
<tr><td>Section 4.3.4: Decommissioning/Closure/Post Closure Activities</td><td>As the Contractors are responsible for environmental conservation, in accordance with the contract, the Contractors shall restore the construction site to original conditions before handing over the site to the Project Proponent as follows;
• Site cleaning
• Erosion and sediment control
• Removal of materials from site</td></tr>
<tr><td colspan="2">Chapter 6 Impact and Risk Assessment and Mitigation Measures</td></tr>
<tr><td>Section 6.2: Identification of Environmental and Social Impacts</td><td>The design operating level of 80 m a.m. s.l, the backwater effects will be manifested</td></tr>
</table>

Commitment Source	Commitment
Section 6.4.1: Site-Specific Management and Monitoring Plan	Project proponent collaborate with Contractors will comply the mitigation measure as follows: Environmental Disturbances Caused by Fugitive Dust • Spray water at and around the construction areas and access roads during site preparation and construction works. • Enforce a speed limit for vehicles and trucks in the construction sites • Restore, resurface, and rehabilitate the disturbed areas as soon as practicable after completion of construction. Gaseous Emissions • The Contractor will be required to adopt best practices to minimize gaseous emissions Noise • Major construction activities which generate loud noise should be limited to only during the day time. Activities that are necessary to be carried out at night time will need approval of the site representative of the Project Proponent, and will need to have adequate noise control or measures. • The contractor will be required to regularly monitor ambient noise levels at the receptors, particularly during the noise generation period such as piling. Vibration • Contractor will prepare a blasting plan to reduce ground vibration and air pressure to the acceptable levels. The blasting plan will be reviewed for approval by the site representative of the Project Proponent. Topography, Geology and Seismology • Use slope design with sufficient safety factor to prevent sliding. Erosion and Sedimentation • Install erosion and sediment control facilities such as sediment settling ponds at suitable locations • All erosion and sediment controls will be visually inspected at least once a week during the dry season and every 24 hours during the wet season to ensure their ongoing effectiveness. Any required remediative or replacement works will be undertaken within 24 hours of detection. Flood Management and Monitoring Plan • The Project Proponent will daily inform the Contractors of the river flow data available at the Yeywa Hydropower Plant. The Contractors should analyze the data and reflect it to their flood warning and countermeasures. Surface Water Quality • Install sediment settling ponds for drainage water from construction sites • The power plant construction site should be surrounded by temporary fences to limit the amount of sediment that could be washed from the construction area during the raining time into the surrounding field. Aquatic Ecology and Fishery

Commitment Source	Commitment
	• Use of best practice to avoid/minimize releasing sediment load into the river, e.g. using appropriate slope protection, surface water drainage system to minimize sediment from steep slope releasing to the river. • Waste water and contaminated water from construction areas and worker camp site must be treated before discharge to Myitnge River. <u>Camp Site</u> ***Surface Water Quality*** • Set up the appropriate sanitary toilet for workers and at least 150 m from the waterway. • Set up wastewater treatment system at every construction camp to meet water quality standard prior to discharge to receiving water body or retention pond. ***Solid Waste*** • Solid waste disposal procedures will comply with solid waste management regulations, as well as any additional disposal facility requirements. ***Personnel Health*** • Ventilation of building within the camp area shall be in accordance with the Applicable Laws and Standards. • Camp sanitation facilities should be provided and inspected.
Section 6.4.2: Thematic Management and Monitoring Plan	<u>Transportation</u> • Strictly enforce drivers in following traffic regulations during transporting material, workers, and equipment during project construction. • Provide sufficient traffic signs and easily observed signs to clearly indicate site construction zone. • In case of accident, the concerned sections must promptly follow the Construction Emergency Response Plan. <u>Water Use</u> • Prepare sufficient and appropriate water tanks to collect water for worker consumption. • Prepare sufficient potable water for workers. <u>Solid Waste</u> • Prohibit open burning wastes in worker campsite and project area. • Prepare garbage bins or containers with covers for garbage collection at the workers' camp sites and construction area. Also, inform concern local authorities or sub-contractor that gets permission from government section to collect and dispose garbage. • Solid waste disposal procedures will comply with solid waste management regulations, • Prohibit dumping waste in watercourse or wildlife habitat. <u>Hazardous Materials</u> • Hazardous materials use will only be handled by

Commitment Source	Commitment
	personnel who are trained and qualified in the handling of these materials and in accordance with the manufacturer's instructions and government regulations. • Disposal of hazardous materials will be in accordance with applicable regulations in effect at the time of disposal. <u>Biomass Clearance</u> • Project optimization to minimize vegetation losses and preserve forest • Logging and log selling process will be based on the concerned laws and regulations and conducted by concern authorities only <u>Tree Species Transplanting</u> • Survey focuses on above near threatened tree species at the appropriate size. <u>Occupational Health</u> • Conduct safety training courses and rehearsal for the workers, to prevent and reduce work accidents. • Camp sanitation facilities should be provided and routinely inspected. • Prepare and enforce the wearing of safety protection equipment or devices to prevent accident or reduce severity such as eye glasses, safety shoes, ear muffs, safety belts, protective clothing and helmets with regular inspection. <u>Community Health</u> • Implement Community Health Management Plan as specified in Chapter (6) of EMP of Deedoke HPP. <u>Construction Supporting Structures Dismantling</u> • Strictly implement Construction Supporting Structures Dismantling management and monitoring plan as specified in Chapter (6) of EMP of Deedoke HPP. <u>Training Program for Workers</u> • Provide Training Program for workers as specified in Chapter (6) of EMP of Deedoke HPP.
Section 6.5.1: Social management and monitoring plan	***Site-Specific Management Plan*** <u>Chance Find</u> • Strictly implement Chance Find procedure according to Chance Find management plan. ***Thematic Management Plan*** <u>Compensation</u> • Pay compensation for the project affected land according to the RAP. <u>Livelihood Restoration</u> • Strictly implement livelihood restoration program specified in RAP. <u>Community Development</u> • Strictly implement community development plans specified in RAP.
Section 6.6: Environmental Management System **(**EMS)	The Project Proponent and the Contractor will have to establish and operate their own environmental management systems (EMS) for the Project construction.

Commitment Source	Commitment
	The Project Proponent's EMS will be focused on monitoring and reviewing environmental compliance at the Project level as part of the Project management. The Contractor's EMS will be focused on environmental management at the task level as part of the construction management.
Section 6.7: Emergency Response Plan (ERP)	Control construction contractors to strictly implement Emergency Response Plan.
Section 6.9: Public Consultation and Disclosure	Conduct public consultation and disclosure as proposed in the ESIA report.
Chapter 7 Cumulative Impact Assessment	
Cumulative Impact Assessment need to be completed with involvement of all others hydropower development on the Myitnge River. Other sectors including forestry, road and transport, agriculture and mining which need to be stakeholder in CIA. Deedoke project had committed that the project will participate in CIA process which may be initiated by DEPP in cooperation with other hydropower developers and existing hydropower stations on the Myitnge River to carry out CIA and cooperation in management of such impacts.	
Chapter 8 Environmental Management Plans	
Management and Monitoring Plans for Construction Phase	
Environmental Management and Monitoring Plan	Site or Area Specific Plans and Programs • Air Quality Management and Monitoring Plan • Noise Management and Monitoring Plan • Vibration Management and Monitoring Plan • Topography, Geology and Seismology Management and Monitoring Plan • Erosion and Sedimentation Management and Monitoring Plan • Flood Management and Monitoring Plan • Surface Water Quality Management and Monitoring Plan • Aquatic Ecology and Fishery Management and Monitoring Plan • Material Storage Area Management and Monitoring Plan • Excavated Soil Disposal Site Management and Monitoring Plan • Rock Dumping Area Management and Monitoring Plan • Borrow Pits Management and Monitoring Plan • Camp Site Management and Monitoring Plan
	Thematic Plans and Programs • Transportation Management and Monitoring Plan • Water Use Management and Monitoring Plan • Solid Waste Management and Monitoring Plan • Hazardous Waste Management and Monitoring Plan • Biomass Clearing Management and Monitoring Plan • Tree Species Transplanting Management and Monitoring Plan • Occupation Health Management and Monitoring Plan • Community Health Management and Monitoring Plan • Construction Supporting Structures Dismantling Management and Monitoring Plan • Training Program for Workers • Construction Emergency Response Plan (CERP)

<table>
<tr><th>Commitment Source</th><th>Commitment</th></tr>
<tr><td rowspan="2">Social Management and Monitoring Plan</td><td>Site or Area Specific Plans and Programs
Chance Find Management and Monitoring Plan</td></tr>
<tr><td>Thematic Plans and Programs
Compensation Management and Monitoring Plan
Livelihood Restoration Management and Monitoring Plan
Community Development Management and Monitoring Plan</td></tr>
<tr><td colspan="2">Management and Monitoring Plans for Operation Phase</td></tr>
<tr><td>Environmental Management and Monitoring Plan</td><td>Site or Area Specific Plans and Programs
Noise Management and Monitoring Plan
Vibration Management and Monitoring Plan
Flood Management and Monitoring Plan
Surface Water Quality Management and Monitoring Plan
Aquatic Ecology and Fishery Management and Monitoring Plan
Solid Waste Management and Monitoring Plan</td></tr>
<tr><td>Social Management and Monitoring Plan</td><td>Thematic Plans and Programs
Livelihood Restoration Management and Monitoring Plan
Community Development Management and Monitoring Plan</td></tr>
<tr><td>Monitoring Station and Frequency</td><td>Monitoring Stations for each environmental component with applicable frequency are mentioned in EMP for all phases and project proponent must be conducted in accordance with Myanmar EQEG.</td></tr>
<tr><td>Budget</td><td>Project proponent commits to conduct according to all plans and programs in all phases with sufficient budget.</td></tr>
<tr><td colspan="2">Chapter 9 Public Consultations and Disclosure</td></tr>
<tr><td>Section 9.1: Introduction</td><td>Project proponent will follow the environmental procedure which public concerns should also be taken into account in assessing impacts, designing mitigation measures, and selecting monitoring parameters.</td></tr>
<tr><td>Section 9.2: Methodology and Approach</td><td>Project proponent follows the standard principles and practices in public participation.
Project proponent will inform the stakeholders about the Project, environmental and social issues</td></tr>
<tr><td>Section 9.4 Result of Consultation During Project Scoping</td><td>Project proponent and the Consultant response on issues during the public consultation meetings as presented in Section 9.4.1 of Chapter 9 and shown in Table below;
<table>
<tr><th>Issues</th><th>Clarifications by the Consultant</th></tr>
<tr><td colspan="2">Government Authorities</td></tr>
<tr><td>- Environmental impact e.g. dust, noise and river water quality.</td><td>- EIA study covers air, noise, water quality and aquatic ecology. The environmental sampling will be conducted in two seasons in order to compile baseline information for assessment of impact</td></tr>
</table></td></tr>
</table>

Commitment Source	Commitment	
		due to project implementation. Furthermore, the Consultant will propose mitigation measures to alleviation expected impacts.
	- Concern about pH level of water in Myitnge River which is currently high and tends to increase during the project operation period	- For water quality study, pH level is included in this study. The result of pH level in river water will be presented in the second meeting. In case that pH level tends to increase and may cause any impacts, the Consultant will propose mitigation measures to alleviation expected impacts.
	- Health impact on villagers	- EIA study will cover assessment of health impact due to project implementation.
	- Land acquisition for project construction area.	- The project will inform and discuss with land owner before project construction.
	- Anxiety on dam failure	- EIA study will cover earthquake issue and project design will comply with international standard.
	- Would the raised water level flood the concrete road ?	- Water level will be raised up about 8 m and will be confined within the river channel. However, if the project site is located at site 44C (Thayet Pin village), some part of concrete road will be relocated for project construction area.
	- How about the compensation process ?	- A compensation committee will be organized consisting of project proponent, government authorities and land owners in order to discuss about compensation rates. - The compensation

Commitment Source	Commitment	
		process will be fair and transparent for project affected persons according to applicable Myanmar laws.
	- How about the project affected area in case of project site 54 ?	- The project affected area would be about 5 ha consisting of 2 ha of farmland and 3 ha of uncultivated land. These areas cover project construction area and area to be flooded during the operation period.
	- Would the project allow local people to pass through the project area ?	- During project construction phase, the project would not allow local people to pass through the project area for safety reasons. For the operation phase, the project will respond to this issue later.
	- If there is any damage on road due to materials and equipment transportation, how about the responsibility of the project ?	- The project will promptly repair the damaged road.
	Local Community Groups	
	- How about the compensation process ?	- A compensation committee will be organized consisting of project proponent, government authorities and land owners in order to discuss about compensation rates. - The compensation process will be fair and transparent for project affected persons according to applicable Myanmar laws.
	- Employment priority for local people nearby project area.	- The consultant will recommend about local worker recruitment for the project as a social impact mitigation measure in EIA report.
	- How about the impacts	- EIA study covers noise,

<table>
<tr><th>Commitment Source</th><th>Commitment</th></tr>
<tr><td></td><td>
<table>
<tr><td>on vibration and noise due to project construction activities?</td><td>vibration issues. Existing noise and vibration level will be measured in order to get baseline information for assessment of impact due to project implementation. Furthermore, the Consultant will propose mitigation measures to alleviate these impacts.</td></tr>
<tr><td>- Community development should be supported by the project e.g. electricity and water supply system.</td><td>- The consultant will recommend these issues in EIA report.</td></tr>
<tr><td>- Possibility in using dam crest as access road linking the two banks of Myitnge River.</td><td>- The consultant will inform about the response on this issue during the second meeting when the detailed feasibility study was finalized.</td></tr>
<tr><td>- Dissemination of clear project information.</td><td>- During this Scoping stage, the detailed feasibility study has not yet been completed, therefore the exact project information will be presented in the second public consultation meeting along with identified major impacts and mitigation measures.</td></tr>
</table>
</td></tr>
<tr><td>Section 9.5 Result of Consultation During The Preparation of EIA Report</td><td>
Project proponent and the Consultant response on issues during the public consultation meetings as presented in Section 9.5.1 of Chapter 9 and shown in Table below;
<table>
<tr><th>Issues</th><th>Clarifications by the Consultant</th></tr>
<tr><td colspan="2">Government Authorities</td></tr>
<tr><td>- Compensation rate for affected people.
- There should be consultation and negotiation on compensation issues among government administration office, developer and local people.</td><td>- A compensation committee will be organized consisting of project proponent, government authorities and land owners in order to discuss about compensation rates.
- The compensation process will be fair and transparent for project</td></tr>
</table>
</td></tr>
</table>

Commitment Source	Commitment	
		affected persons according to applicable Myanmar laws.
	- There should be detailed inventory survey on project affected land and properties.	- The project will be detailed inventory survey before project construction.
	- Impact on water quality on downstream area.	- For water quality study, pH level, turbidity, BOD, COD and salinity are included in this study. The result of water quality in river water will be presented in the EIA report. In case that project construction activities and project operation to cause any impacts on water quality, the Consultant will propose mitigation measures to alleviation expected impacts such as water supply system
	- How to control about salinity in river water ?	
	- Impact on water use of local people.	
	- The exactly flooded area due to project implementation.	- Water level will be raised up about 8 m and will be confined within the river channel.
	- Mitigation measures should be strictly implemented by construction contractor.	- The consultant will present about local suggestion in EIA report
	- The construction contractor should contact closely with local people.	- The consultant will present about local suggestion in EIA report
	- There should be long term mitigation measures during operation period.	- The consultant will present about mitigation measures during construction period and operation period in EIA report.
	Local Community Groups	
	- How about compensation rate for project affected area and properties?	- A compensation committee will be organized consisting of project proponent, government authorities and land owners in order to discuss about compensation rates. - The compensation
	- Compensation rate on both bank of Myitnge River should be equal.	

<table>
<tr><th>Commitment Source</th><th>Commitment</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>process will be fair and transparent for project affected persons according to applicable Myanmar laws.</td></tr>
<tr><td>- How about flooded level due to project implementation?</td><td>- Water level will be raised up about 8 m and will be confined within the river channel.</td></tr>
<tr><td>- They should be demarcation of the area to be flooded.</td><td rowspan="2">- The project will be demarcation of the area to be flooded and detailed inventory survey before project construction.</td></tr>
<tr><td>- They worried about flooded area along both bank of Myitnge River.</td></tr>
<tr><td>- They would like to use the weir crest for crossing river.</td><td>- The consultant will present about local suggestion in EIA report and co-operate with feasibility study team.</td></tr>
<tr><td>- The project proponent should be support the infrastructure development e.g. library construction, teacher and doctor accommodation.</td><td rowspan="2">- The consultant will recommend about local worker recruitment for the project as a social impact mitigation measure in EIA report.</td></tr>
<tr><td>- Job opportunity for local people and local vehicle for project construction activities.</td></tr>
</table>
</td></tr>
<tr><td>Section 9.6: Results of Consultations during EIA Review</td><td>During the EIA review the project proponent organized another public consultation meeting on 23 April 2018. Questions during the April Stakeholder Workshop included:
• Land acquisition impacts;
• Impacts to water quality, including cumulative impacts taking into account Yeywa dam;
• Whether there will be benefit sharing programs;
• Disaster Management Plan / Dam Safety Plan;
• Social and environmental impacts as a result of construction (dust, health, noise, etc.);
• Health surveys being conducted and potential health impacts, and
• Impact of worker influx.</td></tr>
<tr><td>Section 9.7: Recommendations for Ongoing Consultations</td><td>In order to gain full understanding and support from PAPs and stakeholders and interested parties in project implementation, it is vital to have full participation from them at the beginning through the entire process of project development. The program activities are to;
(1) Dissemination of information
• The information dissemination for PAPs are as follows;
• Project components.
• Schedule for start-up of the project.</td></tr>
</table>

Commitment Source	Commitment
	• Detailed information on project policies and implementation procedures. • Compensation Plan and Entitlements. • The grievance mechanism and the appeals process. • Rights to participate and be consulted. • Program for the improve quality of life and social development plan. • Organizational responsibilities. **(2) Consultation with PAPs** a) Informing PAPs about Compensation Payment with letter of notification. The PAPs should also be informed in advance on the relevant documents (e.g. identification card, land title, etc.) that they are required to bring with them for compensation payment purpose. b) Consultation with PAPs to confirm preferences for rehabilitation assistances measures. c) Informing PAPs about site clearance prior to start-up to civil works. d) Informing PAPs about the beginning and ongoing schedule for physical works. e) Consultation and confirmation with PAPs on their participation in Income Restoration measures. f) Consultation with PAPs on Community/Social Development program. g) Informing PAPs on monitoring and supervision activities to be conducted during project implementation.

By: Project Developer and Contractors

၁.၁ စီမံကိန်းဖွံ့ဖြိုးတိုးတက်မှု နောက်ခံနှင့် ပတ်ဝန်းကျင် လူမှုရေး ထိခိုက်မှု ဆန်းစစ်ခြင်း

၁.၁.၁ စီမံကိန်းနှင့် ပတ်ဝန်းကျင် လူမှုရေးထိခိုက်မှု ဆန်းစစ်ခြင်းကို ပြင်ဆင်ခြင်း

မန္တလေးတိုင်းဒေသကြီး မြစ်ငယ်မြစ်ပေါ်တွင် တည်ဆောက်မည့် ဒီးဒုတ်ရေအားလျှပ်စစ် စီမံကိန်းအား ဩစတြီးယားနိုင်ငံ၏ ANDRITZ Hydro GmbH of Austria (ANDRITZ) နှင့် မြန်မာနိုင်ငံလျှပ်စစ် စွမ်းအားဝန်ကြီးဌာန (MOEP) တို့သည် ၂၀၁၄ခုနှစ်၊ နိုဝင်ဘာလ (၂၀) ရက်နေ့ ကပင် နားလည်မှုစာချွန်လွှာကို လက်မှတ်ရေးထိုးထားခဲ့ကြပါသည်။ ၎င်းရေအားလျှပ်စစ် စီမံကိန်းကို လျှပ်စစ်စွမ်းအား (၆၆) မဂ္ဂါဝပ် ထုတ်ယူနိုင်သော အဝင် အထွက်ရေ တူညီစွာ စီးဆင်းနေသော ခေါင်းနိမ့် ရေအားလျှပ်စစ် စီမံချက် ပုံစံအတိုင်း အကောင်အထည်ဖော် ဆောက်လုပ် လည်ပတ်သွားမည် ဖြစ်ပါသည်[၁/]။ ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်းနေရာသည် လက်ရှိတည်ရှိနေသော ရဲရွာရေအားလျှပ်စစ် စီမံကိန်း တည်ရှိရာနေရာမှ မြစ်အောက်ပိုင်း ၂၁.၁ ကီလိုမီတာအကွာတွင် တည်ရှိပါသည်။ စီမံကိန်းကို ANDRITZ၊ Kansai Electric နှင့် HTCT စသည် လုပ်ငန်းစုများက ဖက်စပ် (JV) သို့မဟုတ် တည်ဆောက်၊ လည်ပတ်၊ လွှဲပြောင်း (BOT) အစီအစဉ်ဖြင့် အကောင်အထည်ဖော် ဆောင်ရွက်သွားမည် ဖြစ်ပါသည်။

စီမံကိန်း ဖြစ်နိုင်ချေလေ့လာမှု (FS) ကို Gruner GmbH/Stucky Ltd. လုပ်ငန်းစုမှ ပြင်ဆင်ပြီး ၎င်းနှင့်အတူ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှု ဆန်းစစ်ခြင်း (ESIA) အတွက် အတိုင်ပင်ခံ-အခွဲ (ESIA အတိုင်ပင်ခံ) အဖြစ် ထိုင်းနိုင်ငံ အခြေစိုက် TEAM Consulting Engineering Management Co., Ltd (TEAM) နှင့် မြန်မာနိုင်ငံ အခြေစိုက် Total Business Solution Co., Ltd. (TBS) တို့မှ ပြင်ဆင်ထားပါသည်။

ဖြစ်နိုင်ချေလေ့လာမှု (FS) အတွက် နည်းပညာလေ့လာမှုကို ၂၀၁၄ခုနှစ်၊ ဒီဇင်ဘာ ၁၂ မှ ၂၀၁၅ခုနှစ်၊ ဂျူလိုင်လအထိ ဆောင်ရွက်ခဲ့ပါသည်။ စီမံကိန်း ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှု ဆန်းစစ်ခြင်း နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အစီရင်ခံစာကို ၂၀၁၅ခုနှစ် စက်တင်ဘာလတွင် တင်သွင်းခဲ့ပြီး MOECAF (ယခု MONREC) ထံမှ တရားဝင်မဟုတ်သော သုံးသပ်အကြံပြုချက်ကို ၂၀၁၅ခုနှစ်၊ နောက်ဆုံးအပတ် အောက်တိုဘာလတွင် လက်ခံရရှိခဲ့ပါသည်။

....

[၁/] ယခု အစီရင်ခံစာတွင် ပါဝင်သော စီမံကိန်းနှင့် ဆက်စပ်နေသည့် အချက်အလက်များသည် အကြမ်းဖျင်းသာဖြစ်ပြီး ၎င်းတို့ကို အသေးစိတ်ဒီဇိုင်း လေ့လာမှုတွင် အတည်ပြုသွားမည် ဖြစ်ပါသည်။

နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အစီရင်ခံစာအတွက် MONREC၏ ပထမအကြိမ် သုံးသပ်ချက်ကို ၂၀၁၆ခုနှစ်၊ ဂျူလိုင်လတွင် ရရှိခဲ့ပြီး ပြန်လည်ပြင်ဆင်ထားသော နယ်ပယ်အတိုင်း အတာ သတ်မှတ်ခြင်း အစီရင်ခံစာကို ၂၀၁၆ခုနှစ် စက်တင်ဘာလတွင် ထပ်မံတင်ပြ ခဲ့ပါသည်။ နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အစီရင်ခံစာတွင် စည်းမျဉ်းစည်းကမ်းစနစ်များနှင့် သတ်မှတ်ပုံစနစ်၊ စီမံကိန်း နည်းပညာ အသေးစိတ်များ၊ လက်ရှိ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ အခြေအနေများ ဖော်ပြချက်၊ လုပ်ငန်းလည်ပတ်စဉ် ထိခိုက်မှုများနှင့် ၎င်းတို့၏ လျော့ချရေး နည်းလမ်းများ၏ သတင်းအချက်အလက်များ နှင့် EIA အစီရင်ခံစာ၏ ပြန်လည်ပြင်ဆင်ထားသော အချက်အလက်များ ပါဝင်ပါသည်။

၂၀၁၅ခုနှစ်၊ ဇန်နဝါရီလ ၁ရက်နေ့မှ နိုဝင်ဘာလ ၁၆ရက်နေ့ အထိ ပတ်ဝန်းကျင် နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှု ဆန်းစစ်ခြင်း လေ့လာမှုများကို နည်းပညာ လေ့လာမှုများနှင့် အပြိုင်ပြုလုပ်ခြင်း အားဖြင့် ပတ်ဝန်းကျင်နှင့် လူမှုစီးပွားရှုထောင့်မှ စီမံကိန်းအတွက် စီမံကိန်းနေရာ ရွေးချယ်ခြင်းနှင့် စီမံကိန်း နည်းပညာဒီဇိုင်း ရွေးချယ်မှုများ အတွက် အထောက်အပံ့များ ရရှိနိုင်ပါသည်။ သာမာန်အားဖြင့်ဆိုလျှင် နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အစီရင်ခံစာ ပြီးစီးမှသာ ESIA ကို စတင်ရမည်ဆိုသော်လည်း အစိုးရ၏ ပြန်လည်သုံးသပ်ကာလ ကြာရှည်မှုကြောင့် အတိုင်ပင်ခံတို့သည် နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အစီရင်ခံစာ အပြီးမသတ်ခင် ESIA ကို စတင်ရန် လိုအပ်ကြောင်းကို တွေ့ရှိကာ စတင်လုပ်ဆောင်ခဲ့ပါသည်။

ESIA ပြန်လည်ပြင်ဆင်တင်ပြခြင်းကို MOEE နှင့် MONREC သို့ ၂၀၁၅ခုနှစ်၊ နိုဝင်ဘာလတွင် တစ်ကြိမ်နှင့် ၂၀၁၆ခုနှစ် ဖေဖော်ဝါရီလတွင် နောက်ထပ် တစ်ကြိမ် ထပ်မံ တင်ပြခဲ့ပါသည်။ စီမံကိန်း အကောင်အထည်ဖော်သူများသည် နောက်ဆုံးမူကြမ်း ESIA ကို MOEE နှင့် ECD သို့ ၂၀၁၇ခုနှစ်၊ ဇန်နဝါရီလတွင် တင်ပြခဲ့ပြီး ၂၀၁၇ခုနှစ် ဩဂုတ်လတွင် အစည်းအဝေးပြုလုပ်ခဲ့ပါသည်။

စီမံကိန်း ဒီဇိုင်းသည် ၂၀၁၆ခုနှစ်၊ ဩဂုတ်လတွင် MONREC ထံသို့ တင်သွင်းထားသော ESIA အစီရင်ခံစာတွင် ကနဦးကာလထဲက ပါဝင်ခဲ့ပါသည်။ ဆောက်လုပ်ရေးလုပ်ငန်းများ၊ လျှပ်စစ်-စက်ပစ္စည်းဒီဇိုင်းများ၊ ဟိုက်ဒရောလစ် ဒီဇိုင်းများနှင့် အင်ဂျင်နီယာလုပ်ငန်းဆိုင်ရာနားလည်မှုများနှင့် ငွေကြေးလိုအပ်ချက်များ စသည်တို့နှင့် သက်ဆိုင်နေသော ပြောင်းလဲမှုများ ရှိပါသည်။ ဆောက်လုပ်ရေးကာလ ၏ အထောက်အပံ့ ဖွဲ့စည်းပုံ များဖြစ်သော ချဉ်းကပ်လမ်း၊ မဟာ ဓါတ်အားလိုင်း နှင့် ကျောက်မိုင်းတို့၏ ဥပမာ - စီမံကိန်း တည်ဆောက်ရေး မြေယာလိုအပ်ချက်တွင်

နားလည် မျှော်လင့်ထားသော စီမံကိန်း၏ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှုများနှင့် ၎င်းတို့၏ စီမံခန့်ခွဲမှုများ ပါဝင်ပါသည်။

MONREC ၏ လုပ်ထုံးလုပ်နည်းကို သဘောတူလက်ခံပြီး စီမံကိန်း အသေးစိတ်ဒီဇိုင်း အပြီးသတ်ပြင်ဆင်နေချိန်တွင် ကုမ္ပဏီသည် ၂၀၁၅ခုနှစ်တွင် တင်သွင်းထားသော ESIA အတွက် MONREC ထံမှ အတည်ပြုချက်ရရှိစေရန် လုပ်ဆောင်ပါသည်။ ၎င်းအတည်ပြုချက်သည် အခြား ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ အရေးပါသော လုပ်ဆောင်မှုများဖြစ်သည့် အသေးစိတ် စစ်တမ်းကောက်ယူမှု တိုင်းတာခြင်း၊ ဆုံးရှုံးမှုစာရင်းနှင့် ဒေသခံများနှင့် အသေးစိတ် ဆွေးနွေးတိုင်ပင်ခြင်း စသည့်တို့ကို ဆက်လက်လုပ်ဆောင်နိုင်စေရန် အထောက်အပံ့ဖြစ်ပါသည်။

၂၀၁၅ ESIA နောက်ဆုံးမူကြမ်း အတွက် ဒုတိယအကြိမ် သုံးသပ်ချက်ကို ၂၀၁၈ခုနှစ် ဖွန်လတွင် ရရှိခဲ့ပါသည်။ ၂၀၁၅ ESIA အတွက် တုန့်ပြန်ချက်များနှင့် ပြင်ဆင်ချက်များကို အကောင်အထည်ဖော်သူများမှ ပြင်ဆင်ပြီး ECD နေပြည်တော် နှင့် ၂၀၁၈ခုနှစ်၊ ဖွန်လ ၁၄ရက်နေ့တွင် အစည်းအဝေးပြုလုပ်ခဲ့ပါသည်။ ဤအစည်းအဝေးသည် အကောင်အထည်ဖော်သူများအား ECD သုံးသပ်အကြံပြုချက်များ၏ သဘာဝကို နားလည်စေရန် အခွင့်အရေးများ ရရှိခဲ့ပါသည်။ ECD၏ နောက်ဆုံး သုံးသပ်အကြံပြုချက်များအရ အကောင်အထည်ဖော်သူများသည် ၂၀၁၅ ESIAကို တိုးတက်စေရန် ကတိကဝတ်များပြုခဲ့ပါသည်[၂]။ ၂၀၁၅ခုနှစ် နိုဝင်ဘာလတွင် ပထမဦးဆုံးအကြိမ် တင်သွင်းခဲ့ချိန်မှစ၍ အချိန်ကာလကြာမြင့်မှုကြောင့် တိုင်ပင်ခံ အဖွဲ့များနှင့် ဝန်ထမ်းများကို ၂၀၁၈ခုနှစ် ဖွန်လ နောက်ဆုံးအပတ်တွင် နေပြည်တော်တွင် အလုပ်လုပ်ကိုင်စေရန် အကောင်အထည်ဖော်သူက ဆောင်ရွက်ခဲ့ပါသည်။ ECD ထံသို့ တင်ပြပြီး သုံးသပ်စေရန် ၎င်းအဖွဲ့မှ ၂၀၁၅ ESIA ကို ပြန်လည်ပြင်ဆင်ခဲ့ပါသည်။ ESIA အဖွဲ့ နေပြည်တော်တွင် ရောက်ရှိနေချိန် ECD၏ သုံးသပ်အကြံပြုသူထံမှ ပုံမှန်အစည်းအဝေးများနှင့် အမှန်တကယ် သုံးသပ်ချက်များ ရရှိမည်ဟု မျှော်လင့်ပါသည်။

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[၂] ECD၏ သုံးသပ်ချက်များတွင် အခြားသက်ဆိုင်ရာ ဝန်ကြီးဌာနများဖြစ်သည့် ကျန်းမာရေး ဝန်ကြီးဌာန၊ အလုပ်သမား၊ အလုပ်အကိုင်နှင့် လူမှုဖူလုံရေး ဝန်ကြီးဌာန စသည်တို့ပါဝင်ပြီး ၎င်းတို့၏ နောက်ဆုံး သုံးသပ်ချက်များကို ၂၀၁၈ခုနှစ် ဖွန်လ ၂၀ရက်နေ့တွင် ရရှိခဲ့ပါသည်။

အပြည်ပြည်ဆိုင်ရာမှ ငွေကြေးထောက်ပံ့မှုရရှိရန် ဆောင်ရွက်မှုများပြုလုပ်ရာတွင် MONREC မှ ESIA အစီရင်ခံစာအား အတည်ပြုခြင်းသည် လိုအပ်ချက်တစ်ခု ဖြစ်ပါသည်။ ဒီးဒုတ်စီမံကိန်းကို အပြည်ပြည်ဆိုင်ရာ အဖွဲ့အစည်းများဖြစ်သော ADB, JICA နှင့် IFC တို့မှ ငွေချေးငှားပြီး ဆောင်ရွက်မည် ဖြစ်သောကြောင့် စီမံကိန်း ဒီဇိုင်းနှင့် ဘေးကင်းလုံခြုံမှုတို့သည် ၎င်းအဖွဲ့အစည်းတို့၏ တင်းကြပ်သော လိုအပ်ချက်များနှင့်အညီ ဆောင်ရွက်သွားရမည် ဖြစ်ပါသည်[၃/]။ ၎င်းဆောင်ရွက်မှုများတွင် အင်ဂျင်နီယာ နည်းပညာ၊ ငွေကြေးနှင့် စီးပွားရေး သုံးသပ်ချက်များလဲ ပါဝင်ပါသည်။ MONREC မှ ၂၀၁၅ ESIA အစီရင်ခံစာအား အတည်ပြုပေးပြီးနောက် ယင်းဆောင်ရွက်မှုများပြီးစီးစေရန် အနည်းဆုံး (၆) လကြာမြင့်မည်ဟု မျှော်မှန်းထားပါသည်။

အကောင်အထည်ဖော်သူများသည် အတည်ပြုချက်ရရှိထားသော ၂၀၁၅ ESIA ကို အပြည်ပြည်ဆိုင်ရာ ငွေကြေးအဖွဲ့အစည်းများ၏ အခြား အကဲဖြတ်မှုအတွက် တင်သွင်းပါမည်။ ၂၀၁၅ ESIA အတွက် MONREC ၏ အပိုထပ်ဆောင်း လိုအပ်ချက်များသည် အပြည်ပြည်ဆိုင်ရာ အေဂျင်စီများ၏ ပေါ်လစီ လိုအပ်ချက်များနှင့် ကိုက်ညီပြီး (အောက်တွင်ဖော်ပြထားသော ဇယားတွင်ကြည့်ပါ) ၂၀၁၅ ESIA အတွက် MONREC၏ သုံးသပ်ချက်များ ပြည့်စုံစေပါမည်။ အဘယ့်ကြောင့်ဆိုသော် ပေါ်လစီ လိုအပ်ချက်များနှင့် ကိုက်ညီသော ၂၀၁၈ ဖြည့်စွက် ESIA ကို အပြည်ပြည်ဆိုင်ရာ ငွေကြေး အဖွဲ့အစည်းများသို့ တင်ပြမည် ဖြစ်ပါသည်။ နောက်ဆုံး ၂၀၁၈ ESIA (အပြည်ပြည်ဆိုင်ရာ ငွေကြေး အဖွဲ့အစည်းများသို့) တင်သွင်းရာတွင် အောက်ဖော်ပြပါ ပါဝင်ပြီးစီးပြီး အတည်ပြုထားခဲ့ပါသည်။

က။ စီမံကိန်း နောက်ဆုံး ဒီဇိုင်းကြောင့် ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှုများ၏ နောက်ဆုံး အကဲဖြတ်မှု

ခ။ ပြန်လည်နေရာချထားခြင်း လုပ်ဆောင်မှု အစီအစဉ်

ဂ။ အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်မှု အစီအစဉ်

ဃ။ ပတ်ဝန်းကျင် စီမန်ခန့်ခွဲမှု အစီအစဉ်

င။ ဒေသခံများနှင့် ထိတွေ့ဆက်ဆံမှု အစီအစဉ်

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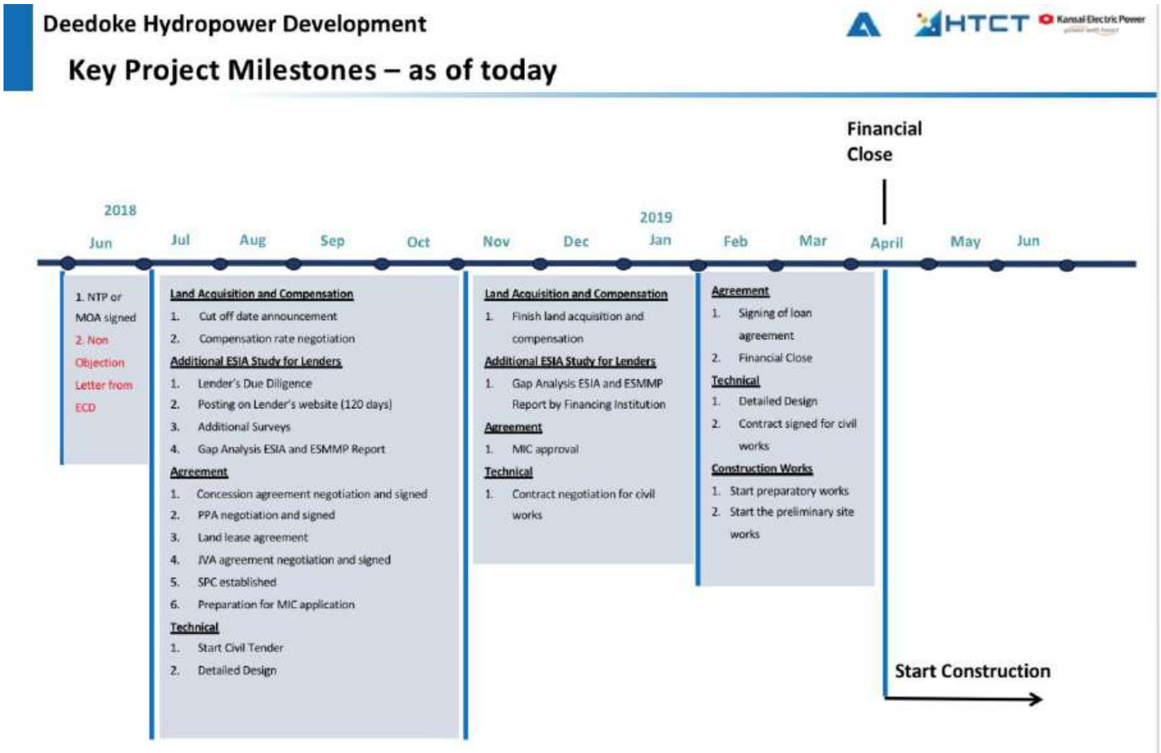
၃/ ၂၀၀၉ခုနှစ် ADB၏ ဘေးကင်းလုံခြုံရေး မူဝါဒနှင့် IFC၏ လုပ်ဆောင်မှု စံနှုန်းများ

၂၀၁၅ ESIA အတွက် MONREC နှင့် အခြား ဝန်ကြီးဌာနများ၏ အပိုထပ်ဆောင်း လိုအပ်ချက်များနှင့် အပြည်ပြည်ဆိုင်ရာ ငွေကြေးအဖွဲ့အစည်းများ၏ လိုအပ်ချက်များအား နှိုင်းယှဉ်ပြထားခြင်း

၂၀၁၈ခုနှစ် ဖွန်လတွင် ၂၀၁၅ ESIA အတွက် MONREC နှင့် အခြား ဝန်ကြီးဌာနများ၏ အပိုထပ်ဆောင်း လိုအပ်ချက်များနှင့် သုံးသပ်ချက်များ	**အပြည်ပြည်ဆိုင်ရာ ငွေကြေး အဖွဲ့အစည်းများနှင့် သက်ဆိုင်သော ဘေးကင်းလုံခြုံရေး သို့မဟုတ် စီမံကိန်း အတည်ပြုချက်**	
	IFC	**ADB**
စီမံကိန်း အကောင်အထည်ဖော်သူ၏ အသေးစိတ်နှင့် မူဝါဒ ဖော်ပြချက်	စီမံကိန်း သဘောတူညီချက် - ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ အန္တရာယ်နှင့် ထိခိုက်မှုများ၏ အကဲဖြတ်မှုနှင့် စီမံခန့်ခွဲမှု	ကွဲပြားသော ငွေကြေးဆိုင်ရာ ပုံစံများ၏ အထူးလိုအပ်ချက်များ
ဥပဒေရေးရာနှင့် ဖွဲ့စည်းတည်ဆောက်ပုံဆိုင်ရာ မူဘောင်များ၊ ဥပဒေများ၊ နည်းဥပဒေများနှင့် စည်းမျဉ်းများ	အလုပ်သမားနှင့် လုပ်ငန်းခွင် အနေအထား - တိုင်းရင်းသား လူမျိုးများ	ပတ်ဝန်းကျင်၊ အတင်း အဓမ္မ ပြန်လည်နေရာချထားခြင်း၊ တိုင်းရင်းသာ လူမျိုးများ၊ တိုင်းပြည်စနစ်များကို အသုံးပြုခြင်း၊ ကွဲပြားသော ငွေကြေးပုံစံများအတွက် အထူး လိုအပ်ချက်များ၊ ADB မှ တားဆီးထားသော လုပ်ရှားမှု စာရင်း
အပြည်ပြည်ဆိုင်ရာ ငွေကြေး အဖွဲ့အစည်း မူဝါဒများ	IFC ၏ လုပ်ဆောင်မှု စံနှုန်းများ	ADB ၏ ဘေးကင်းလုံခြုံရေး ဆိုင်ရာ မူဝါဒ ကြေငြာချက်
ပတ်ဝန်းကျင်ဆိုင်ရာ ဖော်ပြချက်များ လူမှုရေး/ မြေယာ ထိခိုက်မှု ဖော်ပြချက်	ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ အန္တရာယ်နှင့် ထိခိုက်မှုများ အကဲဖြတ်ခြင်း နှင့် စီမံခန့်ခွဲခြင်း - ဒေသခံ ကျန်းမာရေး၊ ဘေးအန္တရာယ် ကင်းရှင်းရေးနှင့် လုံခြုံရေး၊ မြေယာ ရယူခြင်းနှင့် အတင်း အဓမ္မ ပြန်လည်နေရာချ ထားခြင်း၊ ဇီဝ မျိုးကွဲများ နှင့် သဘာဝ အရင်းအမြစ်များ ရေရှည် တည်ရှိမှု စီမံခန့်ခွဲခြင်း	ပတ်ဝန်းကျင်၊ အတင်း အဓမ္မ ပြန်လည်နေရာချထားခြင်း၊ တိုင်းရင်းသား လူမျိုးများ
စီမံကိန်း ဖော်ပြချက် • မဟာဓါတ်အားလိုင်း • ကျောက်မိုင်း	ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ အန္တရာယ်နှင့် ထိခိုက်မှုများ အကဲဖြတ်ခြင်းနှင့် စီမံခန့်ခွဲခြင်း	ပတ်ဝန်းကျင်၊ အတင်း အဓမ္မ ပြန်လည်နေရာချထားခြင်း၊ တိုင်းရင်းသား လူမျိုးများ

• ချဉ်းကပ်လမ်း		
တည်ဆောက်ရေး ထိခိုက်မှု အကဲဖြတ်ခြင်းနှင့် လျှော့ချရေး နည်းလမ်းများ၊ EMMP၊ လုပ်ငန်းလည်ပတ်ရေး ထိခိုက်မှု အကဲဖြတ်ခြင်းနှင့် လျှော့ချရေး နည်းလမ်းများ၊ EMMP၊ RAP LRP တွင် အိမ်ထောင်စုအလိုက် အသေးစား အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်ရေး အစီအစဉ်များပါဝင်ပါသည်။ လူထုဆွေးနွေးခြင်း နှင့် လျှော့ချရေး နည်းလမ်းများ၊ ဒေသခံများနှင့် ထိတွေ့ဆက်ဆံမှု အစီအစဉ်	အရင်းအမြစ် ရရှိနိုင်မှု နှင့် ညစ်ညမ်းမှု ကာကွယ်ခြင်း - ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ အန္တရာယ်နှင့် ထိခိုက်မှုများ အကဲဖြတ်ခြင်း နှင့် စီမံခန့်ခွဲခြင်း - ဒေသခံ ကျန်းမာရေး၊ ဘေးအန္တရာယ် ကင်းရှင်းရေးနှင့် လုံခြုံရေး၊ မြေယာ ရယူခြင်းနှင့် အတင်း အဓမ္မ ပြန်လည်နေရာချထားခြင်း၊ ဇီဝ မျိုးကွဲများ နှင့် သဘာဝ အရင်းအမြစ်များ ရေရှည် တည်ရှိမှု စီမံခန့်ခွဲခြင်း	ပတ်ဝန်းကျင်၊ အတင်း အဓမ္မ ပြန်လည်နေရာချထားခြင်း၊ တိုင်းရင်းသား လူမျိုးများ
ဆက်စပ်သက်ရောက်မှု ဆန်းစစ်ခြင်း	ဆက်စပ်သက်ရောက်မှု ဆန်းစစ်ခြင်း အတွက် ကောင်းမွန်သော လိုက်နာရမည့် နည်းလမ်းများ လက်စွဲစာအုပ် - ပုဂ္ဂလိက ကဏ္ဍတွင် ထွက်ပေါ်လာသော ဈေးကွက်များအတွက် လမ်းညွှန်ချက်	ပတ်ဝန်းကျင်
ရှုပ်ပိုင်းဆိုင်ရာ ယဉ်ကျေးမှု အရင်းအမြစ်များအဖြစ် စီမံကိန်း အနီး ဌက်ကြီးသိုက်ကျေးရွာရှိ အနော်ရထာမင်းကြီး တည်ထား ကိုးကွယ်ခဲ့သော ဘုရားပုထိုးနှင့် နှစ်ပေါင်း ၉၆၀ ကျော် ဘုန်းကြီးကျောင်းများ	ယဉ်ကျေးမှု အမွေအနှစ် မူဝါဒ (၂၀၁၂)	SPS ၂၀၀၉၊ ပတ်ဝန်းကျင်ဆိုင်ရာ ဘေးကင်းလုံခြုံရေး ကဏ္ဍ (၁၁)

စီမံကိန်း၏ အဓိကမှတ်တိုင်များမှာ အောက်တွင်ဖော်ပြထားပါသည်။



MONRECမှ ၂၀၁၅ ESIA အတွက် အတည်ပြုချက်တွင် အောက်ဖော်ပြပါ အရေးပါသော လှုပ်ရှားမှုများ ပါဝင်သည်။

၁။ မြေယာရယူခြင်း

၂။ အပိုထပ်ဆောင်း ESIA လေ့လာခြင်း

၃။ ခွင့်ပြုချက် သဘောတူညီမှု၊ မြေယာငှားရမ်းခြင်း သဘောတူညီချက်၊ စသည့် အမျိုးမျိုးသော အဓိက သဘောတူညီချက်များ

၄။ ဆောက်လုပ်ရေး စတင်ခြင်း တို့ဖြစ်ပါသည်။

စီမံကိန်း အကောင်အထည်ဖော်သူများသည် ၂၀၁၅ ESIA အတည်ပြုချက်ရရှိပြီးလျှင်ပြီးခြင်း တည်ဆောက်ရေးကာလနှင့် လုပ်ငန်းလည်ပတ်မှုကာလ အတွင်း ထိခိုက်မှုအကဲဖြတ်ခြင်းအစီအစဉ်၊ တိုးတက်မှု စီမံခန့်ခွဲခြင်း အစီအစဉ်များနှင့် ပြန်လည်နေရာချထားခြင်းနှင့် အသက်မွေးဝမ်းကြောင်း အစီအစဉ်များကို ဆက်လက်အကောင်အထည်ဖော်သွားမည်ဟု ကတိကဝတ်ပေးကာ ကနဦး ဆောက်လုပ်ရေး လုပ်ငန်းများကို စတင်သွားမည် ဖြစ်ပါသည်။

1.1 BACKGROUND ON PROJECT DEVELOPMENT AND THE ESIA

1.1.1 Project and ESIA Preparation

On 20 November 2014, the Ministry of Electric Power (MOEP) of the Government of Myanmar, signed a memorandum of understanding (MOU) with ANDRITZ Hydro GmbH of Austria (ANDRITZ), for the development of the Deedoke Hydropower Project (the Project) on the Myitnge River in Mandalay Region. The Project will construct and operate a run-of-river, low head hydropower scheme with a generation capacity of about 66 MW[1]. The Deedoke dam site will be located at about 21.1 km downstream of the existing Yeywa hydropower scheme. The Project will be implemented through a JV or BOT arrangement by a consortium consisting of ANDRITZ, Kansai Electric and HTCT.

The feasibility study (FS) of the Project, including its environmental and social impact assessment (ESIA), was prepared by the consortium Gruner GmbH/Stucky Ltd. with TEAM Consulting Engineering Management Co., Ltd., Thailand (TEAM), and Total Business Solution Co., Ltd., Myanmar (TBS) as sub-consultant (ESIA Consultant) for the ESIA.

Technical investigations for the FS were carried out from December 12, 2014 to July 2015. The Project Environment and Social Impact Assessment scoping report was submitted in September 2015 with unofficial comments received from MOECAF in late October 2015. In July 2016, preliminary remarks on the scoping report were received from MONREC and the proponent resubmitted the scoping report in September 2016. Revisions to the scoping report related to confirmations of regulatory systems and nomenclature, project engineering details, description of existing environment and social conditions, further information on operational impacts and their mitigation, and a revised outline of the EIA report.

The ESIA, as detailed in this document was carried out in parallel with the technical study, from 1 January to 16 November 2015, to ensure that environmental and social aspects of the Project would receive due attention in the site selection and technical design of the Project. The ESIA process also took place at the same time as the scoping report submission and review. In normal circumstances, the scoping report would precede the ESIA, however due to extended Government review period, the consultants found it necessary to start the ESIA process before finalising the scoping report.

The submission of the ESIA to MOEE and MONREC took place in November 2015 and again in February 2016.The proponents presented a draft final ESIA to MOEE and ECD in January 2017 with a further meeting taking place in August 2017.

The Project design has evolved since it was first conceived and since this ESIA was first submitted to MONREC in August 2016. The changes relate to civil works, electro-mechanical design, hydraulic design and reflect a better understanding of engineering and financial requirements. The construction phase ancillary structures such as access roads, transmission line and quarries for example also evolve as will understanding of expected environment and social impacts of the project and their management including project construction lands requirements.

[1] All project related figures in this report are still tentative and subject to confirmation by the detailed design study.

In agreement with MONREC procedure, the company has proceeded with the submission of the 2015 ESIA for approval by MONREC while finalizing the detailed design of the project. Such approval is deemed necessary to allow further environmental and social critical path activities including detailed measurement surveys, inventory of loss and detailed consultations with communities to take place.

In June 2018 a second set of comments were received on the draft final 2015 ESIA. Responses were drafted by the proponents and modifications made to the 2015 ESIA and a meeting with ECD took place on 14 June in NPT. This meeting gave the proponents a further opportunity to understand the nature of the ECD comments. The proponents committed to enhance the 2015 ESIA according to ECD final comments[2]. In view of the already extended period of time since first submission in November 2015, the proponents mobilized a team of consultants and staff members to be based in NPT in late June 2018. The team revised the 2015 ESIA for ECD re-submission and review. It was envisaged that ECD reviewers would be available to validate responses real time through timely and regular meetings with the ESIA team while in NPT.

An ESIA approval by MONREC is also required for international financiers to proceed with their due diligence processes. The due diligence of the Deedoke project by international lenders including ADB, JICA and IFC will impose very strict requirements on the project design to ensure compliance with their Safeguards[3] The due diligence process covers also technical engineering, financial and economic review. Such due diligence processes are expected to take at least 6 months to complete after 2015 ESIA approval by MONREC.

The proponents propose to use this present 2015 ESIA once approved as a basis for further assessments to be submitted to the international financing institutions for their due diligence process. The additional requirements from MONREC on the 2015 ESIA correspond to policy requirements of the international agencies. (see Table below) and so the fulfillment of MONREC comments on the 2015 ESIA will be assured because they correspond with policy requirements imposed on the 2018 Supplementary ESIA to be submitted to International Financing Institutions. The submission of the updated 2018 ESIA (version for International Financing Institutions) will contain completed and approved:

a) final assessment of environmental and social impacts of the final design of the project,
b) a resettlement action plan,
c) a livelihood restoration plan,
d) an environment management plan and
e) a stakeholder engagement plan

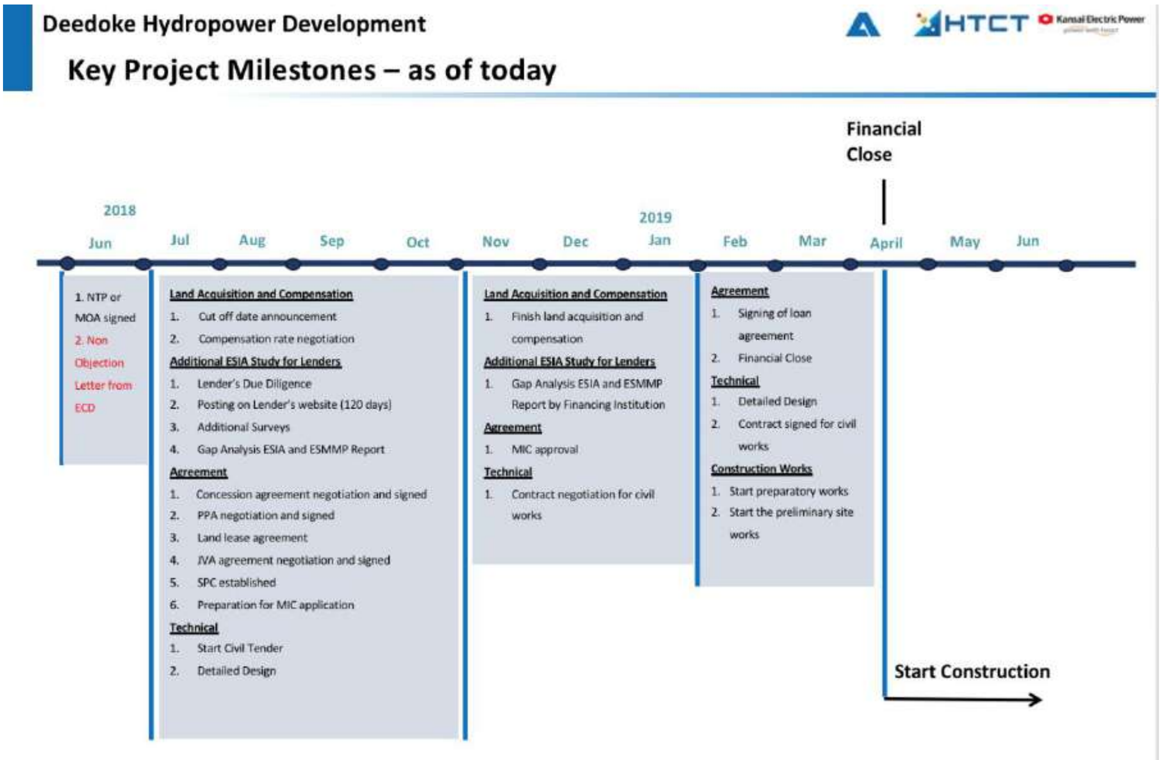
[2] ECD comments include comments from other pertinent ministries including Ministry of Health, Ministry of Labour, Employment and Social Security etc. These comments are complete and final as of June 20 2018.
[3] ADB Safeguard Policy, 2009, IFC Performance standards

Comparison the additional requirements from MONREC and ministries on the 2015 ESIA and Requirements from International Financing Institutions.

Additional requirements (Grouped) on 2015 ESIA based on MONREC and other Ministries June 2018 comments.	**Related International Financing Institutions Safeguard or Project Agreement**	
	IFC	**ADB**
Project Proponent Details & Policy Statement	Project Agreement; Assessment & Management of Environmental & Social Risks & Impacts	Special Requirements for Different Finance Modalities
Legal and Institutional Framework, Laws, rules and regulations	Labour and Working Conditions; Indigenous Peoples;	Environment, Involuntary Resettlement, Indigenous Peoples, Use of Country Systems, Special Requirements for Different Finance Modalities, ADB Prohibited Activities List
International Financing Institution Policies	IFC Performance Standards;	ADB Safeguards Policy Statement, 2009.
Environmental Descriptions Social / Land Impact Description	Assessment & Management of Environmental & Social Risks & Impacts; Community Health, Safety, And Security; Land Acquisition and Involuntary Resettlement; Biodiversity and Sustainable Management of Living Natural Resources;	Environment, Involuntary Resettlement, Indigenous Peoples.
Project Descriptions • Transmission Line • Quarry • Access Roads	Assessment & Management of Environmental & Social Risks & Impacts;	Environment, Involuntary Resettlement, Indigenous Peoples.
Construction Impact Assessment & Mitigation Measures, EMMP, Operational Impact Assessment & Mitigation Measures, EMMP, RAP LRP including household level livelihood restoration micro plans Public Consultation and Mitigation Measures, Stakeholder Engagement Plan	Resource Efficiency & Pollution Prevention; Assessment & Management of Environmental & Social Risks & Impacts; Community Health, Safety, And Security; Land Acquisition and Involuntary Resettlement; Biodiversity and Sustainable Management of Living Natural Resources;	Environment, Involuntary Resettlement, Indigenous Peoples.
Cumulative Impact Assessment	Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for Private Sector in Emerging Markets	Environment
Physical Cultural Resources including King Anawyahtar Pagoda	Cultural Heritage (2012) Policy	SPS 2009, Environmental Safeguard Section 11.

and 960 years old Monasterys near Hnget Kyi Thaik Village in project area		

The key project milestones are shown below:



The approval by MONREC of the present 2015 ESIA will allow the following critical path activities to take place:

1. Land Acquisition
2. Additional ESIA Study for Lenders
3. Various key agreements such as Concession Agreement, PPA, Land Lease Agreement
4. Start Construction

The project proponents commit to continue the impact assessment process, develop management plans and resettlement and livelihood plans and implement these plans as soon as the 2015 ESIA is approved, prior to the start of construction works, during construction phase and during operations.

DRAFT FINAL REPORT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEEDOKE HYDROPOWER PROJECT

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CHAPTER 1

EXECUTIVE SUMMARY

အခန်း(၁)

အစီရင်ခံစာအကျဉ်းချုပ်

၁. ၁ စီမံကိန်းဖွံ့ဖြိုးတိုးတက်မှုနောက်ခံနှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း

၁. ၁. ၁ စီမံကိန်းမူလနှင့် ပြင်ဆင်မှု

မန္တလေးတိုင်းဒေသကြီး မြစ်ငယ်မြစ်ပေါ်ရှိ အဆိုပြုဒီးဒုတ်ရေအားလျှပ်စစ် စီမံကိန်းအား အကောင်အထည်ဖော်ဆောင်ရွက်ရန် ဩစတြီးယားနိုင်ငံ၏ ANDRITZ Gm6H နှင့် မြန်မာနိုင်ငံလျှပ်စစ်စွမ်းအားဝန်ကြီးဌာန (MOEP) တို့သည် ၂၀၁၄ ခုနှစ် နိုဝင်ဘာလ (၂၀) ရက်နေ့တွင် နားလည်မှုစာချွန်လွှာလက်မှတ်ရေးထိုးခဲ့ကြပါသည်။ ၄င်းရေအားလျှပ်စစ် စီမံကိန်းကို အချိန်နှင့်တပြေးညီစီးဆင်းနေသောစီးဝင်ရေအားဖြင့် လျှပ်စစ်စွမ်းအား (၆၆) မဂ္ဂါဝပ်ထုတ်ယူနိုင်စေရန် ဖြစ်ပါသည်။ ဒီးဒုတ်ရေးအားလျှပ်စစ်စီမံကိန်းနေရာသည် လက်ရှိတည်ရှိနေသော ရဲရွာရေအားလျှပ်စစ်ဓါတ်အားပေးစက်ရုံ တည်ရှိရာမှ မြစ်အောက်ပိုင်း ၂၁. ၁ ကီလိုမီတာ (၁၃. ၁၈ မိုင်) ကွာဝေးသော နေရာတွင် တည်ရှိပါသည်။ စီမံကိန်းကို ပြည်တွင်းပြည်ပ လုပ်ငန်းရှင်များပါဝင်ပြီး ANDRITZ ၏ ဦးဆောင်မှုဖြင့် အကောင်အထည်ဖော် ဆောင်ရွက်သွားမည် ဖြစ်ပါသည်။

ပတ်ဝန်းကျင်နှင့် လူမှုစီးပွားထိခိုက်သက်ရောက်မှုလေ့လာဆန်းစစ်ချက် (နူဗ) အပါအဝင် စီမံကိန်းဖြစ်နိုင်မြောက်နိုင်စွမ်းဆိုင်ရာလေ့လာမှုကို ဆွစ်ဇာလန်နိုင်ငံအခြေစိုက် The Consortium Gruner GmbH/ Stucky SA နှင့် ထိုင်းနိုင်ငံ အခြေစိုက် TEAM Consulting Engineering and Management Co., Ltd (TEAM) အပြင် မြန်မာနိုင်ငံအခြေစိုက် Total Business Solution Co., Ltd (TBS) တို့နှင့်အတူ ၂၀၁၄ ခုနှစ် ဒီဇင်ဘာလ၊ ၁၂ရက်နေ့မှ ၂၀၁၅ ခုနှစ် ဇူလိုင်လ အထိပြုလုပ်ခဲ့ပါသည်။ နည်းပညာလေ့လာမှုများနှင့် အပြိုင် ပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုဆန်းစစ်ခြင်း လေ့လာမှုများကို ပြုလုပ်ခြင်းအားဖြင့် ပတ်ဝန်းကျင်နှင့် လူမှုစီးပွားရှုထောင့်မှ စီမံကိန်းအတွက် စီမံကိန်းနေရာရွေးချယ်ခြင်းနှင့် စီမံကိန်းနည်းပညာဒီဇိုင်းရွေးချယ်မှုများအတွက် အထောက်အပံ့များရရှိနိုင်ရန် ၂၀၁၅ခုနှစ် ဇန်နဝါရီလ ၁ရက်နေ့မှစ၍ နိုဝင်ဘာလ ၁၆ရက်နေ့အထိ နည်းပညာလေ့လာများနှင့် အပြိုင် ပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုဆန်းစစ်ခြင်းလေ့လာမှုများပြုလုပ်ခဲ့ပါသည်။ နည်းပညာလေ့လာမှုများနှင့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းလေ့လာမှုများကို MOEP နှင့်အတူ အမျိုးသားအဆင့်၊ တိုင်းဒေသကြီးအဆင့် နှင့် မြို့နယ်အဆင့်ဆိုင်ရာ အခြားသော ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး အေဂျင်စီများအတူတကွပူးပေါင်း ဆောင်ရွက်ခြင်းအားဖြင့် ပြုလုပ်ဆောင်ရွက်ခဲ့ပါသည်။

၁. ၁. ၂ နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်းအစီရင်ခံစာအတွက် MONREC ၏ သုံးသပ်အကြံပြုချက်များ

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ် အတွက်လိုအပ်သော နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အစီရင်ခံစာကို သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာန (MONREC) လက်အောက်တွင် တည်ရှိသော ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီဌာန (ECD) သို့ ANDRITZ မှ ၂၀၁၅ခုနှစ် ဩဂုတ်လတွင် ပေးပို့တင်ပြခဲ့ပါသည်။ သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာန မှ စိုက်ပျိုးမြေများ ဆုံးရှုံးမှုအတွက် မြေယာပေးလျော်ခြင်း၊ စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့် ထိခိုက်သက်ရောက်သူများကို အလုပ်အကိုင်အခွင့်လမ်းများအကောင်အထည်ဖော်ပေးရန်နှင့် ၄င်းတို့၏ လုံခြုံရေးနှင့် ထိခိုက်သက်ရောက်မှုများအတွက် သုံးသပ်အကြံပြုချက်များပေးအပ်ခဲ့ပါသည်။ ၄င်းအကြံပြုချက်များကို ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာတွင် စဉ်စားဆုံးဖြတ်ပြီး တစ်ပါတည်းထည့်သွင်းတင်ပြထားပါသည်။

ထို့အပြင် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာကို နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်း အစီရင်ခံစာတွင် ဖော်ပြထားသော TOR နှင့် သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေ ဝန်ကြီးဌာန၏ သုံးသပ်အကြံပြုချက်များနှင့်အညီဆောင်ရွက်ပြုစုထားပါသည်။

၁. ၁. ၃ ဆက်စပ်စီမံကိန်းနှင့် ဖွံ့ဖြိုးတိုးတက်မှု

ဆက်စပ်စီမံကိန်းနှင့် ဖွံ့ဖြိုးတိုးတက်မှုကဏ္ဍတွင် ရဲရွာ ရေအားလျှပ်စစ်စီမံကိန်း (၂၀၀၉ခုနှစ်တွင် တည်ဆောက်ခဲ့သည်) တည်ရှိနေပြီး ၄င်းသည် မြန်မာနိုင်ငံအလယ်ပိုင်း မန္တလေးမြို့၏ အရှေ့တောင်ဘက် မြစ်ငယ်မြစ်၏ ခန့်မှန်းခြေ ၅၀ ကီလိုမီတာအကွာ၊ ဒီးဒုတ် စီမံကိန်း၏ မြစ်ညာပိုင်း ၂၁. ၁ ကီလိုမီတာ အကွာအဝေးတွင် တည်ရှိပါသည်။ ရဲရွာရေအားလျှပ်စစ်စီမံကိန်း၏ အဓိက အစိတ်အပိုင်းမှာ သန်း၂ယ၆၃၀ ကုဗမီတာ ရေလှောင်ကန်နှင့်အတူ ၁၃၄ မီတာမြင့်သော RCC ရေကာတာနှင့် ၇၉၀ မဂ္ဂါဝပ် ဓါတ်အားပေးစက်ရုံ (တစ်ခုဆီတိုင်းတွင် ၂၁၀ m^3/s ဓါတ်အားထုတ်ဒီဇိုင်းပါဝင်သော မီးသီးတာဘိုင် ၄ခု) တို့ပါဝင်သည်။

ဒီးဒုတ်ခေါင်းနိမ့် ရေအားလျှပ်စစ် စီမံကိန်းသည် ခြောက်သွေ့ရာသီတွင် ရဲရွာရေအားလျှပ်စစ် စီမံကိန်း၏ ဓါတ်အားထုတ်လုပ်မှုကို ထောက်ပံ့ရန်ဖြစ်ပါသည်။ ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်း၏ ရေရရှိမှုသည် ရဲရွာရေကာတာ၏ ဓါတ်အားပေးစက်ရုံနှင့် ရေပိုလွှဲမှ ထိန်းချုပ်၍ လွှတ်လိုက်သော ရေများဖြစ်ပါသည်။

၁. ၂ အဖွဲ့အစည်းများ၏ မူဘောင်များ၊ ဥပဒေများနှင့်မူဝါဒများ

၁. ၂. ၁ သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာမူဝါဒများ

လူမှုရေးနှင့် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်း လမ်းညွှန်မှုများရေရှည်တည်တံ့ခိုင်မြဲရန် ကာကွယ်ခြင်းများကို တစ်ပြိုင်နက်တည်းဆောင်ရွက်ရန်ဖြစ်သည်။

ANDRITZ တွင် ကျန်းမာရေးလူမှုပတ်ဝန်းကျင်ကာကွယ်ရေးဆိုင်ရာနည်းဥပဒေများရှိသောကြောင့် R HY QM 004 တို့ကို အသုံးချခြင်းအားဖြင့် အချပ်ပို ၁-ကတွင် တည်နေရာများကို ဖော်ပြထားရှိပါသည်။

သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာစီမံခန့်ခွဲမှုစနစ်ကို အောက်ဖော်ပြပါနည်းလမ်းများတွင် အခြေခံ၍ ပေါင်းစည်း ထားရှိပါသည်။

(၁) (ကြိုတင်ကာကွယ်ခြင်း)သဘာဝပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုဆိုးကျိုးများမှ ရှောင်ရှားရန်

(၂) မလိုလားအပ်သော သဘာဝပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုဆိုးကျိုးများလျှော့ချခြင်း

(၃) ထိခိုက်သက်ရောက်မှု အရာဝတ္ထုများ၊ အစိတ်အပိုင်းများ ပြန်လည်အသုံးချခြင်း

(၄) အကြွင်းအကျန်ပစ္စည်းများ စနစ်တကျစွန့်ပစ်ခြင်း တို့ဖြစ်ကြပါသည်။

မြန်မာနိုင်ငံ၏ စွမ်းအင် ကဏ္ဍတွင် အဓိကနေရာမှ ပါဝင်နေသော High Tech Construction Trust Co., Ltd. (HTCT) သည် ရွှေတောင်အုပ်စု၏ စီမံကိန်း စီမံခန့်ခွဲခြင်းနှင့် တည်ဆောက်ရေးဆိုင်ရာ ကုမ္ပဏီခွဲတစ်ခုဖြစ်ပြီး အခြေခံအဆောက်အဦးစီမံကိန်းများအတွက် အချိန်မှန် တည်ဆောက်ခြင်း၊ ငွေကြေးနှုန်းထားသင့်တင်ခြင်း စသော အကောင်းဆုံး အရည်အသွေးဖြင့် ဆောင်ရွက်ပေးနေပါသည်။ HTCT မှ ပြည်တွင်း/ပြည်ပ စက်မှုလုပ်ငန်းများဆိုင်ရာ စီမံကိန်းများကို ဦးဆောင် စီမံခန့်ခွဲခြင်း၊ ဆန်းသစ်တီထွင်ခြင်း၊ တည်ဆောက်ရေးနှင့် ဒီဇိုင်းလုပ်ငန်းများတွင် ကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံမှုများကို ကောင်းမွန်သေချာစွာ လုပ်ဆောင်ပါသည်။

(က) လူ့အခွင့်အရေးနှင့် အလုပ်သမားအခွင့်အရေး မူဝါဒ
(ခ) ပွင့်လင်းမြင်သာခြင်း
(ဂ) လုပ်ငန်းခွင် ကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံရေး မူဝါဒ
(ဃ) လူထုနှင့် ပတ်ဝန်းကျင် - ရေရှည်မူဝါဒ
(င) လူထုနှင့် ပတ်ဝန်းကျင် - ပတ်ဝန်းကျင်ဆိုင်ရာ
(စ) ကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံရေး
(ဆ) ပတ်ဝန်းကျင်

KANSAI Electric Power သည် လုပ်ငန်းစဉ်များ၏ အရေးယူမှု စံချိန်စံညွှန်းများအတွက် အလေ့အကျင့် (၅) ခုကို အခြေခံအနေဖြင့် သတ်မှတ်ဖော်ပြထားပါသည်။ ထို့အပြင် CSR လုပ်ဆောင်ခြင်း မူဝါဒများကို လုပ်ငန်းရှင်များနှင့် စီးပွားရေးလုပ်ငန်း ညှိနှိုင်းခြင်းများ၊ ကြည့်ရှုစစ်ဆေးခြင်းများနှင့် ရှင်းလင်းခြင်းများတွင် အသုံးပြုပါသည်။

လုပ်ငန်းစဉ်များ၏ အရေးယူမှု စံချိန်စံညွှန်းများမှာ -

(က) ဘေးကင်းလုံခြုံရေး၊ အရည်အသွေး ထိန်းသိမ်းခြင်းနှင့် တိုးတက်ခြင်းနှင့် နည်းပညာဖွံ့ဖြိုးခြင်း
(ခ) ပတ်ဝန်းကျင်ဆိုင်ရာ လိုက်လျောညီထွေရှိခြင်း
(ဂ) ကြီးကြပ်အုပ်ချုပ်ခြင်းဆိုင်ရာ မိတ်ဖက် တည်ထောင်ခြင်း
(ဃ) ပွင့်လင်းမြင်သာမှုရှိခြင်း၊ စီးပွားရေး လုပ်ဆောင်မှုများ ပွင့်လင်းခြင်း
(င) စည်းကမ်းသတ်မှတ်ခြင်းများကို လေးစားလိုက်နာခြင်း တို့ဖြစ်ပါသည်။

၁. ၂. ၂ ဥပဒေ မူဘောင်များ

(၁) သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအခြေခံတည်ဆောက်ခြင်း

လူမှုစီးပွားဖွံ့ဖြိုးတိုးတက်ရေးလုပ်ငန်းများအတွက် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာစီမံခန့်ခွဲခြင်းကို

ဆောင်ရွက်နိုင်စေရန်နိုင်ငံတော်၏ သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာမူဝါဒကို ၁၉၉၄ ခုနှစ်ကတည်း ကပင်ဖွဲ့စည်း ခဲ့ပြီးဖြစ်ပါသည်။ ၎င်းမူဝါဒသည် ရုပ်ပိုင်းဆိုင်ရာသဘာဝပတ်ဝန်းကျင်သာမက သက်ရှိဇီဝသဘာဝ ပတ်ဝန်းကျင် လူမှုစီးပွားဆိုင်ရာများ နှင့် ယဉ်ကျေးမှုဆိုင်ရာ ထိခိုက်သက်ရောက်မှုများအတွက်ပါ အကျုံးဝင် စေပါသည်။ ၎င်းမူဝါဒသည် ၂၀၀၈ ခုနှစ် ဖွဲ့စည်းပုံအခြေခံဥပဒေ၏ အခန်း ၃၇၊ ၄၂ နှင့် ၃၉၀ တို့ကို ထောက်ခံ၍ ၂၀၁၂ခုနှစ် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်း ရေး ဥပဒေများကိုလည်း ခြုံငုံမိစေပါသည်။

သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဥပဒေနှင့် ၎င်းနှင့် ပတ်သက်ဆက်နွှယ်သည့် စည်းမျဉ်း စည်းကမ်းများ သည် မြန်မာနိုင်ငံတော်၏ ပြဋ္ဌာန်းထားသော သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်း နည်းဥပဒေများကိုလည်း ထောက်ခံအားပေးခြင်းဖြစ်စေပါသည်။

(၂) ပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်နှင့် ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်း လိုအပ်ချက်များ

သဘာဝပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုများ လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ထုံး လုပ်နည်းများ သည် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအတွင် အဓိကသော့ချက်များအဖြစ် ဖွံ့ဖြိုးရေး ဆိုင်ရာလုပ်ငန်းများတွင် ပါဝင်နေပါသည်။

၎င်းလုပ်ထုံးလုပ်နည်းများ၏ လိုအပ်ချက်များမှာမူ သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာလေ့လာဆန်းစစ်ခြင်း ကို လေးစားလိုက်နာလျက် သဘာဝပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုလေ့လာဆန်းစစ်ခြင်းကို စနစ်တကျ ဆောင်ရွက်ရန် ဖြစ်သည့်အားလျော်စွာ သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်း၊ စောင့်ကြည့်ကြီးကြပ်ခြင်းနှင့် စီမံကိန်းတည် ဆောက်စဉ်နှင့် လည်ပတ်နေသောကာလများတွင် အစီရင်ခံခြင်းတို့ဖြစ်ကြပါသည်။

(၃) သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာစီမံခန့်ခွဲမှု စံချိန်စံနှုန်းများ

နိုင်ငံတော်၏ သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ စီမံခန့်ခွဲမှုစံချိန်စံနှုန်းများသည် အပြည်ပြည် ဆိုင်ရာ လုပ်ထုံးလုပ်နည်းများ ကျင့်ဝတ်များနှင့် လိုက်လျောညီထွေဖြစ်စေရပါမည်။ သို့ဖြစ်၍ ထိခိုက် သက်ရောက်မှုလေ့လာ ဆန်းစစ်ခြင်းများ ဆိုးကျိုးဖြစ်စေသော ထိခိုက်သက်ရောက်မှု လျော့နည်းစေရန် လျော့ချနည်းလမ်းများကို ဤသဘာဝပတ်ဝန်းကျင်ထိခိုက်သက်ရောက်မှုအစီရင်ခံစာတွင် ကမ္ဘာ့ဘဏ်အုပ်စုများ၏ ထုံးတမ်းစဉ်လာစံချိန်၊ စံနှုန်းများနှင့်အညီ ပြုစုထားရှိအပ်ပါသည်။

(၄) အပြည်ပြည်ဆိုင်ရာ အစည်းအဝေးများ၊ စာချုပ်များနှင့် သဘောတူညီချက်များ

မြန်မာနိုင်ငံသည် ပတ်ဝန်းကျင်နှင့်သက်ဆိုင်သော အပြည်ပြည်ဆိုင်ရာ အစည်းအဝေးများ၊ စာချုပ်များနှင့် သဘောတူညီချက်များအား လက်မှတ်ရေးထိုးခဲ့ပါသည်။

(က) အရှေ့တောင်အာရှနှင့် ပစိဖိတ်ဒေသ အပင်ကာကွယ်ရေးသဘောတူညီချက်များ၊ ရောမ၊ ၁၉၅၆ခုနှစ်

(ခ) ရာသီဥတုပြောင်းလဲမှုအတွက် ကုလသမဂ္ဂ မူဘောင်အစည်းအဝေး၊ နယူးယောက်၊ ၁၉၉၂ခုနှစ် (ပြုယယ)

(ဂ) ဇီဝဗေဒ မျိုးကွဲများဆိုင်ရာအစည်းအဝေး၊ ရီရိုဒီဂျနေးဒိုး၊ ၁၉၉၂ခုနှစ်

(ဃ) ကမ္ဘာ့ယဉ်ကျေးမှုနှင့် သဘာဝအမွေအနှစ်ကာကွယ်ရေး အစည်းအဝေး၊ ပြင်သစ်၊ ၁၉၇၂ခုနှစ်

(င) သဘာဝနှင့် သဘာဝအရင်းအမြစ်များ ထိန်းသိမ်းစောင့်ရှောက်ရေး အာဆီယံ သဘောတူညီချက်၊ ကွာလာလန်ပူ၊ ၁၉၈၅ခုနှစ်

(စ) ဇီဝဘေးကင်းလုံခြုံမှု ကာတီဂါနာ ပရိုတိုကော၊ ကာတီဂါနာ၊ ၂၀၀၀ခုနှစ်

(ဆ) ရာသီဥတုပြောင်းလဲခြင်းဆိုင်ရာ ကျိုတို ပရိုတိုကော၊ ကျိုတို၊ ၁၉၉၇ခုနှစ်

စီမံကိန်း ဓါတ်အားထုတ်လုပ်မှုမှ ဖန်လုံအိမ်ဓါတ်ငွေ့ထုတ်လွှတ်မှုကို အစိုးရ၏ သဘောတူညီမှု ဖြစ်သော ကျိုတို ပရိုတိုကော၏ လိုအပ်ချက်များအတိုင်း လိုက်နာဆောင်ရွက်သွားမည် ဖြစ်ပါသည်။

(၅) အပြည်ပြည်ဆိုင်ရာ ပေါ်လစီများ၊ လမ်းညွှန်ချက်များနှင့် စံချိန်စံညွှန်းများ

စီမံကိန်း၏ ပတ်ဝန်းကျင်နှင့်လူမှုစီးပွားဆိုင်ရာထိခိုက်မှု များသည် အခြားနိုင်ငံများတွင် ဖြစ်ပွားလေ့ရှိသော ပြဿနာများဖြစ်ပြီး ၎င်းတို့ကို အပြည်ပြည်ဆိုင်ရာ ပေါ်လစီများ၊ လမ်းညွှန်ချက်များနှင့် စံချိန်စံညွှန်းများ ဖြစ်သော World Health Organization (WHO)၊ the U.S. Environmental Protection Agency (EPA)၊ the World Bank နှင့် the International Finance Corportation (IFC) စသည်တို့နှင့်အညီ ကိုင်တွယ်ဖြေရှင်းသွားမည် ဖြစ်ပါသည်။

၁. ၂. ၃ မြန်မာနိုင်ငံ အစိုးရအဖွဲ့အစည်းဆိုင်ရာ မူဘောင်

၁. ၂. ၃. ၁ အမျိုးသားအဆင့်နှင့် ကဏ္ဍအလိုက်အစီအစဉ်

အမျိုးသားအဆင့်တွင် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းစောင့်ရှောက်ရေးကော်မတီ (ENCC) သည် ညှိနှိုင်းရေး ကဏ္ဍအဖြစ်ဆောင်ရွက်သည်။ သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းစောင့်ရှောက်ရေးကော်မတီ၏ အာဏာ နှင့် တာဝန်များကို ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးနည်းဥပဒေ စာပိုဒ် ၇ မှ ၁၃ တွင်ဖော်ပြထားပါသည်။

ဤစီမံကိန်း၏ သဘာဝပတ်ဝန်းကျင် ထိန်းသိမ်းစောင့်ရှောက်ရေး ကော်မတီ၏ အဓိကတာဝန်တစ်ခုမှာ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းအစီရင်ခံစာကို သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းစောင့်ရှောက် ရေးဝန်ကြီးဌာန လက်အောက်ရှိ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာနမှ စီမံခန့်ခွဲမှုကို ကြီးကြပ်ခြင်းဖြစ်သည်။ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာနသည် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း အစီရင်ခံစာနှင့် ပတ်ဝန်းကျင်စီမံ ခန့်ခွဲမှုအစီအစဉ်အကောင်အထည်ဖော်ရာတွင် ဖြစ်ပေါ်လာသော ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာပြဿနာများ နှင့် ဆက်စပ်သော ဌာနများအား ညှိနှိုင်းဖြေရှင်းရန် ညှိနှိုင်းရေးမှူးအဖြစ် လုပ်ကိုင်ဆောင်ရွက်မည် ဖြစ်ပါသည်။

ဤစီမံကိန်း၏ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းလုပ်ငန်းအတွက် ပင်မရုံးချုပ်ဖြစ်သော ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဦးစီးဌာနမှ သက်ဆိုင်ရာ အစိုးရဌာနများဖြစ်သည့် ဒေသဆိုင်ရာ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာန

နှင့် ဒေသဆိုင်ရာ၊ မြို့နယ်ဆိုင်ရာ နှင့် ရပ်ကွက်ဆိုင်ရာ အခြားသော အစိုးရဌာနများ ကို ကြီးကြပ်အုပ်ချုပ်မည်ဖြစ်ပါသည်။

၁. ၂. ၃. ၂ ဌာနဆိုင်ရာ ဖွဲ့စည်းမှုပုံစံ/ယန္တရား

အစိုးရဌာနများနှင့် ၎င်းတို့၏ အဓိက ပတ်ဝန်းကျင်ဆိုင်ရာကိစ္စများမှာ သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ အမျိုးသားရေး ကော်မရှင်၊ သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာန၊ စိုက်ပျိုးရေးနှင့် ဆည်မြောင်းဝန်ကြီးဌာန၊ မွေးမြူရေးနှင့် ရေလုပ်ငန်း ဝန်ကြီးဌာန၊ စက်မှုဝန်ကြီးဌာန၊ ကျန်းမာရေးဝန်ကြီးဌာန၊ စွမ်းအင်ဝန်ကြီးဌာန၊ လျှပ်စစ်ဓါတ်အား ဝန်ကြီးဌာန၊ ပို့ဆောင်ဆက်သွယ်ရေးဝန်ကြီးဌာန၊ ပြည်ထဲရေးဝန်ကြီးဌာန၊ အလုပ်သမားဝန်ကြီးဌာန၊ သိပ္ပံနှင့် နည်းပညာဝန်ကြီးဌာန၊ ပညာရေးဝန်ကြီးဌာန၊ အမျိုးသားစီမံကိန်းနှင့် စီးပွားရေးဖွံ့ဖြိုးတိုးတက်မှုဝန်ကြီးဌာန၊ နယ်စပ်ဒေသနှင့် တိုင်းရင်းသားလူမျိုးများဖွံ့ဖြိုးတိုးတက်ရေးဝန်ကြီးဌာန၊ မြန်မာရင်နှီးမြှုပ်နှံမှု ကော်မရှင်၊ ရေနှင့် သန့်ရှင်းရေး အမျိုးသားရေးကော်မရှင်၊ စက်မှုဖွံ့ဖြိုးတိုးတက်ရေး ဗဟိုကော်မတီ တို့ဖြစ်ပါသည်။

၁. ၃ စီမံကိန်းဖော်ပြချက်

၁. ၃. ၁ စီမံကိန်းဖော်ပြချက်နှင့် အခြားသောနည်းလမ်းများ ဖော်ပြချက်များ

ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်းသည် အဝင်/အထွက်ရေ ပမာဏတူညီစွာစီးဆင်းနေသည့် (ROR) ရေအားလျှပ်စစ် စီမံကိန်း ဖြစ်ပြီး မြစ်ငယ်မြစ်ပေါ်တွင် တည်ရှိနေသော ရဲရွာ ရေအားလျှပ်စစ် စီမံကိန်းနှင့် (၂၀) ကီလိုမီတာ၊ မန္တလေးမြို့မှ အရှေ့တောင်ဘက် (၃၀) ကီလိုမီတာနှင့် ဧရာဝတီမြစ်၏ မြစ်ခွဲ မြစ်ငယ်မြစ်၏ မြစ်အထက်ပိုင်း ၈၂ ကီလိုမီတာအကွာတွင် တည်ရှိပါသည်။ မြစ်ငယ်မြစ်၏ ဘယ်ဘက်ကမ်းသည် မန္တလေးတိုင်းဒေသကြီး ကျောက်ဆည်မြို့နယ်တွင် တည်ရှိပြီး ညာဘက်ကမ်းသည် မန္တလေးတိုင်းဒေသကြီး ပြင်ဦးလွင်မြို့နယ် တွင်တည်ရှိပါသည်။

ROR ရေအားလျှပ်စစ် စီမံကိန်းသည် အဝင်ရေစီးဆင်းမှုနှင့် အထွက်ရေစီးဆင်းမှု ပမာဏသည် တစ်နှစ်ပတ်လုံးတူညီနေပါသည်။ ROR ရေအားလျှပ်စစ် စီမံကိန်းသည် ပုံမှန်ရေစီးဆင်းမှုဖြစ်ပေါ်စေကာ ရေစုကန်၏ ထုထည်မှာ အလွန်သေးငယ်ပါပြီး ရဲရွာ ရေအားလျှပ်စစ်စီမံကိန်းကဲ့သို့ ရေလှောင်ကန် အမျိုးအစား မဟုတ်ပေ။ ထို့ကြောင့် ဒီးဒုတ်စီမံကိန်း၏ အဝင်ရေစီးဆင်းမှုမှာ ရဲရွာ၏ အထွက်ရေ စီးဆင်းမှုအပေါ် မူတည်နေပြီး မိုးရာသီသာမက ခြောက်သွေ့ရာသီတွင်လည်း ရဲရွာ စီမံကိန်းမှ မြစ်ငယ်မြစ်၏ မြစ်အောက်ပိုင်းတွင် သိသာထင်ရှားသော ပြောင်းလဲမှုမျိုးကို မဖြစ်ပေါ်စေပါ။

အဆောက်အဦးများ	အဓိက အင်္ဂါရပ်များ
ရေကာတာ	ဘေးနှစ်ဘက်တွင် ဆင်ခြေလျှောပါဝင်ပြီး ရေတွင်နစ်မြုပ်နေသော ထိပ်လုံးဝန်းသော ရေကာတာ၊ လုံဝန်းမှု အနေအထား ၆၅ m.asl၊ စုစုပေါင်းအရှည် ၁၅၀ မီတာဖြစ်ပါသည်။
ဂိတ်	တစ်ခုလျှင်အကျယ် ၁၇မီတာရှိသော ရေထိန်းတံခါး ၇ခု ပါဝင်ပါသည်။
ရေသိုလှောင်ရာနေရာ	အရှည် ၅၀မီတာ ဖြစ်ပါသည်။
ဓါတ်အားရုံ	ရေကာတာ၏ ဘယ်ဘက်အခြမ်းတွင်တည်ရှိပါသည်။ ဂျန်နရေတာ တစ်ခုလျှင် ၂၉ MVA ရှိသော မီးသီးတာဘိုင် ဂျန်နရေတာ ၃ခု ပါဝင်ပါသည်
ချဉ်းကပ်လမ်း	စီမံကိန်းနေရာတွင် ချဉ်းကပ်လမ်း၂ခုရှိပြီး ဘယ်ဘက်ကမ်းရှိချဉ်းကပ်လမ်းမှာ ၄၃၀မီတာရှည်လျားပြီး ညာဘက်ကမ်းရှိချဉ်းကပ်လမ်းအရှည်မှာ ၅၇၀ မီတာဖြစ်ပါသည်။ ချဉ်းကပ်လမ်း၂ခုသည် လက်ရှိလမ်းဟောင်းမှ

အဆောက်အဦးများ	အဓိက အင်္ဂါရပ်များ
	ခွဲထွက်ဖောက်လုပ်မည်ဖြစ်ပြီး ချဉ်းကပ်လမ်း၂ခု၏ စုစုပေါင်းအရှည်မှာ မီတာ ၁၀၀၀ ဖြစ်ပါသည်။
ဓါတ်အားလိုင်းများ	ဘဲလင်းပင်မ ဓါတ်အားခွဲရုံသို့ ဆက်သွယ်သော အရှည် ၂၀ ကီလိုမီတာရှိသော ဘယ်ဘက်ကမ်းပေါ်ရှိ ၁၃၂.၄ ရှိသော ဓါတ်အားလိုင်းတစ်ခုပါဝင်ပါသည်။
ဓါတ်အားခွဲစက်ရုံ	ဘဲလင်းပင်မဓါတ်အားရုံခွဲတွင် (၁၃၂) kV (လက်ရှိ ဓါတ်အားခွဲရုံကို တိုးချဲ့ပါမည်)
ထောက်ပံ့ အဆောက်အဦးများ	-

ROR ရေအားလျှပ်စစ်စီမံကိန်းတွင် ရွေးချယ်ထားသော ရေကာတာနေရာနှင့် ဓါတ်အားရုံနေရာတွင် ပတ်ဝန်းကျင်နှင့် လူမှုရေးထိခိုက်မှုများရှိနိုင်ပါသည်။ အကယ်၍ ဓါတ်အားပေးစက်ရုံကို ခွဲထုတ်ကာ ရေကာတာ (ပုံ - ၄. ၁-၅) ၏ မြစ်အောက်ပိုင်းတွင် တည်ဆောက်ပါက ရေကာတာနှင့် စက်အားပေးစက်ရုံ၏ ရေထုတ်မြောင်းကြားတွင် ရေစီးဆင်းနည်းမှုဖြစ်ပေါ်ခြင်းကြောင့် ပြဿနာဖြစ်ပေါ်နိုင်ပါသည်။ သို့သော် ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်းတွင် ဓါတ်အားရုံသည် အဓိကကဏ္ဍတွင်ပါဝင်နေပါသည်။ ထို့ကြောင့် ရေကာတာ၏ မြစ်အောက်ပိုင်းတွင် ခြောက်သွေ့ခြင်းလုံးဝမဖြစ်ပေါ်နိုင်ပါ။

နည်းပညာလေ့လာမှုမှ ရဲရွာရေကာတာ၏ အောက်ပိုင်းတွင် အခြားသောရွေးချယ်မှုနေရာ လေးခုကို ရွေးချယ်ခဲ့ပါသည်။ (၁) စီမံကိန်းတည်ရှိရာနေရာ၏ အပေါ်ဘက် (၂) စီမံကိန်းနေရာ ၄၄ (၃) စီမံကိန်းနေရာ ၄၆ နှင့် (၄) စီမံကိန်းနေရာ ၅၄ တို့ဖြစ်ပါသည်။

၁. ၃. ၂ အခြားရွေးချယ်မှုနှင့် နှိုင်းယှဉ်ချက်

ရေကာတာစီမံကိန်းနေရာရွေးချယ်ခြင်းတွင် အဆင့်နှစ်ဆင့်ရှိပါသည်။ ပထမအဆင့်တွင် မသင့်လျော်သော စီမံကိန်းနေရာများကို ကနဦးစစ်ဆေးခြင်းပြုလုပ်သည်။ ဒုတိယအဆင့်တွင် ကျန်ရှိသော စီမံကိန်းနေရာများအား အသေးစိတ်စစ်ဆေးခြင်းများပြုလုပ်ပါသည်။

ပထမအဆင့်စစ်ဆေးခြင်းတွင် အောက်ဖော်ပြပါ အချက်အလက်များကို စစ်ဆေးခြင်းဖြစ်ပါသည်။

- ပြင်ပသတ်မှတ်ချက်များ -
- အနယ်ကျမှု
- စိုက်ပျိုးမြေနေရာများ
- ဘာသာရေးအဆောက်အအုံများ (ဘုရားစေတီ)
- ရှားပါးသစ်ပင်

နည်းပညာအကဲဖြတ်လက္ခဏာများ

- အခြေခံအုတ်မြစ်
- ပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာထိခိုက်မှု
- ရေအား နှင့် စွမ်းအင်ထုတ်လုပ်မှု

ဒုတိယအဆင့်စီစစ်ခြင်းတွင် ကျန်ရှိသော စီမံကိန်းနေရာများ၏ အခြေခံစီမံကိန်းနေရာ၊ စွမ်းအင်ထုတ်လုပ်မှု။ ဘူမိအခြေအနေ၊ ပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာထိခိုက်မှုတို့ပါဝင်ပါသည်။

စီမံကိန်းနေရာ ၅၄ သည် ကြိုတင်ဒီဇိုင်းများပြုလုပ်ဆောင်ရွက်ရန် အကောင်းဆုံးအနေအထား ဖြစ်ပါသည်။

၁. ၃. ၃ အခြားသောရွေးချယ်မှုဖော်ပြချက်

(၁) စီမံကိန်းအဆောက်အဦး၏မြေနေရာ

ရေကာတာ စီမံကိန်းအဆောက်အဦး၏ မြေနေရာများကို အခန်း (၄) ၏ ပုံ ၄. ၃-၁တွင် ဖော်ပြ ထားပါသည်။

(၂) ချဉ်းကပ်လမ်းများ

စီမံကိန်းနေရာတွင် ချဉ်းကပ်လမ်း ၂ခုပါဝင်ပြီး ပထမတစ်လမ်းမှာ ညာဘက်ကမ်းပေါ်တွင် တည်ရှိပြီး အခြားတစ်လမ်းမှာ ဘယ်ဘက်ကမ်းပေါ်တွင် တည်ရှိပါသည်။

ညာဘက်ကမ်းတွင်တည်ဆောက်မည့် ချဉ်းကပ်လမ်းသည် လက်ရှိရှိနေသောလမ်းဟောင်းမှ ခွဲထွက်ကာ စီမံကိန်းနေရာသို့ ဆက်သွယ်ဖောက်လုပ်ခြင်းဖြစ်သည်။ စုစုပေါင်းအရှည် ၅၇၀ မီတာရှည်လျားသည်။ လမ်းကို အမြင့်ဆုံးရေလွှမ်းမှု ၈၂ m.asl ခံနိုင်သော တာတမံအမြင့် ၈၄ m.asl ပေါ်တွင်တည်ဆောက်မည် ဖြစ်ပါသည်။

ဘယ်ဘက်ကမ်းတွင်တည်ဆောက်မည့် ချဉ်းကပ်လမ်းသည် လက်ရှိတည်ရှိနေသော လမ်းကို ပြန်လည်အဆင့်မြင့်တင်ဖောက်လုပ်ကာ စီမံကိန်းတည်ရှိရာနေရာသို့ဆက်သွယ်မည်ဖြစ်ပါသည်။ အဆင့်မြင့် တင်မည့် လမ်း၏အရှည်မှာ ၄၃၀မီတာရှိပြီး အမြင့်ဆုံးရေလွှမ်းမှု ၈၂ m.asl ခံနိုင်သော တာတမံအမြင့် ၈၄ m.asl ပေါ်တွင်တည်ဆောက်မည် ဖြစ်ပါသည်။

(၃) ရေကာတာ

ရေကာတာဆောက်လုပ်မှုကို ဓါတ်အားပေးစက်ရုံနှင့်တွဲလျက် နစ်မြုပ်နေသော ဂိတ်တံခါးများ ပါဝင်သော ဒီဇိုင်းဖြင့်တည်ဆောက်မည်ဖြစ်ပါသည်။

ရေပိုလွှဲသည် အရှည် ၁၄၁. ၅မီတာရှည်ပြီး ၂၆မီတာမြင့်သည်။ ရေပိုလွှဲ၏ ရေလျှံကျမှုကိုထိန်းချုပ်ရန် အတွက် ရေထိန်းတံခါးများပါဝင်သော ရေတွင်နစ်မြုပ်နေသော ထိပ်လုံးဝန်းသော ရေကာတာပုံစံမျိုး တည်ဆောက်မည်ဖြစ်ပါသည်။ ရေပိုလွှဲကို ရေကြီးရေလျှံမှုကာလ နှစ် ၁၀,၀၀၀ အပေါ်အခြေခံ၍ ရေကြီးရေလျှံ ဖြစ်ပေါ်မှုကို ကိုင်တွယ်ဖြေရှင်းရန် စက္ကန့်လျှင် ၇၃၀၀ ကုဗမီတာ ထုတ်လွှတ်ရန် ဒီဇိုင်းပြုလုပ်ထားပါသည်။

ရေပိုလွှဲဖွဲ့စည်းပုံစံကို မြင့်တင်ပြီး ရေကာတာ၏ လုပ်ငန်းလည်ပတ်မှုအမြင့်ဆုံးအဆင့်တွင်ရှိသော ရေအမြင့် ၈၀ m.asl ကိုထိန်းသိမ်းထားမည်ဖြစ်ပါသည်။ ဒီးဒုတ်ရေကာတာနှင့် ရဲရွာရေကာတာ အတွင်းရှိ မြစ်ရေထုထည်မှာ ကုဗမီတာ ၁၃ သန်းရှိပါသည်။

ရေကာတာ၏ ရေလျှံမှုထိန်းသိမ်းရေးဇုန်တွင် အမြင့်ဆုံးရေကြီးရေလျှံမှုမှာ ၁မီတာမှ ၄မီတာ အထိသာရှိပါသည်။

(၄) ဓါတ်အားပေးစက်ရုံ

ဓါတ်အားပေးစက်ရုံကို ရေပိုလွှဲအပိုင်းမှ နံရံခြားကာ ခွဲထုတ်တည်ဆောက်ထားပါသည်။ စုစုပေါင်းအရှည်မှာ ၆၇ မီတာရှိပါသည်။ ၎င်းဓါတ်အားပေးစက်ရုံတွင် မီးသီးတာဘိုင် ဂျင်နရေတာ ၃ခု ပါဝင်ပါသည်။

(၅) ရေသိုလှောင်ရာနေရာ

ရေသိုလှောင်ရာနေရာသည် စွမ်းအင်ဆုံးရှုံးမှုကာကွယ်ရန်နှင့် မြစ်၏ကြမ်းပြင် တိုက်စားမှုများကို ကာကွယ်ရန်ဖြစ်ပါသည်။ ၎င်းကို Type IV ဒီဇိုင်းပြုလုပ်ထားပြီး အရှည် မီတာ ၅၀ရှိပါသည်။

(၆) ယိုစိမ့်မှုထိန်းချုပ်ခြင်း

ယိုစိမ့်မှုထိန်းချုပ်ခြင်းကို ၃၃ မီတာ ပါဝင်သော grout curtain နှင့် grout curtain ၏ အောက်ပိုင်း တိုးချဲ့ထားသော ရေနုတ်မြောင်းကို ပေါင်းစပ်ခြင်းအားဖြင့် ထိန်းချုပ်မည်ဖြစ်ပါသည်။ ၎င်းဒီဇိုင်းကြောင့် မြင့်မားသော ဖိအားဖြစ်ပေါ်မှုကို လျော့ချနိုင်ပြီး ရေကာတာ၏ တည်ငြိမ်မှုကို တိုးတက်စေပါသည်။

(၇) ဓါတ်အားထိန်းချုပ်ရေးနေရာ

ဓါတ်အားထိန်းချုပ်ရေးနေရာသည် ဓါတ်အားပေးစက်ရုံ၏ အနောက်ဘက်ရှိ ၄၀×၅၀ မီတာကျယ်ဝန်းသော မြေပေါ်တွင် တည်ရှိပါသည်။

(၈) မဟာဓါတ်အားလိုင်း

MOEE ၏ ၂၀၁၇ ခုနှစ်တွင် ညွှန်ကြားချက်ဖြင့် ကီလိုမီတာ (၂၀) ရှည်ပြီး ဆားကစ် (၂) ခု ပါသော ၁၃၂ ကေဗွီ ဒီးဒုတ် မဟာဓါတ်အားလိုင်းကို ရဲရွာ ဓါတ်အားခွဲရုံသို့မဆက်သွယ်ပဲ ဘဲလင်း ဓါတ်အားခွဲရုံသို့ ဆက်သွယ် ပေးပို့ရန် စီစဉ်ထားပါသည်။

(၉) ရေကြီးရေလျှံမှု သတိပေးစနစ်

မြစ်အထက်ပိုင်းနှင့် မြစ်အောက်ပိုင်းရှိ လူထုနှင့် ဒေသခံများကို ရေကြီးရေလျှံမှုအတွက် ချက်ချင်း သတိပေးရန် အတွက် ရေကြီးရေလျှံမှု သတိပေးစနစ်ကို စီစဉ်ထားပါသည်။

၁. ၃. ၄ တည်ဆောက်ရေးအစီအစဉ်နှင့် လုပ်ဆောင်မှုများ

တည်ဆောက်ရေးအချိန်ဇယားသည် ၄ နှစ်မှ ၄. ၅ နှစ်အတွင်း ဆောင်ရွက်မည်ဖြစ်ပြီး ကာလ ၄ခုပါဝင်ဖွဲ့စည်းထားပါသည်။

ကာလ (၀) - စီမံကိန်းနေရာ ပြင်ဆင်ခြင်းနှင့် ချဉ်းကပ်လမ်းအသစ် ဖောက်လုပ်ခြင်းကို တစ်လအတွင်း ဆောင်ရွက်ခြင်း

ကာလ (၁) - ခြားနားသောန်ရံနှင့် မြစ်ရေလွှဲမြောင်း တည်ဆောက်ခြင်းကို ၁နှစ်မှ ၁. ၅နှစ်အတွင်း ဆောင်ရွက်ခြင်း

ကာလ (၂) - ရေပိုလွှဲနှင့် ဓါတ်အားပေးစက်ရုံဖွဲ့စည်းပုံတည်ဆောက်ခြင်းကို ၂နှစ်မှ ၂. ၅နှစ်အတွင်း ဆောင်ရွက် ခြင်း

ကာလ (၃) - ဓါတ်အားပေးစက်ရုံအတွက် စက်ပိုင်းနှင့် လျှပ်စစ်ပိုင်းဆိုင်ရာအလုပ်များလုပ်ကိုင်ခြင်းကို ၁. ၅နှစ်မှ ၂ နှစ်အတွင်းဆောင်ရွက်ခြင်း တို့ဖြစ်ပါသည်။

၁. ၃. ၄. ၁ လုပ်ငန်းစဉ် နည်းလမ်း

စီမံကိန်း အစိတ်အပိုင်းများ၏ ယေဘူယျ ဆောက်လုပ်ရေး နည်းလမ်းများတွင် အောက်ဖော်ပြတို့ ပါဝင်နေပါသည်။

(က) ရေပိုလွှဲ
(ခ) ဓါတ်အားရုံ
(ဂ) ဓါတ်အားပေးစခန်း
(ဃ) ယာယီ အဆောက်အဦးများ
- ကျောက်မိုင်း
- မြေသားယူသည့်နေရာ
- မြေသားတမံ
- ကြိတ်ခွဲစက်

- ဘိလပ်မြေဖျော်စက်
- နောက်ကျိရေများကို သန့်စင်သည့်နေရာ
- ယာယီရေထောက်ပံ့ပေးမှု
- ယာယီ လျှပ်စစ်ဓါတ်အား ထောက်ပံ့ပေးမှု
- အမြဲချဉ်းကပ်လမ်း
- အခြေစိုက် စခန်းနှင့် ဝန်ထမ်းအိမ်ယာ
- အခြေစိုက်စခန်းနှင့် ဝန်ထမ်းအိမ်ယာတွင် ရေသန့်စင်မှု စနစ်

၁. ၃. ၅ တည်ဆောက်ရေးလိုအပ်ချက်များ

ဝတ္ထုပစ္စည်းများ

တည်ဆောက်ရေးအတွက်လိုအပ်သော တည်ဆောက်ရေးပစ္စည်းအရေအတွက်နှင့် အရည်အသွေးကို စီမံကိန်းနေရာ လုပ်ငန်းခွင် အနီးအနားတွင် ရရှိနိုင်ပါသည်။ ဖြစ်နိုင်ချေ အစီရင်ခံစာ၏ ရွေးချယ်ထားသော စီမံကိန်းနေရာ ယ ၇၀၀/၃ အရ လိုအပ်သော တည်ဆောက်ရေး ပစ္စည်းများ၏ ခန့်မှန်းချေ အရည်အတွက်ကို ဇယား ၄. ၃-၁၀ တွင်ဖော်ပြထားပါသည်။

အလုပ်သမားများ

တည်ဆောက်ရေးအတွက် ပျမ်းမျှ အလုပ်သမားအင်အား ၃၀၀ ခန့်လိုအပ်ပါသည်။ အလုပ်သမားများကို ဒေသခံများအတွင်းမှ ရနိုင်သလောက် စုဆောင်းပါမည်။ အခြားဒေသမှ လာရောက်အလုပ်လုပ်ကိုင်သော အလုပ်သမားများသည် စီမံကိန်းနေရာအတွင်းရှိသော ထောက်ပံ့ပေးထားသော စခန်းနေရာများတွင် နေထိုင်နိုင်ပါသည်။

၁. ၃. ၆ ပိတ်သိမ်းခြင်း/ အပြီးသတ် ပိတ်သိမ်းခြင်း လုပ်ဆောင်မှုများ

ကန်ထရိုက်တာသည် စာချုပ်ထဲတွင်ဖော်ပြထားသည့်အတိုင်း ပတ်ဝန်းကျင်ထိန်းသိမ်းမှု ဆိုင်ရာများကို စီမံကိန်း အကောင်အထည်ဖော်သူမှ တည်ဆောက်ရေး လုပ်ငန်းများ မစတင်ခင် နဂိုမူလ အတိုင်း ပြန်လည်ဖြစ်ပေါ်စေရန် အောက်ဖော်ပြပါ လုပ်ငန်း တာဝန်များကို တာဝန်ယူ ဆောင်ရွက်ရပါမည်။

(၁) စီမံကိန်းနေရာ ရှင်းလင်းခြင်း

(၂) မြေပြိုခြင်းနှင့် အနယ်အနှစ် ထိန်းချုပ်ခြင်း

(၃) စီမံကိန်းမှ ကိရိယာများ ဖယ်ရှားခြင်း တို့ဖြစ်ပါသည်။

၁. ၄ ပတ်ဝန်းကျင်ဖော်ပြချက်

၁. ၄. ၁ စီမံကိန်းနေရာသတ်မှတ်ခြင်း

က။ စီမံကိန်းနေရာနှင့် ပတ်ဝန်းကျင်နယ်မြေသတ်မှတ်ခြင်း

လေ့လာမှုဧရိယာတွင် အောက်ဖော်ပြပါ စီမံကိန်း၏သက်ရောက်မှု ဧရိယာတို့ပါဝင်သည်။

အဓိကထိခိုက်မှုလေ့လာခြင်းဧရိယာ - လေ့လာမှုဧရိယာသည် စီမံကိန်းရေကာတာနေရာ၏ မြစ်အလယ် ဗဟိုမှ အချင်းဝက် ၅ ကီလိုမီတာ အတွင်းဖြစ်သည်။ ၎င်းလေ့လာမှုဧရိယာတွင် မြစ်ကမ်းနစ်ဖက်လုံးရှိ ဆောက်လုပ်ရေးလုပ်ငန်းခွင်အားလုံး နှင့် ရေကာတာ၏ မြစ်အထက်ပိုင်း၊ အောက်ပိုင်းနေရာအားလုံးပါဝင်သည်။

ရေနေသတ္တဝါများထိခိုက်မှုလေ့လာခြင်းဧရိယာ - လေ့လာမှုဧရိယာသည် မြစ်ငယ်မြစ်ပေါ်ရှိ ရဲရွာရေကာတာမှ အဆိုပြုထားသော ဒီးဒုတ်စီမံကိန်းနေရာပါဝင်သည့်အပြင် ဒီးဒုတ်ရေကာတာ၏ မြစ်အောက်ပိုင်း နေရာဖြစ်သော မြစ်ငယ်မြစ်နှင့် ဧရာဝတီမြစ်ဆုံရာနေရာလဲ ပါဝင်ပါသည်။

မြစ်ဘယ်ဘက်ကမ်းရှိ ဓါတ်အားလိုင်းထိခိုက်မှုလေ့လာခြင်းဧရိယာ - လေ့လာမှုဧရိယာသည် ဘယ်ဘက်ကမ်းပေါ်ရှိ ဓါတ်အားလိုင်းတစ်လျှောက် အကျယ် မီတာ ၁၀၀ (ဓါတ်အားလိုင်းကို အလယ်ဗဟိုပြု၍ တစ်ဖက်တစ်ချက်စီတွင် ၅၀မီတာ) ကျယ်ဝန်းသော လေ့လာမှုများပါဝင်ပါသည်။

ကျောက်မိုင်းနေရာထိခိုက်မှုလေ့လာခြင်းဧရိယာ - ကျောက်မိုင်းနေရာတစ်ခုစီ၏ ၁ကီလိုမီတာ ပတ်ချာလည်ကိုလေ့လာမှု ဧရိယာအဖြစ်သတ်မှတ်ကာ ထိခိုက်မှုများကိုလေ့လာပါသည်။

ပတ်ဝန်းကျင်လေ့လာမှု၏ နယ်မြေသတ်မှတ်မှုသည် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ထုံးလုပ်နည်းတွင်ဖော်ပြထားသော ရုပ်ပိုင်းဆိုင်ရာ၊ ဇီဝဗေဒဆိုင်ရာ၊ လူမှု-စီးပွားဆိုင်ရာ၊ ယဉ်ကျေးမှုနှင့် စက္ခုပသာဒဆိုင်ရာ အစိတ်အပိုင်းများပါဝင်ပါသည်။

စီမံကိန်းလေ့လာမှုဧရိယာ၏ ပတ်ဝန်းကျင်ဆိုင်ရာ သတင်းအချက်အလက်များသည် နယ်မြေစုံစမ်းစစ်ဆေးခြင်း နှင့် စာပေပြန်လည်သုံးသပ်ချက်များ ပါဝင်သည်။

၁. ၄. ၂ ရုပ်ပိုင်းဆိုင်ရာ အစိတ်အပိုင်းများ

ရာသီဥတု

မန္တလေးတိုင်းဒေသကြီး၏ ရာသီဥတုသည် ဇွန်လမှ အောက်တိုဘာလတိုင်အောင် မိုးရွာသွန်းစေသော အနောက်တောင် မုတ်သုံလေအားဖြင့်လည်းကောင်း၊ နိုဝင်ဘာလမှ မေလတိုင်အောင် ခြောက်သွေ့သည့် အရှေ့မြောက် လေအေးများဖြစ်သည်။ မုတ်သုန်ကာလနှောင်းပိုင်းသည် ပထမဦးစွာ အေးသော ရာသီကို ယူဆောင်လာသည်။ သို့သော် မတ်လ၊ ဧပြီလနှင့် မေလအတွင်း၌ တခါတရံ ၄၀ ဒီဂရီစင်တီဂရိတ် အထိ အပူချိန်မြင့်တက် လာတတ်သည်။ နှစ်စဉ် မိုးရွာသွန်းမှု မိုးရေချိန်မှာ ၁၀၀၀ - ၁၈၀၀ မီလီမီတာဖြစ်ပြီး လုပ်ငန်းဧရိယာ၏ ရာသီဥတုမှာလည်း မန္တလေးဒေသနှင့် အတူတူပင်ဖြစ်သည်။ ဆိုလိုသည်မှာ မန္တလေးဒေသ၏ အပူချိန်မှာ ၂၇. ၈ ဒီဂရီစင်တီဂရိတ် ဖြစ်၍ ဧပြီလတွင် အမြင့်ဆုံးမှာ ၃၈. ၅ သဃ ဖြစ်ပြီး ဇန်နဝါရီလတွင် အနိမ့်ဆုံးမှာ ၁၃. ၈ ဒီဂရီစင်တီဂရိတ် ဖြစ်ပါသည်။

ပထဝီ အနေအထား

မြစ်ငယ်မြစ်သည် အမရပူရ၌ ဧရာဝတီမြစ်အတွင်းသို့ ကွေ့ကောက်စီးဝင်သည့် ရဲရွာဆည်မှာ ၉၃ ကီလိုမီတာခန့် ရှိသည်။ မြစ်တလျှောက်ရှိ တောင်များသည် ကမ်းနှစ်ဖက်တလျှောက်တွင် အကျယ်အဝန်း အမျိုးမျိုးဖြင့် မြစ်ဝှမ်းလွင်ပြင်ကို ဖြစ်ပေါ်စေသည်။ မြစ်ဝှမ်းတလျှောက်တွင် သစ်တောများ ဖုံးလွှမ်းမှု မရှိပဲ လယ်ယာစိုက်ပျိုးရေးအတွက် အဓိက သုံးသည်။ အဓိက သီးနှံပင်များမှာ သရက်၊ ငှက်ပျောနှင့် သံပရာတို့ဖြစ်ပြီး ဝါဝှမ်း၊ ပဲနှင့် ပြောင်းတို့ကိုလည်း တွေ့ရသည်။ မြစ်ကမ်း တလျှောက်တွင် ကျူပင်များ၊ အပင်ပုများ၊ ချုံပုတ်များနှင့် ပေါင်းပင်များ ဖုံးလွှမ်းလျက်ရှိသည်။ မြစ်ကမ်းပြိုမှုများနှင့် ပက်သက်၍ မိုးကာလတွင် မြစ်ရေတိုက်စားမှု ပြင်းထန်သောကာလများ၌ သိသာထင်ရှားနိုင်လောက်သော ပမာဏတိုင်အောင် ဖြစ်ပေါ်သည်ကို တွေ့ရသည်။

ဘူမိဗေဒ

လုပ်ငန်းစီမံကိန်းနေရာ၏ယေဘုယျ ဘူမိဗေဒဆိုင်ရာ အခြေအနေများမှာ မြစ်ကြောင်းပို့ချမှုဖြင့် လွှမ်းခြုံသော ပါမို တြိုင်ရေးစစ် ဒိုလိုမက်တစ် ထုံးကျောက် (Permo- Triassic dolomitic limestone) များအားဖြင့် ဖြစ်ပေါ်နေသည်ကို တွေ့ရှိနိုင်သည်။

လုပ်ငန်းစီမံကိန်းသည် ရဲရွာ ရေအားလျှပ်စစ် စီမံကိန်းကဲ့သို့သော တူညီသည့် ငလျှင်ရပ်ဝန်းတွင် တည်ရှိသည်။ ရဲရွာ၏ မြေပြင်လှုပ်ခါမှု အရှိန်နှုန်း အမြင့်ဆုံး (PGA) ကို အောက်ပါအတိုင်း အကျဉ်းချုပ် ပြုလုပ်ထားသည်။

လျှောင်ဖြစ်ရပ်	OBE	MCE
ဘေးတိုက်မြေပြင်လှုပ်ခါမှု အရှိန်နှုန်း အမြင့်ဆုံး	0.10 g	0.25 g
အထက်အောက်မြေပြင်လှုပ်ခါမှု အရှိန်နှုန်း အမြင့်ဆုံး	0.07 g	0.17 g

မှတ်ချက်။ OBE = Operating Basis Earthquake, MCE = Maximum Credible Earthquake

မြန်မာနိုင်ငံ မြေငလျှင် ကော်မတီက ၂၀၁၂ ခုနှစ်တွင် ထုတ်ဝေသည့် မြန်မာနိုင်ငံ၏ မြေငလျှင်ရပ်ဝန်း မြေပုံ အသစ်တွင် မြေပြင်လှုပ်ခါမှု အရှိန်နှုန်း အမြင့်ဆုံး (PGA) တန်ဖိုးကို ၄၇၅ နှစ် မြေငလျှင် (နှစ် ၅၀ တွင် ၁၀ % ဖြစ်နိုင်ခြေထက်ပိုလွန်မှု) အတွက် ၀. ၁၁ - ၀. ၂၀ ါ အစီအစဉ်ရှိမည်ဟု အကြံပြုထားသည်။

ဇလဗေဒ

ရဲရွှာ ရေလှောင်တမံနှင့် အဆိုပြု ဒီးဒုတ် ရေအားလျှပ်စစ် စီမံကိန်းအကြား တိုးလာသော ရေသိုလှောင် ပမာဏ ဧရိယာသည် ရဲရွှာ ရေလှောင်တမံ ရေသိုလှောင် ပမာဏ ဧရိယာ၏ ၁% ခန့်ဖြစ်သော ၂၉၀ စတုရန်းကီလိုမီတာသာ ဖြစ်မည်ဟု ခန့်မှန်းတွက်ချက်ရရှိပါသည်။ ဒီးဒုတ် ရေအားလျှပ်စစ် စီမံကိန်း၏ စုစုပေါင်း ရေသိုလှောင် ပမာဏ ဧရိယာသည် ၂၈ ၄၉၆ စတုရန်းကီလိုမီတာ ဖြစ်သည်။ ရဲရွှာ ရေလှောင်တမံမှ စီးထွက်လာသော ရေများသည် ဒီးဒုတ် ရေအားလျှပ်စစ် စီမံကိန်းသို့ စီးဝင်မည်ဟု ယူဆနိုင်ပါသည်။ ရဲရွှာ ရေလှောင်တမံမှ ရေ စီးထွက်မှု ဒီဇိုင်း အမြင့်ဆုံး ရေလွှမ်းမှတ်များသည် ဒီးဒုတ် ရေအားလျှပ်စစ် စီမံကိန်းသို့ ရေ စီးဝင်မှု ဒီဇိုင်း အမြင့်ဆုံး ရေလွှမ်းမှတ်များဟုလည်း ထင်မြင်နိုင်သည်။ ဒီးဒုတ် ရေအားလျှပ်စစ် စီမံကိန်းတွင် ခွင့်ပြုနိုင်သောရေသည် ရဲရွှာ ရေလှောင်တမံမှ စီးထွက်လာခြင်း (ရဲရွှာ ဓာတ်အားပေးရုံနှင့် ရေပိုလွှဲမှ လွှတ်ထားသော) ဖြစ်သည်။

တွင်းထွက်သတ္တုအရင်းအမြစ်များ

စီမံကိန်းနေရာ၏ အဓိကဆောက်လုပ်ရေးနေရာများတွင် ဆောက်လုပ်ရေးတွင် အသုံးပြုသော ထုံးကျောက်နှင့် ကျောက်ခဲများမှအပ အခြားသော တန်ဖိုးကြီးတွင်းထွက်သတ္တုများ မထွက်ရှိပါ။

သဘာဝပတ်ဝန်းကျင် အရည်အသွေး

လေထု အရည်အသွေး

စက်မှုလုပ်ငန်းလုပ်ဆောင်မှုများနှင့် အနီးအနားရှိလမ်းများတွင် ယာဉ်သွားလာမှုများ နည်းပါးမှုတို့ကြောင့် ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံး၏ TSP နှင့် PM-10 အရည်အသွေးမှာ မြန်မာနိုင်ငံ အမျိုးသား ပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) ၏ သတ်မှတ်ချက်များ အောက်လျော့နည်းပါသည်။

အသံဆူညံမှု

ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံး၏ LAeq-1 hr. နေ့အချိန်နှင့် ညအချိန် အခြေခံ အမြင့်ဆုံး ဆူညံမှုအဆင့်မှာ မြန်မာနိုင်ငံ အမျိုးသား ပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး (ထုတ်လွှတ်မှု) လမ်းညွှန်ချက်များ စံနှုန်းများထက် ကျော်လွန်နေပါသည်။

တုန်ခါမှု

ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံး၏ အခြေခံ တုန်ခါမှုအဆင့်မှာ ၂.၀ mm/s ရှိပြီး ဂျာမာန်တုန်ခါမှုလမ်းညွှန်ချက် (Din4150-3, 1999) ထက် များစွာလျော့နည်းနေပါသည်။

မြစ်ရေအရည်အသွေး

ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံး၏ မြစ်ငယ်မြစ်ရေ အရည်အသွေးသည် အလွန်သန့်ရှင်းပြီး DO မြင့်မားစွာပါဝင်ခြင်း၊ BOD5 အလွန်နည်းခြင်း၊ ကြည်လင်မှုမြင့်မားခြင်း၊ အနယ်အနှစ်နည်းပါခြင်း၊ နောက်ကျိုမှုနည်းပါးခြင်း၊ coliform ပါဝင်မှုနည်းပါးခြင်း တို့ဖြစ်ပါသည်။ သို့သော်လည်း TDS၊ total hardness၊ ကာဗွန်နိတ် အယ်ကာလီနှင့် မက်ဂနီဆီယမ် ပါဝင်မှုများ မြင့်မားပါသည်။ ထိုသို့မြင့်မားခြင်းသည် မြစ်၏ ဘူမိအနေအထားဖြစ်သော ထုံးကျောက်များတည်ရှိ ပျော်ဝင်ခြင်းကြောင့် ဖြစ်နိုင်ပါသည်။

ဧရာဝတီမြစ်၏ မြစ်ရေအရည်အသွေးသည် သန့်ရှင်းသော်လည်း ၎င်း၏ ခသူင်သမာ ပါဝင်မှုသည် မြစ်ငယ်မြစ်ထက် မြင့်မားပါသည်။ မြစ်ငယ်မြစ်ထက် အနည်းငယ် နောက်ကျိုပါသည်။ နမူနာကောက်ယူသောနေရာနှင့် တစ်ကီလိုမီတာမျှသာကွာဝေးသော ဧရာဝတီမြစ် ညာဘက်ကမ်းပေါ်တွင် စစ်ကိုင်းမြို့တည်ရှိနေသောကြောင့် ထိုသို့ ညစ်ညမ်းမှုများဖြစ်ပေါ်ခြင်းဖြစ်နိုင်ပါသည်။

မြေအောက်ရေအရည်အသွေး

ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံးတွင် မြေအောက်ရေ နမူနာကောက်ယူမှုနေရာတိုင်း၏ မြေအောက်ရေအရည်အသွေးသည် conductivity အရည်အသွေးမြင့်မားမှုမှလွဲ၍ ကျန်အရည်အသွေးများသည် WHO ၏ မြေအောက်ရေ အရည်အသွေး စံနှုန်းသတ်မှတ်ချက်ထက် လျော့နည်းပါသည်။ TDS နှင့် total hardness ၏ သိပ်သည်းပါဝင်မှုပမာဏသည် ခွင့်ပြုသတ်မှတ်ချက်ထက် အနည်းငယ်မြင့်မားနေပါသည်။ TDS နှင့် total hardness သိပ်သည်းပါဝင်မှုပမာဏမြင့်မားမှုသည် စီမံကိန်းဧရိယာ၏ ထုံးကျောက်ဘူမိဖွဲ့စည်းပုံ အနေအထားကြောင့် ဖြစ်ပေါ်နိုင်ပါသည်။

၁. ၄. ၃ ဇီဝဗေဒဆိုင်ရာ ပါဝင်ပေါင်းစပ်မှုများ

ကုန်းတွင်းပိုင်းဂေဟစနစ်

လေ့လာသည့် နယ်မြေဧရိယာသည် မြေပြန့်တွင်သာမက တောင်တန်းများတွက်ပါ သစ်တောဖုံးလွှမ်းမှု မတွေ့ရပါ။ နယ်မြေဧရိယာသည် ဝါး၊ အပင်ပုများ၊ ခြုံပုတ်များနှင့် ပေါင်းပင်များဖြင့် အလေ့ကျ ပေါက်ရောက်နေသည်ကို တွေ့ရသည်။ နယ်မြေဧရိယာအပေါ်တွင် အမျိုးမျိုးသော သစ်ပင်များသည် ပြန့်ကျဲစွာပေါက်ရောက်နေကြသော်လည်း စိုက်ပျိုးမြေ ဧရိယာများတွင်မူ သစ်သီးပင်များ စိုက်ပျိုးထားရှိသည်။ တနှစ်ပတ်လုံး ရေမပြတ်ပဲ ခြောက်သွေ့၍ စိုက်ပျိုးနိုင်သောမြေအဖြစ်ပုံဆောင်သည်။ ဤမြေအမျိုးအစားသည် ကုန်းတွင်းပိုင်းဂေဟစနစ်ကြွယ်ဝမှုအတွက် အထောက်အပံ့ မပေးနိုင်ပါ။ အထူးသဖြင့် တောရိုင်းတိရစ္ဆာန်များ မရှိပါ။ ထို့ပြင် ငှက်မျိုးစိတ်များလည်း ပေါများမှုမရှိပါ။ အခြားရွေးချယ်နည်းလမ်းအားဖြင့် ဆည် တည်ဆောက်မည့်နေရာများမှ အောက်ဖက်အတော်ဝေးဝေး မြစ်ပိုင်းရှိ သဲသောင်ကျွန်းများပေါ်တွင် အချို့ ငှက်မျိုးစိတ် များကို တွေ့ရပါသည်။ သဲသောင်ကျွန်းများသည် စိုက်ပျိုးပင် ထူထပ်သောကြောင့် ငှက်တို့ ကျင်လည် ကျက်စားရာဖြစ်သည်ကို ထင်ရှားစွာ သိရှိနိုင်သည်။

အထက်ပါ လေ့လာ တွေ့ရှိချက်များအရ ကုန်းတွင်းပိုင်းဂေဟစနစ်သည် မြေပြင် ကွင်းဆင်းလေ့လာချက်များပြုလုပ်၍ အတည်ပြုရန် မလိုအပ်သေးကြောင်း အကြံပြုအပ်ပါသည်။ မြစ် အောက်ဖက် အတော်ဝေးဝေးတွင် ငှက်တို့ ကျင်လည် ကျက်စားရာနေရာနှင့် ဆက်စပ်မှုမရှိသောကြောင့် ငှက်များကို အကျိုးသက်ရောက်မှု မရှိနိုင်သည့်အပြင် လုပ်ငန်းစီမံကိန်း လည်ပတ်မှုကြောင့်လည်း ဆိုရွားသည့် သက်ရောက်မှုများ မဖြစ်နိုင်ပါ။

အဏ္ဏဝါ ဂေဟစနစ်

လေ့လာသည့် နယ်မြေဧရိယာတွင် တည်ရှိနေသော မြစ်၏ ဂေဟစနစ်သည် ရဲရွာ ရေအား လျှပ်စစ်စီမံကိန်းအားဖြင့် ရေစီးနှုန်းပြောင်းလဲခြင်းများ သိသာထင်ရှားစွာ ဖြစ်ပေါ်လာသည်ကို မှတ်သားထား သင့်သည်။ ရေအောက်ပေါင်းပင်များသည် မြစ်ကြမ်းပြင်တွင် ကျယ်ပြန့်ပေါများစွာ ပေါက်ရောက်နေသည်ကို တွေ့ရသည်။ ထိုင်းနိုင်ငံရှိ မြစ်တွင် ရေလှောင်ဆည် ရေအားလျှပ်စစ်စီမံချက်များ လုပ်ငန်းလည်ပတ်ပြီးနောက် ထူးခြားသည့် အချက်များ ဖြစ်ပေါ်လာသည်ကို တွေ့ရသည်။ ဤကဲ့သို့ ရေအောက်ပေါင်းပင် ထူးခြားဖြစ်စဉ်များ၏ သိပ္ပံဆိုင်ရာ ဖြေရှင်းချက်များကို တွေ့ရှိရန် စာပေများတွင် ရှာဖွေရမည် ဖြစ်သည်။

ကွင်းဆင်းလေ့လာစဉ်အတွင်း မြစ်တွင်း ငါးဖမ်းခြင်းလုပ်ငန်းများကို မတွေ့ခဲ့ရပါ။ ကျေးရွာ လူကြီးများ၏ အတည်ပြုချက်အရ အသက်မွေးဝမ်းကြောင်းအတွက် ငါးဖမ်းခြင်း အလေ့အထ မရှိသည်ကို သိရသည်။ ဤအချက်က လေ့လာသည့် နယ်မြေဧရိယာတွင် တည်ရှိနေသော မြစ်တွင် ငါးသယံဇာတ နည်းပါးကြောင်းကို သိရှိရသည်။ အဆိုပါ ကျေးရွာ လူကြီးများကပင် ငါးဖမ်းလုပ်ငန်းများသည် ရဲရွာ ရေလှောင်တမံတွင် ပိုမို လုပ်ကိုင်လေ့ရှိကြသည်ဟု အတည်ပြုကြသည်။ သို့သော် ဧရာဝတီမြစ်၌သာလျှင် ငါးများ ပေါကြွယ်ဝသည်။

၁. ၄. ၄ လူမှု-စီးပွားဆိုင်ရာ ပါဝင်ပေါင်းစပ်မှုများ

မြေယာအသုံးချမှု

စီမံကိန်းလေ့လာမှု၏ စုစုပေါင်းဆောက်လုပ်ရေးနေရာမှာ ၁၇၃. ၆၆ ဧက ရှိပါသည်။ အများဆုံး ၂၉. ၉၂% မှာ သစ်တော ဧရိယာ ဖြစ်ပါသည်။ လေ့လာမှုဧရိယာတွင် သီးနှံမျိုးစုံစိုက်ပျိုးမှုနေရာ ၂၂. ၇၀% နှင့် ဥယျာဉ်ခြံမြေ ဧရိယာများ ၂၀. ၆၃% ပါဝင်ပါသည်။

ကျောက်မိုင်းလေ့လာမှုဧရိယာသည် စုစုပေါင်း ၃၆. ၃၂ ဧက ရှိပြီး (၁) မြေလွတ်မြေရိုင်း (၃၂. ၆၅%) နှင့် (၂) ကျောက်တူးဖော်မည့်နေရာ (၆၇. ၃၅%) ဟူ၍ အမျိုးအစား (၂)မျိုး ပါဝင်ပါသည်။

လေ့လာမှု ဧရိယာ တစ်ဖက်တစ်ချက်လျှင် ၂၂. ၅ မီတာ ရှိသော အဆိုပြုခါတ်အားလိုင်းလေ့လာမှုဧရိယာသည် ၂၄၇ ဧက ဖြစ်ပြီး ၎င်းကို မြေအသုံးပြုမှု အမျိုးအစား (၉) မျိုးခွဲခြားထားပါသည်။ (၁) လမ်း၊ (၂) တပ်မြေ၊ (၃) အစိုးရကောလိပ်၊ (၄) ပလပ်မြေ၊ (၅) သီးနှံစိုက်ခင်း၊ (၆) မြေလွတ်၊ (၇) ဥယျာဉ်ခြံမြေ အမျိုးအစားများ၊ (၈) သစ်တော ဧရိယာနှင့် (၉) ကျောက်မိုင်းတို့ဖြစ်ပါသည်။

ရေအားလျှပ်စစ်စီမံကိန်းအကောင်အထည်ဖော်မှု ပတ်ဝန်းကျင်ရှိ လူမှု-စီးပွားအခြေအနေများ

လေ့လာမှုဧရိယာ၏ လူမှု-စီးပွား အခြေအနေသတင်းအချက်အလက်များသည် ကျေးရွာ ၄ရွာဖြစ်သော မန္တလေးတိုင်းဒေသကြီးအတွင်းရှိ ကျောက်ဆည်မြို့နယ် သရက်ပင်ကျေးရွာ နှင့် ပြင်ဦးလွင်မြို့နယ် ဌက်ကြီးသိုက်ကျေးရွာ၊ မန်းကျည်းအင်းကျေးရွာနှင့် ဝါးနက်ကျေးရွာတို့မှ ကျေးရွာလူကြီးများကို မေးမြန်းခြင်းဖြင့် ရရှိခဲ့ပါသည်။ ၎င်းကျေးရွာများ၏ လူမှု-စီးပွား အခြေအနေများမှ တွေ့ရှိသော အဓိကအချက်အလက်များမှာ အောက်ဖော်ပြပါအတိုင်းဖြစ်ပါသည်။

- လေ့လာမှုဧရိယာတွင် စုစုပေါင်းလူဦးရေ ၂၀၁၈ ဦးနေထိုင်ပြီး အိမ်ထောင်စု စုစုပေါင်း ၄၃၅ အိမ်ထောင်စုတည်ရှိကာ အိမ်ထောင်စုတစ်ခုတွင်ရှိသော ပျမ်းမျှလူဦးရေမှာ ၄-၅ဦး ရှိပါသည်။
- အဆိုပါ ၂၀၁၈ဦးတွင် ၃၃၁ဦး (၁၆% ခန့်)သည် ကျောင်း၊ တက္ကသိုလ်တက်ရောက်နေသူများ ဖြစ်ပါသည်။ ကျန်ရှိသော လူဦးရေ၏ အများစုမှာ ကျောင်းပညာရေးပြီးမြောက်ပြီးသား ဖြစ်ပါသည်။
- လေ့လာမှုဧရိယာ၏ အဓိကအိုမင်းမစွမ်းအုပ်စု၏ အိမ်ထောင်ဦးစီးအသက်များမှာ အသက် ခြောက်ဆယ် အထက်များဖြစ်ပါသည်။ ၎င်းဒေသတွင်းရှိ အိုမင်းမစွမ်းအုပ်စုများကို ထောက်ပံ့ ပေးရန် အထူးအစီအစဉ်များ လည်းမရှိပါ။

- သရက်ပင်ကျေးရွာတွင် နေထိုင်သော အိမ်ထောင်စုတစ်စုသည်သာ မွန်လူမျိုးဖြစ်ပြီး ကျန်ရှိသော ကျေးရွာနေလူထုသည် ဗမာလူမျိုးဖြစ်ပြီး ဗုဒ္ဓဘာသာကိုးကွယ်ကြပြီး မြန်မာစကား ပြောဆိုကြပါသည်။
- လေ့လာမှုဧရိယာတွင် ကျား၊ မဆိုင်ရာ ပြဿနာရပ်များဖြစ်ပေါ်ခြင်းမရှိပါ။ ယောကျာ်းနှင့် မိန်းမ အကြားရှိ အလုပ်အဆင့်၊ အလုပ်နေရာနှင့် ဆုံးဖြတ်ချက်များသည် ရုပ်ပိုင်းဆိုင်ရာ အခြေအနေ၊ လူမှုရေးဖွဲ့စည်းမှုများနှင့် ထုံးထမ်းထလေ့များအပေါ်မူတည်၍ ခွဲခြားသတ်မှတ်ကြပါသည်။ အချို့သော ရှုထောင့်များအပေါ် ဆုံးဖြတ်ချက်များချမှတ်ခြင်းတွင် ယောကျာ်းနှင့် မိန်းမ၏ သဘောထားများ ပေါင်းစပ်ခြင်း သို့မဟုတ် ဝေမျှခြင်းဖြင့် ဆုံးဖြတ်ကြပါသည်။
- ကျေးရွာလေးရွာ၏ အိမ်ထောင်စုအများစုတွင် စိုက်ပျိုးရေးသည် အဓိကစီးပွားရေးဖြစ်ပြီး ဌက်ကြီးသိုက် ကျေးရွာ၏ အိမ်ထောင်စု ၅၀%သည်လည်ကောင်း၊ သရက်ပင်ကျေးရွာ၏ အိမ်ထောင်စု ၁၀၀%သည် လည်းကောင်း အသီးသီး စိုက်ပျိုးရေးပြုလုပ်သူများဖြစ်ပါသည်။ အခြားသော စီးပွားရေးလုပ်ငန်းများမှာ ကုန်သွယ်ခြင်း သို့မဟုတ် အသေးစား စီးပွားရေးလုပ်ငန်းများ၊ အစိုးရဝန်ထမ်းများနှင့် လခစားအလုပ်သမားများ ဖြစ်ပါသည်။
- ကျေးရွာလူထုသည် သမာရိုးကျ စိုက်ပျိုးရေးအလေ့အထများကိုသာ အသုံးပြုကြပါသည်။ သို့သော် ၎င်းတို့သည် ကောက်ရိတ်သိမ်းမှုများကို နွားများဖြင့်သာ လုပ်ကိုင်ကြသည်။ စိုက်ပျိုးရေးမဟုတ်သော ထုတ်လုပ်မှုတွင် ဝါးမှပြုလုပ်သော ခြင်းတောင်းယက်လုပ်ခြင်းကို အိမ်ထောင်စုအများစု လုပ်ကိုင်ကြပါသည်။
- ကျေးရွာလေးရွာတွင် အိမ်ထောင်စုတစ်ခု၏ တစ်နှစ်ပျမ်းမျှ ဝင်ငွေသည် သိသာစွာ ကွဲပြားခြင်းမရှိပါ။ တစ်နှစ်ပျမ်းမျှ အနိမ့်ဆုံးဝင်ငွေသည် ဝါးနက်ကျေးရွာမှ အမေရိကန်ဒေါ်လာ ၂၀၄၅ ဒေါ်လာဖြစ်ပြီး အမြင့်ဆုံးဝင်ငွေမှာ သရက်ပင်ကျေးရွာမှ အမေရိကန်ဒေါ်လာ ၂၂၅၈ ဒေါ်လာဖြစ်ပါသည်။ လယ်ယာမလုပ်ခြင်းမှ ရရှိသော ဝင်ငွေမှာ လယ်ယာပြုလုပ်ခြင်းမှ ရရှိသော ဝင်ငွေထက်ပို၍များပြားပြီး အိမ်ထောင်စု ဝင်ငွေ၏ ၅၃% မှ ၅၈% အထိရရှိပါသည်။
- ကျေးရွာလေးရွာရှိ အိမ်ထောင်စုများ၏ တစ်နှစ်ပျမ်းမျှ သုံးစွဲငွေ သည် ဝင်ငွေထက် အနည်းငယ်ပိုမိုနေ၍ သုံးစွဲငွေ၏ အနည်းဆုံးမှာ ဝါးနက်ကျေးရွာမှ အမေရိကန်ဒေါ်လာ ၁ယ၉၄၀ဒေါ်လာ ဖြစ်ပြီး အများဆုံးမှာ မန်ကျည်းအင်းကျေးရွာမှ အမေရိကန်ဒေါ်လာ ၂၀၆၄ ဒေါ်လာဖြစ်ပါသည်။
- ကျေးရွာများတွင် အကြွေးရှိသော အိမ်ထောင်စုသည် စုဆောင်းငွေရှိသော အိမ်ထောင်စု အများစုထက် ပိုမိုများပြားသည်။
- ကျေးရွာလေးရွာရှိမြေနေရာများကို အိမ်ဆောက်ရန်နှင့် စိုက်ပျိုးရန်အတွက် အသုံးပြု ကြပါသည်။ စုစုပေါင်းကျေးရွာဧရိယာ၏ လေးပုံပုံ သုံးပုံမှာ စိုက်ပျိုးမြေဖြစ်ပြီး ကျန်တစ်ပုံမှာ နေထိုင်ရာနေရာအဖြစ် အသုံးပြုကြပါသည်။ အိမ်ထောင်စုတစ်ခု၏ ပျမ်းမျှမြေပိုင်ဆိုင်မှုမှာ ၂. ၅၅ ဧက မှ ၃. ၃၃ ဧက ဖြစ်ပါသည်။
- ကျေးရွာလေးရွာတွင် ငါးလုပ်ငန်း သို့မဟုတ် အဏ္ဏဝါလုပ်ငန်းလုပ်ကိုင်သူ တစ်ဦးတစ်ယောက်မှ မရှိပါ။ စီမံကိန်းပြီးဆုံးသွားပါက ဒီးဒုတ်ရေကာတာ၏ အနောက်ဘက်တွင်ရှိသော တိုးချဲ့ ထားသောမြစ်တွင် ငါးဖမ်းလုပ်ငန်းနှင့် အဏ္ဏဝါလုပ်ငန်းများ ပေါ်ပေါက်ရန် အခွင့်အလမ်းများ ရရှိလာနိုင်ပါသည်။

- ကျေးရွာလေးရွာတွင် တွေ့ရလေ့ရှိသော ကူးစက်ရောဂါများမှာ အအေးမိခြင်း၊ အစာအိမ်ရောဂါ၊ တီဘီ၊ ဌက်ဖျားနှင့် သွေးလွန်တုပ်ကွေးတို့ဖြစ်ပါသည်။
- မြေအောက်ရေနှင့် မြစ်ရေတို့သည် အဓိက အိမ်သုံးရေအဖြစ် ထောက်ပံ့သော ရေအရင်းအမြစ် ၂ခု ဖြစ်ပါသည်။
- သရက်ပင်ကျေးရွာတွင်သာ ကျန်းမာရေးဆေးပေးခန်းရှိပါသည်။ ကျေးရွာလေးရွာ၏ အားထားနေရသော အုန်းကြောမြို့နယ်ရှိပုဂ္ဂလိကဆေးခန်းသည် ၁၂. ၁၇ မိုင်အကွာ၊

ကြောင်မဲမြို့မှ ဆေးရုံငယ်သည် ၁၇.၂၁ မိုင်အကွာနှင့် မန်းလေးဆေးရုံကြီးသည် ၃၆မိုင်အကွာအဝေးတွင် တည်ရှိကြပါသည်။

- ကျေးရွာအားလုံးတွင် မူကြိုနှင့် မူလတန်းကျောင်းများ တည်ရှိပါသည်။ သို့သော် မန်ကျည်းအင်း ကျေးရွာ တွင်သာ အလယ်တန်းကျောင်း တည်ရှိပါသည်။ ကျေးရွာလေးရွာတွင် ဘုန်းကြီးကျောင်းတစ်ကျောင်းနှင့် သီချိုင်းတစ်ခုရှိပါသည်။

ဓါတ်အားလိုင်းတစ်လျောက်ရှိ လူမှု-စီးပွားအခြေအနေများ

မဟာဓါတ်အားလိုင်းတစ်လျောက်တွင် တည်ရှိနေသော အင်ကုန်းနှင့် ဖလမ်းပင် ကျေးရွာ ၂ရွာတည်ရှိနေပြီး ၄င်းကျေးရွာများသည် စဉ့်ကိုင်မြို့နယ်တွင် တည်ရှိပါသည်။

အင်ကုန်းကျေးရွာသည် လွန်ခဲ့သော နှစ်ပေါင်း ၇၀ခန့်တွင် တည်ထောင်ခဲ့ပြီး အိမ်ထောင်စု (၇၈) အိမ်ထောင်စု ရှိပါသည်။ ကျေးရွာလူထုသည် မြန်မာလူမျိုး၊ ဗုဒ္ဓဘာသာ ကိုးကွယ်ကြပြီး အခြား လူမျိုးခွဲများ မပါရှိပါ။ စွန်ရဲကန်သည် အင်ကုန်းကျေးရွာ အနီးတွင် တည်ရှိပြီး ခရီးသွား စွဲဆောင်မှုနေရာတစ်ခုဖြစ်ပါသည်။ ၄င်းကျေးရွာတွင် တံငါးလုပ်ငန်းသည် အဓိကမိသားစု စီးပွားရေးဖြစ်ပါသည်။ အင်ကုန်းရွာတွင် မူလတန်းကျောင်း ရှိပြီး ကျေးရွာမှ (၁) ကီလိုမီတာအနီးရှိ စွန်ရဲကျေးရွာတွင် အလယ်တန်းကျောင်း တည်ရှိပါသည်။

ဖလမ်းပင် ကျေးရွာသည် အင်ကုန်းကျေးရွာ၏ မြောက်ဘက်တွင် တည်ရှိနေပြီး အဆိုပြု မဟာဓါတ်အားလိုင်းသည် ကျေးရွာ အနီးမှ ဖြတ်သန်းသွားမည် ဖြစ်ပါသည်။ ကျေးရွာတွင် လူဦးရေ (၄၀၀) ရှိပြီး အိမ်ထောင်စု (၇၁) အိမ်ထောင်စု ရှိပါသည်။ ၄င်းကျေးရွာလူထုသည် မြန်မာလူမျိုးဖြစ်ပြီး ဗုဒ္ဓဘာသာ ကိုးကွယ်ကြပါသည်။ ဝါးခုတ်ခြင်းနှင့် ထင်းရှာခြင်းတို့သည် အဓိကမိသားစု စီးပွားရေး ဖြစ်ပြီး အိမ်ထောင်စု (၁၀)စုတွင် ကိုယ်ပိုင်လယ်ယာရှိပြီး နှမ်း၊ ပဲနှင့် ဝါ စိုက်ပျိုးကြပါသည်။ ကြက်နှင့် ဝက်ကို စားသုံးရင် မွေးမြူပြီး ဆိတ်ကို ရောင်းချရန်နှင့် နွားကို စိုက်ပျိုးရေးလုပ်ငန်းတွင် ခိုင်းစေရန် မွေးမြူကြပါသည်။

ဖလမ်းပင်ကျေးရွာသည် စီမံကိန်းနှင့် ဝေးပါသည်။ ကျေးရွာအနီးတွင် မြစ်ချောင်းမရှိပဲ (၆.၅) ကီလိုမီတာ ကွာဝေးသော စွန်ရဲကန်မှ ဆည်မြောင်းရေသွင်းကာ ရယူပါသည်။ ကျေးရွာတွင် မူလတန်းကျောင်းတစ်ခု တည်ရှိပြီး (၅) ကီလိုမီတာဝေးသော စွန်ရဲကျေးရွာတွင် အလယ်တန်းကျောင်း တည်ရှိပါသည်။ အနီးဆုံး ကျန်းမာရေး ဆေးပေးခန်းသည် (၃) ကီလိုမီတာ ကွာဝေးသော နတ်ရေကန် ကျေးရွာတွင် တည်ရှိပါသည်။

လမ်းပန်းဆက်သွယ်ရေး

ရဲရွာရေကာတာမှ ကမ်းတစ်လျောက်တွင် လမ်းကျဉ်း ၂လမ်းရှိပါသည်။ ညာဘက်ကမ်းပေါ်ရှိ ကွန်ကရစ်လမ်းကျဉ်းလေးမှာ မန္တလေးသို့ဆက်သွယ်ထားသော လမ်းဖြစ်ပါသည်။ ဘယ်ဘက်ကမ်းပေါ်ရှိ မခင်းရသေးသောလမ်းမှာ စစ်ကိုင်းမြို့ရှိ ကျောက်ဆည်-မန္တလေးလမ်းနှင့် ဆက်သွယ်ထားပါသည်။ ကမ်းဘယ်ဘက်ခြမ်းတွင်နေထိုင်သော ကျေးရွာလူထုသည် ကမ်းညာဘက်ခြမ်းကို လှေဖြင့်သာ ဖြတ်သန်းကြပါသည်။ လှေလာမှုဇရိယာတွင် ပုံမှန်ပြေးဆွဲနေသော ပို့ဆောင်ရေး ဘတ်စ်ကားဝန်ဆောင်မှု မရှိပါ။

၁.၄.၅ ယဉ်ကျေးမှုဆိုင်ရာ ပါဝင်မှုများ

ရေအားလျှပ်စစ်စီမံကိန်း လှေလာမှုဇရိယာတွင် ၄ုက်ကြီးသိုက်ကျေးရွာအနီးတွင် ဘုန်းကြီးကျောင်း တစ်ကျောင်း တည်ရှိပါသည်။ ၎င်းဘုန်းကြီးကျောင်းသည် ခန့်မှန်းချေသက်တမ်း နှစ် ၉၇၀ကျော်ရှိပြီး ဖြစ်ပါသည်။ ထိုဘုန်းကြီးကျောင်းဝင်းတွင် အနော်ရထာဘုရင် တည်ထားကိုးကွယ်ခဲ့သော စေတီ၊ ဘုန်းကြီးကျောင်း နှင့် သံဃာများ သတင်းသုံးရာကျောင်းဆောင်တို့ ပါဝင်ပါသည်။

၁. ၄. ၆ စက္ကူပသာဒဆိုင်ရာ ပါဝင်မှုများ

စီမံကိန်းဧရိယာ၏ အဓိက စက္ကူပသာဒဆိုင်ရာပါဝင်မှုများမှာ တောင်တန်းများ၊ မြစ်၊ စိုက်ပျိုးမြေ၊ လစ်လပ်မြေ၊ သဘာဝစိုက်ပျိုးမြေများနှင့် မြစ်ငယ်မြစ်ကမ်း တစ်လျှောက် တို့ဖြစ်ပါသည်။

၁. ၅ ပတ်ဝန်းကျင်အပေါ်သက်ရောက်မှုနှင့် ဘေးအန္တရာယ်ရှိမှု ဆန်းစစ်ခြင်းနှင့် လျှော့ချစေရေး နည်းလမ်းများ

၁. ၅. ၁ ဆန်းစစ်ခြင်းအတွက်နယ်မြေသတ်မှတ်ခြင်း

သက်ရောက်မှုဧရိယာရှိ ပြဿနာတစ်ခုချင်းဆီကို ဇယား ၁. ၅-၁ တွင်ဖော်ပြထားပါသည်။

ဇယား ၁. ၅-၁ သက်ရောက်မှုဧရိယာ၏ အဓိပ္ပါယ်ဖွင့်ဆိုချက်များ

လူမှုပတ်ဝန်းကျင်ဆိုင်ရာ ပြဿနာ	သက်ရောက်မှုဧရိယာ
ဆူညံမှု	ဆူညံမှုထုတ်လွှတ်သောနေရာ၏ ဆူညံမှုသည် လက်ခံနိုင်သော အဆင့်အနေ အထား ရှိပါသည်။
တုန်ခါမှု	တုန်ခါမှုထုတ်လွှတ်သောနေရာ၏စွမ်းအင်လှိုင်းထုတ်လွှတ်မှုသည် လက်ခံနိုင် သောအဆင့်အနေအထား ရှိပါသည်။
ဆောက်လုပ်ရေးလုပ်ငန်းခွင်ရှိ ဖုန်မှုန့်	ဆောက်လုပ်ရေးလုပ်ငန်းခွင်မှထုတ်လွှတ်သော ဖုန်မှုန့်အဆင့်သည် လက်ရှိ နဂိုမူလအခြေအနေထက် ပိုမိုများပြားလာနိုင်ပါသည်။
ဆက်သွယ်ရေးယာဉ်များကြောင့် ထွက်ပေါ်လာသော ဖုန်မှုန့်	လမ်းတစ်လျှောက်ယာဉ်များသွားလာမှုမှထုတ်လွှတ်သော ဖုန်မှုန့်အဆင့်သည် လက်ရှိ နဂိုမူလအခြေအနေထက် ပိုမိုများပြားလာနိုင်ပါသည်။
မြစ်တူးဖော်ခြင်း သို့မဟုတ်သောင်တူးခြင်း	မြစ်တူးဖော်ခြင်း သို့မဟုတ် သောင်တူးခြင်းလုပ်ငန်းခွင် မြစ်အောက်ပိုင်းတွင် ပျံ့နှံ့အမှုန် ထွက်ပေါ်လာမှုသည် မမြင်ရပါ။
ကျောက်မိုင်းတူးဖော်ခြင်း	ကျောက်မိုင်းတူးဖော်ခြင်းနေရာ၏ ဆူညံမှုနှင့် တုန်ခါမှုနှုန်းသည် မြင့်မားပါသည်။
ဆောက်လုပ်ရေးလုပ်ငန်းခွင်အမှိုက်များ စွန့်ပြစ်နေရာ	အမှိုက်စွန့်ပြစ်နေရာနှင့် ထိခိုက်လွယ်သောနေရာများ တို့ဖြစ်ပါသည်။
အဏ္ဏဝါ ဂေဟစနစ်	ဒီးဒုတ်ရေကာတာမှရဲရွာရေကာတာအထိမြစ်တစ်လျှောက်လုံးဖြစ်ပါသည်။ ထိခိုက်မှုဆန်းစစ်ခြင်းသည် ထိခိုက်မှုဧရိယာနှင့်ဆက်စပ်နေသော ဂေဟစနစ် အားလုံးကို ခြုံငုံမိရန် တိုးချဲ့သွားမည်ဖြစ်ပါသည်။
ကုန်းတွင်းပိုင်းဂေဟစနစ်	စီမံကိန်းအဆောက်အဦးများနှင့်ဆောက်လုပ်ရေးလုပ်ငန်းများလုပ်ဆောင်ရန် ဧရိယာတစ်လုံးခုကို ဝယ်ယူပါမည်။ ရေအားလျှပ်စစ်စီမံကိန်းတွင် အုပ်ချုပ် ရေးပိုင်း၊ ရေအားလျှပ်စစ်အကောင်အထည်ဖော်ရေးနှင့်ထောက်ပံ့ပေးသော အပိုင်းဟူ၍ပါဝင်သည်။ ဓါတ်အားလိုင်းတွင်အလယ်ဗဟိုမှစ၍တစ်ဖက်လျှင် မီတာ ၂၀ သို့မဟုတ် ဆောက်လုပ်ရေးတစ်လျှောက်လုံးဖြစ်ပါသည်။
ရေအရည်အသွေး	ဒီးဒုတ်ရေကာတာမှရဲရွာရေကာတာအထိ မြစ်တစ်လျှောက်လုံးဖြစ်ပါသည်။
ပတ်ဝန်းကျင်အခြေခံ လေထုအရည်အသွေး	ဆောက်လုပ်ရေးလုပ်ငန်းခွင်များအနီးရှိကျေးရွာများ
ပတ်ဝန်းကျင်အခြေခံ ဆူညံမှုအဆင့်	ဆောက်လုပ်ရေးလုပ်ငန်းခွင်များအနီးရှိကျေးရွာများ
မြေယာသိမ်းဆည်းခြင်း	စီမံကိန်းတည်ဆောက်မှုကြောင့် ဧရိယာတစ်ခုလုံး ထိခိုက်မြေများ
မြစ်ကမ်းနားစိုက်ပျိုးရေး	မြစ်ကမ်းတစ်လျှောက်ရှိ သစ်ပင်စိုက်ပျိုးရေး ဧရိယာ
အမြင်အာရုံအရည်အသွေးကိုပျက်စီး စေခြင်း	မြစ်တစ်ခုလုံးနှင့် မြစ်တစ်လျှောက်
ရှေးဟောင်းဆိုင်ရာသက်ရောက်မှုများ	မြစ်တစ်ခုလုံးနှင့် မြစ်တစ်လျှောက်

လူမှုပတ်ဝန်းကျင်ဆိုင်ရာ ပြဿနာ	**သက်ရောက်မှုဧရိယာ**
ယဉ်ကျေးမှုဆိုင်ရာ သက်ရောက်မှုများ	ဆောက်လုပ်ရေးလုပ်ငန်းခွင်များအနီးရှိကျေးရွာများ
ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု ဧရိယာ	ဆောက်လုပ်ရေးကာလတစ်လျောက်ရှိ ဆောက်လုပ်ရေးဧရိယာအားလုံး လုပ်ငန်းလည်ပတ်စဉ် မြစ်တစ်ခုလုံး

ပတ်ဝန်းကျင်နှင့် လူမှု-စီးပွားပြဿနာများ ထိခိုက်မှုဆန်းစစ်ခြင်း အပေါ်မူတည်၍ ယာယီနယ်မြေသတ်မှတ်ခြင်းကို ဇယား ၁. ၅-၂တွင် ဖော်ပြထားပါသည်။

ဇယား ၁. ၅-၂ ယာယီနယ်မြေသတ်မှတ်ခြင်း

လူမှုပတ်ဝန်းကျင်ဆိုင်ရာ ပြဿနာ	**သက်ရောက်မှုဧရိယာ**
ဆူညံမှု	ဆောက်လုပ်ရေးကာလကျော်လွန်၍ နေ့စဉ်နှင့် နာရီအလိုက် ပျမ်းမျှဆူညံမှု အဆင့်
တုန်ခါမှု	ဆောက်လုပ်ရေးကာလကျော်လွန်၍ အမြင့်ဆုံးသောအမှုန်အလျင် mm/s
ဆောက်လုပ်ရေးလုပ်ငန်းခွင်ရှိ ဖုန်မှုန့်	ဆောက်လုပ်ရေးကာလကျော်လွန်၍ နေ့စဉ်နှင့် နာရီအလိုက် ပျမ်းမျှ ဖုန်မှုန့် အဆင့်
ဆက်သွယ်ရေးယာဉ်များကြောင့် ထွက်ပေါ်လာသော ဖုန်မှုန့်	ဆောက်လုပ်ရေးကာလကျော်လွန်၍ နေ့စဉ်နှင့် နာရီအလိုက် ပျမ်းမျှ ဖုန်မှုန့် အဆင့်
မြစ်တူးဖော်ခြင်း သို့မဟုတ် သောင်တူးခြင်းကြောင့်ဖြစ်ပေါ် လာသော နောက်ကျိမှု	မြစ်တူးဖော်ခြင်း သို့မဟုတ် သောင်တူးခြင်းကာလကို ကျော်လွန်၍ နေ့စဉ်နှင့် နာရီအလိုက် နောက်ကျိမှုအဆင့်
မြေဆီလွှာညစ်ညမ်းခြင်း	စီမံကိန်းသက်တမ်းထက်ကျော်လွန်
အဏ္ဏဝါ ဂေဟစနစ်	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကို ကျော်လွန်
ကုန်းတွင်းပိုင်းဂေဟစနစ်	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကို ကျော်လွန်
ရေအရည်အသွေး	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကို ကျော်လွန်
ပတ်ဝန်းကျင်အခြေခံ လေထုအရည်အသွေး	ဆောက်လုပ်ရေးကာလကိုကျော်လွန်၍ နေ့စဉ်နှင့် နာရီအလိုက် ပျမ်းမျှ လေထု အရည်အသွေး ပါရာမီတာများ
မြေယာသိမ်းဆည်းခြင်း	စီမံကိန်းပြင်ဆင်ရေးကာလ
မြစ်ကမ်းနားစိုက်ပျိုးရေး	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကိုကျော်လွန်
အမြင်အာရုံအရည်အသွေးကိုပျက်စီးစေခြင်း	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကိုကျော်လွန်
ရှေးဟောင်းဆိုင်ရာသက်ရောက်မှုများ	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကိုကျော်လွန်
ယဉ်ကျေးမှုဆိုင်ရာ သက်ရောက်မှုများ	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကိုကျော်လွန်
ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု ဧရိယာ	ဆောက်လုပ်ရေးကာလနှင့်လုပ်ငန်းလည်ပတ်ခြင်းကာလကိုကျော်လွန်

ပတ်ဝန်းကျင်ဆိုင်ရာပြဿနာတစ်ခုဆီတိုင်းတွင် ထိခိုက်မှုဧရိယာရှိပါသည်။ ထိခိုက်လွယ်သောနေရာ၏ သက်ရောက်မှုဧရိယာတွင် လူ၊ ဂေဟစနစ်နှင့် သဘာဝပြဿနာများအပေါ်မူတည်၍ ဂုဏ်သတ္တိများပါဝင်ပါသည်။ ထိခိုက်လွယ်သောနေရာ၏ သက်ရောက်မှုများသည် ပတ်ဝန်းကျင်ဆိုင်ရာ သက်ရောက်မှုများနှင့် ဆက်စပ်နေကြပါသည်။

အဓိကပြဿနာနှင့် ပတ်ဝန်းကျင်ဆိုင်ရာပါဝင်မှုတန်ဖိုးများရွေးချယ်ခြင်း

စီမံကိန်း၏ ပတ်ဝန်းကျင်ဆိုင်ရာပါဝင်မှုတန်ဖိုး **(VECs)** တွင် အဆိုပြုစီမံကိန်း ဖွံ့ဖြိုးတိုးတက်ရေးအတွက် အများပြည်သူများ၊ အစိုးရ သို့မဟုတ် ကျွမ်းကျင်ပညာရှင်များနှင့် ပူပေါင်းဆောင်ရွက်ကာ ၎င်းတို့နှင့် ဆက်စပ်၍ ပတ်ဝန်းကျင်နှင့် လူမှုရေးရာဆိုင်ရာ ကိစ္စရပ်များကို လုပ်ဆောင်ရပါမည်။ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း **(EIA)**

တွင် **VECs** ၏လိုအပ်ချက်များဖြစ်သည့် အစိုးရမှလိုအပ်သည့် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း လိုအပ်ချက်များ၊ စီမံကိန်း၏သဘာဝ၊ ဆောက်လုပ်ရေးလုပ်ကိုင်မှုများ၊ စီမံကိန်း အကောင်အထည်ဖော်မှုကြောင့် ဖြစ်ပေါ်လာသော ပတ်ဝန်းကျင် လူမှု-စီပွားဆိုင်ရာနှင့် စီမံကိန်းကြောင့် သက်ရောက်မှုများဖြစ်ပေါ်သည့် ယဉ်ကျေးမှုဆိုင်ရာဇရိယာနှင့် တိုင်းဒေသကြီးအတွင်းရှိ ရေအားလျှပ်စစ်ထုတ်လုပ်မှု စီမံကိန်းများ ဖွံ့ဖြိုးတိုးတက် မှုများကို ခြုံငုံပါဝင်စေပါသည်။ **VECs** တွင်ဖော်ပြချက်များနှင့် ပါဝင်ပတ်သက်သူများအား သက်ဆိုင်ရာ ပြသာနာများအား တင်ပြရှင်းလင်းခြင်းနှင့် ပါဝင်ပတ်သက်သူများ၏ အကြံပေးချက်များ အပေါ်မူတည်၍ နိဂုံးချုပ်ရမည်ဖြစ်ပါသည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းကို အဓိကပြသာနာအဖြစ်ဖြေရှင်းပြီး **VECs** သည် **ESIA** လုပ်ဆောင်မှုကိုခြုံငုံမိကြောင်းကို ဇယား ၁. ၅-၃တွင်ဖော်ပြထားပါသည်။ ဖြစ်ပေါ်နိုင်သော စီမံကိန်း သက်ရောက်မှုများနှင့် ဆက်စပ်သက်ရောက်မှုများ၏ အရေအတွက်နှင့် အရည်အသွေးအပေါ်မူတည်၍ **VEC** တစ်ခုစီအတွက် တစ်ခုသို့မဟုတ် တစ်ခုထက်ပိုသော ပါရာမီတာများကို ရွေးချယ်ရပါမည်။ တိုင်းတာမှုများ၏ ရလဒ်များကို **VEC** ၏ ထိခိုက်မှုအဆင့်နှင့် ပမာဏတို့ပြောင်းလဲမှုသတ်မှတ်ရာတွင် အသုံးပြုပါမည်။ ဖြစ်နိုင်ပါက တိုင်းတာရရှိသော ပါရာမီတာတစ်ခုချင်းဆီတိုင်း၏ စံနှုန်းများကို သတ်မှတ်ပါမည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း **(EIA)** သည် **VECs** တွင်ဖြစ်ပေါ်သော စီမံကိန်း၏ တိုက်ရိုက်သက်ရောက်မှုများကို ခြုံငုံမိပြီး **VECs** ၏ အနာဂတ်စီမံကိန်းထိခိုက်မှုများ၏ တိုက်ရိုက်သက်ရောက်မှုများ သို့မဟုတ် ဆက်စပ်သက်ရောက်များကိုပါ ခြုံငုံမိပါသည်။

ဇယား ၁. ၅-၃ စီမံကိန်းတည်ဆောက်ရေးနှင့် လုပ်ငန်းလည်ပတ်ရေးကာလများ၏ VECs

VEC	တည်ဆောက်ရေးနှင့် လုပ်ငန်းလည်ပတ်ရေးကာလအတွင်း အဓိက ပါဝင် ပတ်သက်မှု
တည်ဆောက်ရေးကာလ	
လေထုအရည်အသွေး	ကျောက်ခွဲခြင်း၊ စီမံကိန်းနေရာရှင်းလင်းခြင်း၊ ကျောက်မိုင်းလုပ်ငန်း လုပ်ဆောင်ခြင်း၊ ပို့ဆောင်ရေးယာဉ်များသွားလာခြင်းနှင့်ဆောက်လုပ်ရေးယန္တရားကြီးများလည်ပတ်ခြင်း တို့ကြောင့် လေထုညစ်ညမ်းမှုများ တိုးပွားလာနိုင်ပါသည်။
ဆူညံမှု	ဆောက်လုပ်ရေးလုပ်ငန်းနေရာ၊ ကျောက်မိုင်းတွင်းနှင့် လူနေထိုင်ရာနေရာ အနီးအနားတွင် ပို့ဆောင်ရေးများ လုပ်ကိုင်ခြင်းများကြောင့် ပတ်ဝန်းကျင်ဆူညံမှုများ တိုးပွားလာနိုင်ပါသည်။
တုန်ခါမှု	ဆောက်လုပ်ရေးလုပ်ငန်းနေရာ၊ ကျောက်မိုင်းတွင်းနှင့် လူနေထိုင်ရာနေရာ အနီးအနားတွင် ပို့ဆောင်ရေးများ လုပ်ကိုင်ခြင်းများကြောင့် တုန်ခါမှုများတိုးပွားလာ နိုင်ပါသည်။
မြစ်ရေ အရည်အသွေး	မြစ်အတွင်း ဆောက်လုပ်ရေးလုပ်ငန်းများပြုလုပ်ခြင်း နှင့် မြေကြမ်းပြင်တူးဖော်ခြင်း သို့မဟုတ် သောင်တူးခြင်းတို့ကြောင့် မြစ်ရေနောက်ကျိမှုများပြားလာနိုင်ပါသည်။
အဏ္ဏဝါဂေဟစနစ်နှင့် ငါး	မြစ်အတွင်း ဆောက်လုပ်ရေးလုပ်ငန်းများပြုလုပ်ခြင်း နှင့် မြေကြမ်းပြင်တူးဖော်ခြင်း သို့မဟုတ် သောင်တူးခြင်းတို့ကြောင့် ရေနေသတ္တဝါများ ဆုံးရှုံးခြင်းနှင့် ငါးဖမ်းလုပ်ငန်း အတားအဆီးဖြစ်ခြင်းတို့ ဖြစ်ပေါ်နိုင်ပါသည်။
ရေကြောင်းပို့ဆောင်ရေး	မြစ်အတွင်း ဆောက်လုပ်ရေးလုပ်ငန်းများပြုလုပ်ခြင်း နှင့် မြေကြမ်းပြင်တူးဖော်ခြင်း သို့မဟုတ် သောင်တူးခြင်းတို့ကြောင့် ရေကြောင်းဆက်သွယ်ရေးများ အတားအဆီးဖြစ်နိုင်ပါသည်။
ပို့ဆောင်ဆက်သွယ်ရေးနှင့် လမ်းအန္တရာယ်ကင်းရှင်းရေး	လုပ်ငန်းသုံးပစ္စည်းများ သယ်ယူပို့ဆောင်ခြင်းကြောင့် ယာဉ်သွားလာမှုများပြား လာနိုင်ပါသည်။
မြေယာအသုံးချမှု	စီမံကိန်းတည်ဆောက်ခြင်းနှင့်ကျောက်မိုင်းတူးဖော်ခြင်းတို့အတွက်မြေပေးလျှော်ခြင်းများပြု လုပ်ကာ မြေပိုင်ရှင်များထံမှ မြေယာပိုင်ဆိုင်မှုများကို လွှဲပြောင်းယူမည်ဖြစ်ပါသည်။
စွန့်ပြစ်အမှိုက်	အမှိုက်စွန့်ပြစ်ရာနေရာတွင် မသင့်တော်သော စီမံခန့်ခွဲမှုများပြုလုပ်ခြင်းဖြင့် အမှိုက်စွန့်ပြစ်ရာ နေရာ ပျက်စီးမှုများ ဖြစ်ပေါ်စေပါသည်။

လုပ်ငန်းလည်ပတ်မှုကာလ	
အသက်မွေးဝမ်းကြောင်းမှု	မြစ်ကိုပိတ်ကာ စီမံကိန်းတည်ဆောက်မှုပြုလုပ်ခြင်းဖြင့် မြစ်ရေမြင့်တက်လာနိုင်ကာ မြစ်ကမ်းများပေါ်ရှိစိုက်ပျိုးရေးလုပ်ငန်းများ ဆုံးရှုံးနိုင်ပါသည်။
ငါးလုပ်ငန်း	ရေကာတာအပေါ်မှ မြစ်ရေပြောင်းလဲမှုများဖြစ်ပေါ်မှုကြောင့် မြစ်အပေါ်ပိုင်းနှင့် မြစ်အောက်ပိုင်းရှိ ငါးနှင့် အဏ္ဏဝါဂေဟစနစ် ထိခိုက်မှုများ ဖြစ်ပေါ်နိုင်ပါသည်။
မြေအောက်ရေ	စီမံကိန်းလုပ်ငန်းလည်ပတ်မှုကြောင့် မြစ်အထက်ပိုင်းရှိ မြစ်ကမ်းနားများတွင် မြေအောက်ရေများ တိုးမြင့်လာနိုင်ပါသည်။

၁. ၅. ၂ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း (EIA) တွင် ပါဝင်သော စီမံကိန်းကာလများ

အဓိကပတ်ဝန်းကျင်ဆိုင်ရာ ပါဝင်ပတ်သက်မှုများ၏ ရလဒ်တစ်ခုစီတိုင်းကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း အစီရင်ခံစာတွင် အကြိုတည်ဆောက်ရေးကာလ၊ တည်ဆောက်ရေးကာလနှင့် လုပ်ငန်းလည်ပတ်ခြင်းကာလ ဟူ၍ ကာလများခွဲခြား၍ ဖော်ပြထားပါသည်။

လုပ်ငန်းပိတ်သိမ်းခြင်းကာလအကြောင်းကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းအစီရင်ခံစာတွင် မဟုတ်ပဲ နယ်မြေသတ်မှတ်ခြင်း အစီရင်ခံစာတွင် ဖော်ပြပြီးဖြစ်ပါသည်။

၁. ၅. ၃ စီမံကိန်းကာလတစ်ခုခြင်းစီတွင်ပါဝင်သော အကြောင်းအရာများ

စီမံကိန်းကာလတစ်ခုခြင်းစီအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်စစ်ခြင်းတွင်ပါဝင်သော ပတ်ဝန်းကျင် ဆိုင်ရာ ပါဝင်ပတ်သက်မှုများကို အကြောင်းအရာ (၄)ခုခွဲထားပါသည်။ (၁)ဖြစ်လာနိုင်သော ထိခိုက်မှုများ (၂) အဆိုပြုလျော့ချရေးနည်းလမ်းများ (၃) ကြွင်းကျန်ထိခိုက်မှုများ (၄) အဆိုပြုစောင့်ကြပ်ကြည့်ရှုခြင်းတို့ ဖြစ်ပါသည်။ ပတ်ဝန်းကျင်ဆိုင်ရာ ပါဝင်ပတ်သက်မှုများ၏ အဆိုပြုစောင့်ကြပ်ကြည့်ရှုခြင်းကို စုပေါင်း၍ အခန်း (၈) ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအခန်းတွင် ဖော်ပြထားပါသည်။

၁. ၅. ၄ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ပြဿနာ/ထိခိုက်မှုများအားဖော်ပြခြင်း

စီမံကိန်းတွင် အစိတ်အပိုင်း ၂ခုပါဝင်ပါသည်။ ၎င်းတို့မှာ (၁) အဓိကအစိတ်အပိုင်းဖြစ်သော ရေအားလျှပ်စစ်ထုတ်လုပ်မှုစီမံကိန်းနှင့် (၂) ဓါတ်အားလိုင်းသွယ်တန်းခြင်း စီမံကိန်း တို့ဖြစ်ပါသည်။ အဆိုပါ အစိတ်အပိုင်း ၂ခု၏ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ပြဿနာများဖြစ်သော သဘာဝအခြေအနေ၊ ပမာဏနှင့် အကွာအဝေး နယ်မြေများသည် မတူညီကြပါ။ စီမံကိန်း၏ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာစီမံခန့်ခွဲမှုတွင် ရေအားလျှပ်စစ်ထုတ်လုပ်မှု တည်ဆောက်ရေးစီမံကိန်းသည် ဓါတ်အားလိုင်းသွယ်တန်းခြင်းစီမံကိန်းထက်ပို၍ အဓိကကျ၍ သိသာထင်ရှားပါသည်။

(၁) တည်ဆောက်ရေးကာလ

ရေအားလျှပ်စစ်ထုတ်လုပ်ခြင်း အစိတ်အပိုင်းများ တည်ဆောက်ခြင်းကို အဓိကတည်ဆောက်ရေးလုပ်ငန်းအဖြစ် သတ်မှတ်ပြီး အမျိုးမျိုးသော ဆောက်လုပ်ရေး လုပ်ငန်းများ (CW)၊ စက်ပိုင်းဆိုင်ရာနှင့် လျှပ်စစ်ပိုင်းဆိုင်ရာလုပ်ငန်းများ (MEW) ပါဝင်သည်။ ဆောက်လုပ်ရေးလုပ်ငန်းများကို စီမံကိန်းနေရာမှ သတ်မှတ်ထားသော နေရာတွင်သာ ဆောင်ရွက်မည်ဖြစ်ပါသည်။ ပုံမှန်အားဖြင့် တည်ဆောက်ရေးလုပ်ငန်း လုပ်ကိုင်မှုကြောင့် စီမံကိန်းနေရာရှိ ရုပ်ပိုင်းဆိုင်ရာပတ်ဝန်းကျင်များ ပျက်စီးစေပြီး စီမံကိန်းနေရာအနီးရှိ ဂေဟစနစ်နှင့် နေထိုင်သူလူထုအား အနှောက်အယှက်များဖြစ်ပေါ်စေပါသည်။

သို့သော် ဓါတ်အားလိုင်းသွယ်တန်းခြင်း ဆောက်လုပ်ရေးလုပ်ငန်းသည် စတီးတာဝါတိုင်များကို အခြေခံ အုတ်မြစ်များပြုလုပ်၍ တည်ဆောက်ခြင်းသာ ဖြစ်ပြီး အနည်းငယ်တည်ဆောက်ရေးလုပ်ငန်းသာ ဖြစ်ပါသည်။ စက်ပိုင်းဆိုင်ရာနှင့် လျှပ်စစ်ပိုင်းဆိုင်ရာလုပ်ငန်းများ (MEW) အဖြစ် စတီးတာဝါတိုင်များ တပ်ဆင်ခြင်းနှင့် ကေဘယ် ဓါတ်အားကြိုးများ တပ်ဆင်ခြင်းတို့ပြုလုပ်ရပါမည်။ ၎င်းလုပ်ငန်းခွင်သည် ဓါတ်အားလိုင်းသွယ်တန်းရာ တစ်လျှောက် မီတာ ၄၀ခန့်ရှိသော ဆောက်လုပ်ရေးလုပ်ငန်းခွင်နေရာ အနည်းငယ်သာ လိုအပ်ပါသည်။ ဓါတ်အားလိုင်း သွယ်တန်းမှုဆောက်လုပ်ရေးကြောင့် ဓါတ်အားလိုင်းသွယ်တန်းရာတစ်လျှောက်တွင် နေထိုင်သူများကို ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ပြဿနာ အနည်းငယ်သာ ဖြစ်ပေါ်စေပါသည်။ သို့သော် ဓါတ်အားလိုင်း သွယ်တန်းရာတစ်လျှောက်တွင် မြေယာအသုံးပြုမှုများ ကန့်သတ်ထားမည်ဖြစ်သောကြောင့် ထိခိုက်လွယ်သော ကုန်းတွင်းပိုင်းဂေဟစနစ်တွင် မကောင်းသော အကျိုးဆက်များ ဖြစ်ပေါ်လာနိုင်ပါသည်။

(၂) လုပ်ငန်းလည်ပတ်ရေးကာလ

ရေအားလျှပ်စစ်စီမံကိန်း၏ လုပ်ငန်းလည်ပတ်ရေးကာလတွင် မြစ်ကိုပိတ်ကာ စီမံကိန်း တည်ဆောက်မှုပြုလုပ်ခြင်းဖြင့် မြစ်ရေမြင့်တက်လာခြင်းသည် အဓိက ပြဿနာဖြစ်ပါသည်။ လုပ်ငန်းလည်ပတ်မှု အဆင့်ဒီဇိုင်းပုံစံတွင် ၈၀ m a.s.l ဖြစ်ပြီး မြစ်ရေတက်လာမှု၏ ထင်ရှားသော အကျိုးမှာ (၁) ရဲရွာရေကာတာနှင့် ဒီးဒုတ်ရေကာတာကြားတွင် မြစ်ရေ ၇မီတာ မြင့်တက်လာခြင်း (၂) ဒီးဒုတ်ရေကာတာမပါဝင်ပဲ မြစ်အထက်ပိုင်း တွင် မြစ်ရေထုထည်သည် သဘာဝမြစ်ရေထုထည်ထက် ကုဗမီတာ ၁၃သန်း တိုးလာပါမည်။ မြစ်ကိုပိတ်ကာ စီမံကိန်းတည်ဆောက်မှုပြုလုပ်ခြင်းဖြင့် မြစ်ရေမြင့်တက်လာမှုကြောင့် အကျိုးရှိခြင်းနှင့် အကျိုးယုတ်ခြင်း စသော အကျိုးဆက်များ ဖြစ်ပေါ်လာနိုင်ပါသည်။

ဓါတ်အားလိုင်းသွယ်တန်းခြင်း လုပ်ငန်းလည်ပတ်မှုကာလတွင် မကောင်းသော အကျိုးဆက်အသစ်များ ထပ်မံဖြစ်ပေါ်လာခြင်း မရှိပါ။ အကယ်၍ တည်ဆောက်ရေးကာလ မှစတင်ဖြစ်ပေါ်လာသော မြေယာအသုံးပြု၏ မကောင်းသော အကျိုးဆက်များရှိခဲ့ပါက ၎င်းအကျိုးဆက်သည် လုပ်ငန်းလည်ပတ်မှုကာလတွင်ပါ သက်ရောက်မှုရှိမည် ဖြစ်ပါသည်။ ဓါတ်အားလိုင်းသွယ်တန်းမှုကို ထိန်းသိမ်းခြင်းပြုလုပ်လျှင် ဓါတ်အားလိုင်း တစ်လျှောက် အနည်းငယ်သော ပတ်ဝန်းကျင်ဆိုင်ရာ အနှောက်အယှက်များ ဖြစ်ပေါ်စေနိုင်ပါသည်။

(၃) ပိတ်သိမ်းခြင်း ကာလ

ဒီးဒုတ် စီမံကိန်းတွင် ပိတ်သိမ်းခြင်းကို မလုပ်ဆောင်ပါ။ အဘယ့်ကြောင့်ဆိုသော် လုပ်ငန်းလုပ်ကိုင်ခွင့်ကာလ ပြီးဆုံးသွားချိန်တွင် BOT အခြေခံဖြင့် MOEE ကို လွှဲပြောင်း ပေးအပ်သွားမည် ဖြစ်ပါသည်။ စီမံကိန်း တည်ဆောက်ခြင်း ပြီးစီးသွားသည့်အချိန်တွင် ဆောက်လုပ်ရေးအတွက် အသုံးပြုထားသော အထောက်အပံ့ ကိရိယာများကို ဖျက်သိမ်းခြင်း လုပ်ဆောင်မှုများသာ ပြုလုပ်သွားမည် ဖြစ်ပါသည်။

၁. ၅. ၅ ပြဿနာဖော်ပြချက်များ အကျဉ်းချုပ်

ဖြစ်နိုင်ချေလေ့လာမှုနောက်ဆုံးအစီရင်ခံစာတွင် ဖော်ပြထားသော နည်းပညာသတင်းအချက်များ အပေါ်မူတည်၍ စီမံကိန်းတည်ဆောက်ရေးနှင့် လုပ်ငန်းလည်ပတ်ရေးလုပ်ဆောင်မှုများ၏ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ပြဿနာများဖော်ပြချက် အကျဉ်းချုပ်ကို ဇယား ၁. ၅. ၄တွင် ဖော်ပြထားပါသည်။

ဇယား ၁. ၅ - ၁ လုပ်ငန်းစီမံကိန်း၏ ES အဖြစ်အပျက်များမှ အကြို ခွဲခြမ်းစိတ်ဖြာခြင်း

လုပ်ငန်းဆောင်ရွက်မှုများ	ရုပ်ပိုင်းဆိုင်ရာ သဘာဝပတ်ဝန်းကျင်အပေါ် ထိခိုက်မှုများ	ထည့်ဝင်မှုများအပေါ် အမျိုးမျိုးသော အကျိုးသက်ရောက်မှုများ	ဤလုပ်ငန်းစီမံကိန်းတွင် သိသာထင်ရှားမှု၏ အဆင့်
လုပ်ငန်းတည်နေရာတွင် လုပ်ငန်းလှုပ်ရှားမှုများဖြစ်သည့် ဆည်နှင့် ရေအားလျှပ်စစ် ဓာတ်အားပေးရုံ တည်ဆောက်ခြင်း			
၁. ကျောက်မိုင်းခွဲခြင်းနှင့် လုပ်ငန်းတည်နေရာ ပြင်ဆင်ခြင်း	• ဆူညံမှု၊ တုန်ခါမှုနှင့် ဖုန်မှုန်	• တည်ဆောက်ရေး လုပ်ငန်းခွင်အနီးရှိ လူထုကို သက်တောင်သက်တာ မရှိစေပဲ ကျန်းမာရေးဆိုင်ရာ စိန်ခေါ်မှုများ	• အလယ်အလတ်၊ ဆောက်လုပ်ရေးလုပ်ငန်းခွင်အနီးတွင် လူနေကျေးရွာ ၁ရွာရှိပါသည်။
၂. တည်ဆောက်ရေး လုပ်ငန်းသုံး ယန္တယားများနှင့် ကုန်တင် ယာဉ်များ အသုံးပြုခြင်း	• ဆူညံမှု၊ တုန်ခါမှုနှင့် ဖုန်မှုန့်	• တည်ဆောက်ရေး လုပ်ငန်းခွင်အနီးရှိ လူထုကို သက်တောင်သက်တာမရှိစေပဲ ကျန်းမာရေးဆိုင်ရာ စိန်ခေါ်မှုများ	အလယ်အလတ်၊ ဆောက်လုပ်ရေးလုပ်ငန်းခွင်အနီးတွင် လူနေကျေးရွာ ၁ရွာရှိပါသည်။
၃. မြစ်ကြမ်းပြင် တူးဖော်ခြင်းနှင့် ရှင်းလင်းခြင်း အပါအ ဝင် မြစ်တွင်း တည်ဆောက်မှု -	မြစ်ရေ ညစ်ညမ်းမှု တိုးလာခြင်း၊ သက်ရှိများ ဆုံးရှုံးခြင်း - လှေသွားလာမှုကို အနှောက်အယှက်ဖြစ်ခြင်း • - ငါးမျှားခြင်းလုပ်ငန်းကို အနှောက်အယှက်ဖြစ်ခြင်း -	ငါးဂေဟစနစ်ကို အကျိုးသက်ရောက်မှုများ၊ ငါးဖမ်းဆီးမှု လျော့ကျနိုင် - မြစ်ရေ အသုံးပြုသူများကို အကျိုးသက်ရောက် မှုများ၊ - လူထု အဆင်မပြေမှုများ၊ လှေသမားများ၏ အသက်မွေးမှု • - အသက်မွေးမှုအပေါ် အကျိုးသက်ရောက်မှုများ၊	မသိသာ၊ ငါးသယံဇာတ နည်းပါး - အလယ်အလတ်၊ ကျေးရွာများ မြစ်ရေကို အသုံးပြု - မသိသာ၊ မြစ်ဖြတ်ကူးခြင်းမှတပါး မြစ်တွင်းပုံမှန်သွားလာမှု မရှိ - မသိသာ၊ မြစ်တွင်း ငါးဖမ်းခြင်း အလေ့အထမရှိ •
၄. တည်ဆောက်ရေး စွန့်ပစ် ပစ္စည်းများ စွန့်ပစ်မှု	• စွန့်ပစ်နေရာတွင် စုပုံ စွန့်ပစ်ခြင်း	• မြေဆီလွှာ ညစ်ညမ်းစေခြင်း၊ ကမ္ဘာမြေကြီးနှင့် စပ်ဆိုင်သော ဂေဟစနစ်အပေါ် အကျိုးသက်ရောက်မှုများ၊ (စွန့်ပစ်နေရာများ၏ သွင်ပြင်လက္ခဏာ အပေါ် တည်မှီ)	နည်းပါး၊ စွန့်ပစ်နေရာအတွက် မြေအနည်းငယ် ရှာဖွေရန် မခက်ခဲပါ •
၅. မြေ ပိုင်ဆိုင်မှု	• မြေအသုံးပြုမှုနှင့်ပိုင်ဆိုင်မှု ပြောင်းလဲခြင်း	• လူထုကို သက်ရောက်နိုင်၊ ပိုင်ဆိုင်မှုနှင့် အသက်မွေးမှု ဆုံးရှုံး၊ ပြန်လည်နေရာချထား	• နည်းပါး၊ စိုက်ပျိုးရေးမြေယာ အနည်းငယ်ကို တည်ဆောက်ရေးနေရာအတွက် အသုံးပြုမည်ဖြစ်ပြီး ပြန်လည်နေရာချထားခြင်းမရှိပါ။

လုပ်ငန်းပြင်ပ ဆောင်ရွက်မှုများ			
၁. ကျောက်မိုင်း လုပ်ငန်း လည်ပတ် ခြင်း	• ဆူညံမှု၊ တုန်ခါမှုနှင့် ဖုန်မှုန့် .	• တည်ဆောက်ရေး လုပ်ငန်းခွင်အနီးရှိ လူထုကို သက်တောင်သက်တာ မရှိစေပဲ ကျန်းမာရေးဆိုင်ရာ စိန်ခေါ်မှုများ	အလယ်အလတ်၊ ကျောက်မိုင်းလုပ်ငန်းခွင်အနီးတွင် လူနေကျေးရွာ ၁ရွာရှိပါသည်။
၂. တည်ဆောက်ရေး လုပ်ငန်းခွင်နှင့် ကျောက်မိုင်းသို့ ပစ္စည်းများသယ်ယူ ပို့ဆောင်ခြင်း	• ဆူညံမှု၊ တုန်ခါမှု၊ ဖုန်မှုန့် ထုတ်လွှတ်မှုများ လမ်းများပေါ်တွင် ကုန်တင်ယာဉ်များ တိုးလာခြင်း	• သယ်ယူပို့ဆောင်ရေး လမ်းတလျှောက်ရှိ လူထုကို သက်တောင်သက်တာ မရှိစေပဲ ကျန်းမာရေးဆိုင်ရာ စိန်ခေါ်မှုများ • လမ်း နှင့် ပြည်သူ့ ဘေးကင်း လုံခြုံမှု	-သိသာ၊ လမ်းတလျှောက်တွင် လူထု တည်ရှိ -သိသာ၊ လမ်းတလျှောက်တွင် လူထု တည်ရှိ
ဓာတ်အား ဖြန့်ဖြူးမှု လိုင်းတည်ဆောက်ခြင်း စကြိုန်တလျှောက် လှုပ်ရှားဆောင်ရွက်မှုများ			
၁. လမ်းအူကြောင်းတလျှောက် စိုက်ပျိုးမှုများ ရှင်းလင်း ခြင်း (၄၀ ၁ ခသမမငိသမ)	• မြေအသုံးပြုမှု ပြောင်းလဲ	• ကမ္ဘာမြေကြီးနှင့်စပ်ဆိုင်သော ဂေဟဗေဒကို အကျိုးသက်ရောက်မှု	• မသိသာ၊ ခြောက်သွေ့ပျက်စီးနေသော သစ်မာအမျိုးအစား သစ်တောကို ဓါတ်အားလိုင်းတစ်လျောက်တွင်တွေ့ရှိရပါသည်။
၂. စွန့်ပစ် စိုက်ပျိုးပင်များ စွန့်ပစ်ခြင်း	• ဆူညံမှုနှင့် ဖုန်မှုန့်	• လမ်းအူကြောင်းတလျှောက်အနီး လူထုကို သက်တောင်သက်တာ မရှိစေပဲ ကျန်းမာရေး ဆိုင်ရာ စိန်ခေါ်မှုများ	• - မသိသာ၊ ဓါတ်အားလိုင်းဆုံးတွင် လူနေကျေးရွာ ၂ရွာရှိပါသည်။
၃. တာဝါတိုင် အုတ်မြစ် တည်ဆောက်ခြင်း	• ဆူညံမှုနှင့် ဖုန်မှုန့်	• လမ်းအူကြောင်းတလျှောက်အနီး လူထုကို သက်တောင့်သက်သာ မရှိစေပဲ ကျန်းမာရေး ဆိုင်ရာ စိန်ခေါ်မှုများ	• - မသိသာ၊ ဓါတ်အားလိုင်းဆုံးတွင် လူနေကျေးရွာ ၂ရွာရှိပါသည်။
ရေအားလျှပ်စစ် စီမံချက် လုပ်ငန်းလည်ပတ်ခြင်း			
၁. ဆည်အနောက်ဘက်ရှိ ရေအမှတ်ကို ထိန်းသိမ်းခြင်း	- ဆည်၏ အထက်ပိုင်း ရေစီးဆင်းမှု ပြောင်းလဲခြင်း - မြစ်အထက်ပိုင်း ကမ်းများတလျှောက် မြေအောက်ရေအမှတ် တိုးလာခြင်း -	- ငါး ဂေဟနှင့် မြစ် အထက်/အောက်ပိုင်းရှိ ငါးလုပ်ငန်းများအပေါ် အကျိုးသက်ရောက်မှု - သီးနှံစိုက်ပျိုးမှုအတွက် မြစ်ကမ်းနဖူးမြေများ ဆုံးရှုံးခြင်း၊ အသက်မွေးမှုအပေါ် အကျိုး သက်ရောက်မှုများ၊ - စိုက်ပျိုးမြေများသို့ ရေတိုးဝင်မှု	- နည်းပါး၊ ငါးသယံဇာတ နည်းပါး - နည်းပါး၊ စိုက်ပျိုးမှု နေရာ နည်းပါး - နည်းပါး၊ မြေမျက်နှာပြင်မြင့်

	- လှေသွားလာမှုကို ပိတ်ပင်ခြင်း	- ရေကြောင်းသွားလာမှု ကန့်သတ်ထားသည့်အတွက် လှေအသုံးပြုခြင်းဖြင့် အချိန်နှင့် ကုန်ကျစရိတ် တိုးလာခြင်း •	-မသိသာ၊ မြစ်ဖြတ်ကူးခြင်းမှတပါး မြစ်တွင်း ပုံမှန်သွားလာမှု မရှိ
ဓာတ်အားဖြန့်ဖြူးမှု လိုင်း၏ လုပ်ငန်းလည်ပတ်ခြင်း			
၁. ဓာတ်အားဖြန့်ဖြူးမှု လိုင်းနှင့် စကြိန်၏ ပြုပြင်ထိန်း သိမ်းမှု	• သစ်ပင်များ ခုတ်ဖြတ်ပါက ဆူညံ	- စကြိန်အနီးနေထိုင်သူများကို အနှောင့်အယှက်ပြုခြင်း	-မသိသာ၊ ဓါတ်အားလိုင်းဆုံးတွင် လူနေကျေးရွာ၂ရွာရှိပါသည်။ ဓါတ်အားလိုင်း အောက်ရှိ သဘာဝပေါက်ပင်များအား ထူထပ်စွာပေါက်ရောက်ခွင့်မပြုပါ။ •

၁.၆ ဆက်စပ်သက်ရောက်မှုဆန်းစစ်ခြင်း

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း လမ်းညွှန်ချက်တွင် ဆက်စပ်သက်ရောက်မှုများအား ထည့်သွင်းစဉ်းစားရန် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း စုံစမ်းစစ်ဆေးခြင်းပြုလုပ်ရန် လိုအပ်ပါသည်။ (အပိုဒ် ၅၃)

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းလမ်းညွှန်ချက်တွင် ဆက်စပ်သက်ရောက်မှု၏ အဓိပ္ပါယ်ကို အောက်တွင်ဖော်ပြထားပါသည်။

-ဆက်စပ်သက်ရာက်မှုဆိုသည်မှာ စီမံကိန်းတစ်ခု၏ ပတ်ဝန်းကျင်အပေါ် သက်ရောက်မှုသည် ယင်းတို့သက်သက်အားဖြင့် သိသာထင်ရှားမှု မရှိသော်လည်း အလားတူ သို့မဟုတ် အမျိုးအစား မတူညီသည့် စီမံကိန်း သို့မဟုတ် နယ်မြေ၊ ဒေသတစ်ခုတည်းတွင် ဆောင်ရွက်လုပ်ကိုင်နေသော စီမံကိန်းများမှ လက်ရှိ သို့မဟုတ် ဖြစ်ပေါ်လာနိုင်သော သက်ရောက်မှုများနှင့် ပေါင်းစပ်လိုက်သောအခါ ဖြစ်ပေါ်လာသည့် သိသာထင်ရှားသော သက်ရောက်မှုကို ဆိုသည်-

ယေဘူယျတွင် ဆက်စပ်သက်ရောက်မှု၏ ဆိုလိုရင်းမှာ -

ပတ်ဝန်းကျင်ပြောင်းလဲဖြစ်ပေါ်ခြင်းသည် အဆိုပြုစီမံကိန်း၏ အခြားသော အတိတ်နှင့်လက်ရှိကာလ ပေါင်းစပ်ခြင်းနှင့် အကျိုးကြောင်းဆီလျော်သောကာလတွင် စီမံကိန်း သို့မဟုတ် လူထုလှုပ်ရှားမှုကြောင့် ဖြစ်ပေါ်လာမှုကို ဆိုလိုသည်။

အခြေခံပတ်ဝန်းကျင်ဆိုင်ရာ လေထုအရည်အသွေးကဲ့သို့သော ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း လေ့လာမှုဧရိယာ၏ အခြေခံပတ်ဝန်းကျင်ဆိုင်ရာအရည်အသွေးသည် လက်ရှိစီပွားရေးလုပ်ဆောင်မှုများနှင့် လုပ်ငန်းလည်ပတ်မှုစီမံကိန်း ရလဒ်များဖြစ်ပါသည်။ ထို့ကြောင့် စီမံကိန်း၏ ဆက်စပ်သက်ရောက်မှုနှင့် စီမံကိန်းလေ့လာမှုဧရိယာ သို့မဟုတ် လက်ရှိ စီးပွားရေးလုပ်ဆောင်မှုများအကြောင်းကို အခန်း (၆)၏ စီမံကိန်း၏ ထိခိုက်မှု ကဏ္ဍတွင် ဖော်ပြထားပါသည်။

ရဲရွာရေကာတာသည် ဒီးဒုတ်စီမံကိန်းနှင့် ဆက်စပ်နေသည့် တစ်ခုတည်းသော စီမံကိန်းဖြစ်ပါသည်။ မြစ်ငယ်မြစ်အောက်ပိုင်း၏ လက်ရှိ ရေအရည်အသွေးနှင့် အဏ္ဏဝါဂေဟစနစ်သည် ရဲရွာရေကာတာ၏ သက်ရောက်မှုပေါ်မူတည်နေပါသည်။ ရဲရွာ ရေကာတာနှင့် ဒီးဒုတ်ရေကာတာကြားရှိ မြစ်ပိုင်း၏ ကြိုတင်မျှော်လင့်ထားသော သက်ရောက်မှုသည် ဆက်စပ်သက်ရောက်မှုဖြစ်ပါသည်။

စီမံကိန်းတွင် ပတ်ဝန်းကျင်ဆိုင်ရာအရည်အသွေး သက်ရောက်မှု မရှိခဲ့လျှင် လေထုနှင့် ရေအရည်အသွေး စသည်တို့သည် စီမံကိန်းအနီးအနားတွင် အနာဂတ်၌ စက်ရုံများနှင့် ဖွံ့ဖြိုးတိုးတက်သော အခြေခံအဆောက်အအုံ စီမံကိန်းများပေါ်ပေါက်လာသည့်အချိန်တွင် ဆက်စပ်သက်ရောက်မှုများ မဖြစ်ပေါ် စေနိုင်ပါ။ ဒီးဒုတ်ရေကာတာ၏ မြစ်အပေါ်ပိုင်း သို့မဟုတ် မြစ်အောက်ပိုင်းတွင် အကောင်အထည်ဖော်သော ရေအားလျှပ်စစ်စီမံကိန်းအသစ်နှင့်သာ ဆက်စပ်သက်ရောက်မှု ဖြစ်ပေါ်စေပါသည်။ သို့သော် စီမံကိန်းတွင် ပတ်ဝန်းကျင်ဆိုင်ရာသက်ရောက်မှုနှင့်အတူ အခြားသော ဖွံ့ဖြိုးတိုးတက်မှု စီမံကိန်း အခွင့်အလမ်းများ ဖွင့်လှစ်ပေးလိုက်ချိန်တွင် ရေကာတာ၏ လျှပ်စစ်မီးနှင့် ရေအသုံးပြုခြင်းမှ စီမံကိန်းသက်ရောက်မှုများကို ဖြစ်ပေါ်စေပါသည်။

ယခုလက်ရှိကာလတွင် ရဲရွာရေကာတာသည် မြစ်ငယ်မြစ်ဝှမ်းတွင် လက်ရှိတည်ရှိနေသော အဓိက ရေကာတာတစ်ခုဖြစ်ပြီး မြန်မာနိုင်ငံတွင် အကြီးဆုံးရေကာတာ ဖြစ်ပါသည်။ အထက်ရဲရွာရေကာတာသည် ယခုလက်ရှိတွင် တည်ဆောက်ဆဲကာလဖြစ်ပါသည်။ အဆိုပြုထားသော ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်းအပြင် အခြားသောရေအားလျှပ်စစ်စီမံကိန်းများဖြစ်သော နမတူနှင့် အလယ်ရဲရွာ စီမံကိန်းတို့သည် အကောင်အထည်ဖော်ရန် ကြိုးစားဆဲအနေအထားဖြစ်ပါသည်။ ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်း၏ မြစ်အောက်ပိုင်းတွင်

မြေမျက်နှာသွင်ပြင် အနေအထားများကြောင့် စီမံကိန်းအသစ်များအကောင်အထည်ဖော်ရန် မဖြစ်နိုင်ပါ။ ရဲရွာရေအားလျှပ်စစ်စီမံကိန်းနှင့် ဒီးဒုတ်ရေအားလျှပ်စစ်စီမံကိန်းအကြားတွင်လည်း အဆိုပါ မြေမျက်နှာသွင်ပြင် အနေအထားများကြောင့် စီမံကိန်းအသစ်များ အကောင်အထည်ဖော်ရန် မဖြစ်နိုင်ပါ။ ထို့ကြောင့် မြစ်ငယ်မြစ်ဝှမ်းပေါ်တွင် စုစုပေါင်းရေအားလျှပ်စစ် စီမံကိန်း (၅)ခုသာ အကောင်အထည်ဖော် ဆောင်ရွက်နိုင်မည်ဖြစ်ပြီး ဆက်စပ်သက်ရောက်မှုတွင် ၎င်းတို့ကိုသာ ထည့်သွင်းစဉ်းစားမည် ဖြစ်ပါသည်။

မြစ်ငယ်မြစ်ပေါ်တွင် အကောင်အထည်ဖော်သည့် ရေအားလျှပ်စစ် စီမံကိန်းများအားလုံး ပါဝင်သော ဃမဗ ဆန်းစစ်ချက် ပြီးမြောက် အကောင်အထည်ဖော်မှုတွင် ပါဝင် ဆောင်ရွက်ပါမည်။ ဃမဗ တွင် အခြားအစိတ်အပိုင်းများ ဖြစ်သော သစ်တော၊ လမ်းနှင့် လမ်းပန်းဆက်သွယ်ရေး၊ စိုက်ပျိုးရေးနှင့် မိုင်းလုပ်ငန်းတို့ပါဝင်နေပါသည်။ ထို့ကြောင့် CIA နှင့် ထိခိုက်မှု စီမံခန့်ခွဲခြင်းပေါင်းစပ်မှုများအတွက် DEPP မှ စတင် အကောင်အထည်ဖော်မည့် မြစ်ငယ်မြစ် ပေါ်တွင် တည်ရှိနေသော ရေအားလျှပ်စစ် အကောင်အထည်ဖော်သူများနှင့် လက်ရှိ ရေအားလျှပ်စစ် စီမံကိန်းများ ပေါင်းစပ်ပါဝင်မှုတွင် ဒီးဒုတ် စီမံကိန်းသည်လည်း ပါဝင်ပါမည်ဟု ကတိကဝတ်ပြုပါသည်။

၁. ၇ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်

စီမံကိန်းလုပ်ဆောင်မှုကာလတွင် ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှု (EMP)ကို အသုံးပြုခြင်းနှင့် ပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်းလမ်းညွှန်ချက် ၂၀၁၄ခုနှစ် ဖော်ပြချက်တွင် တည်ဆောက်ဆဲကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှု အစီအစဉ်နှင့် လုပ်ငန်းလည်ပတ်ဆောင်ရွက်သည့်ကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှု အစီအစဉ်များကို ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း အပြီးသတ်အစီရင်ခံစာအတွဲ (၂)တွင် ထည့်သွင်းဖော်ပြရပါမည်။

ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် ၂ခု ဖြစ်သော စီမံကိန်းတည်ဆောက်ဆဲကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှု အစီအစဉ် အကောင်အထည်ဖော်ခြင်းနှင့် အခြားသောလုပ်ငန်းလည်ပတ်ဆောင်ရွက်သည့်ကာလ ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ် အကောင်အထည်ဖော်ခြင်းများကို လုပ်ဆောင်ခြင်းမရှိလျှင် နှင့် ပတ်ဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်းစုံစမ်းမှုသည် အကျိုးဖြစ်ထွန်းသည့် ရလဒ်များကို ပေးစွမ်းနိုင်မည် မဟုတ်ပါ။ ၎င်းအချက်များကြောင့် တည်ဆောက်ဆဲကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် (CEMP) နှင့် လုပ်ငန်းလည်ပတ်ဆောင်ရွက်သည့်ကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် (OEMP) ၂ခုလုံးကို အပြီးသတ်အစီရင်ခံစာတွင် ထည့်သွင်းဖော်ပြရမည့်ဟု ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း လုပ်ထုံးလုပ်နည်းတွင် ဖော်ပြထားပါသည်။

၁. ၇. ၁ တည်ဆောက်ဆဲကာလပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် အကျဉ်းချုပ်

အခန်း (၆)တွင် ဖော်ပြခဲ့သကဲ့သို့ စီမံကိန်းတည်ဆောက်မှုကြောင့် ဖြစ်ပေါ်လာသော ပတ်ဝန်းကျင်ဆိုင်ရာ သက်ရောက်မှုများသည် သာမာန်ရေအားလျှပ်စစ်တည်ဆောက်ရေးလုပ်ငန်းခွင်များတွင် ဖြစ်ပေါ်တတ်သော သက်ရောက်မှုများကိုသာ တွေ့ရှိရပြီး အခြားသော ပတ်ဝန်းကျင်ဆိုင်ရာသက်ရောက်မှု ကြီးကြီးမားမား ဖြစ်ပေါ်ခြင်းမရှိပါ။ သို့သော် ကန်ထရိုက်တာမှ စီမံကိန်းတည်ဆောက်ဆဲကာလတွင် ဖြစ်ပေါ်လာနိုင်သော ထိခိုက်မှုများကို အနည်းဆုံးဖြစ်အောင် ပြုလုပ်ရန် စီမံကိန်းအကောင်အထည်ဖော်သူမှ သေချာစွာ စိစစ်ရန်လိုအပ်ပါသည်။ ကန်ထရိုက်တာမှ ရေကာတာ၏ အသေးစိတ်ဒီဇိုင်းပုံစံ၊ ဓါတ်အားပေးစက်ရုံနှင့် ၎င်း၏ သက်ဆိုင်ရာ အစိတ်အပိုင်းများ၊ ဆောက်လုပ်ရေး နည်းလမ်းနှင့် အသေးစိတ်အစီအစဉ်များ အတွက် လျှော့ချစေသော နည်းလမ်းများအား CEMP ဖော်ပြထားသကဲ့သို့ သေချာစွာလိုက်နာဆောင်ရွက်စေရန် စီမံကိန်းအကောင်အထည်ဖော်သူမှ စိစစ်ရန်လိုအပ်ပါသည်။

ပတ်ဝန်းကျင်ဆိုင်ရာစီမံခန့်ခွဲမှု၏ အခြေခံလိုအပ်ချက်များကို တည်ဆောက်ဆဲကာလ ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ် အတွဲ (၂) အပိုင်း ၈.၁.၃ တွင်ဖော်ပြထားပါ။ တည်ဆောက်ဆဲကာလ ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ်၏ အဓိကကဏ္ဍများကို အောက်တွင်ဖော်ပြထားပါသည်။

(၁) သက်ရောက်မှုနှင့် စီမံခန့်ခွဲမှုအစီအစဉ်

တည်ဆောက်ရေးလုပ်ငန်းများကြောင့် ပတ်ဝန်းကျင်ဆိုင်ရာ အနှောက်အယှက်များ ယာယီ ဖြစ်ပေါ်စေသော်လည်း ပြန်လည်သက်ရောက်မှုဖြစ်ပေါ်ခြင်းများ မရှိပါ။ ဆောက်လုပ်ရေးလုပ်ငန်းများပေါ်မူတည်၍ ပတ်ဝန်းကျင်ဆိုင်ရာသက်ရောက်မှု အမျိုးအစား၊ ပမာဏ၊ ကာလနှင့် နေရာများ ကွာခြားပြီး စီမံကိန်း တည်ဆောက်ဆဲကာလ၏ လအလိုက် ပတ်ဝန်းကျင်သက်ရောက်မှုများကို ဇယား ၁.၇-၁ တွင်ဖော်ပြထားပါသည်။

စီမံကိန်းတည်ဆောက်ရေးကာလရှိ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်းနှင့် စောင့်ကြည့် လေ့လာခြင်း အစီအစဉ်၏ စီမံကိန်းနေရာ သို့မဟုတ် အသေးစိတ်နေရာချထားမှု အစီအစဉ်တွင် အောက်ဖော်ပြပါတို့ ပါဝင်ပါသည်။ (၁) ရေကာတာတည်ဆောက်ရေးနေရာ (၂) ပစ္စည်းများသိုလှောင်ရာဧရိယာ (၃) တူးဖော်ရရှိသော မြေများ စုပုံရာနေရာ (၄) ကျောက်များ စုပုံရာနေရာ (၅) Borrow Pits (၆) စခန်းနေရာ (၇) ကျောက်မိုင်းနေရာ နှင့် အကြောင်းအရာအလိုက် အစီအစဉ်များဖြစ်သော - (၈) ပို့ဆောင်ဆက်သွယ်ရေးစီမံခန့်ခွဲမှု အစီစဉ် (၉) ရေအသုံးပြုမှု စီမံခန့်ခွဲမှု အစီအစဉ် (၁၀) စွန့်ပြစ်အမှိုက် စီမံခန့်ခွဲမှု အစီအစဉ် (၁၁) အန္တရာယ်ရှိသော အမှိုက်စွန့်ပြစ်မှု စီမံခန့်ခွဲမှု အစီအစဉ် (၁၂) ဇီဝလောင်စာများရှင်းလင်းခြင်း စီမံခန့်ခွဲမှု အစီအစဉ် (၁၃) လုပ်ငန်းခွင်ကျန်းမာရေး စီမံခန့်ခွဲ အစီအစဉ် (၁၄) တည်ဆောက်ရေးကာလ အရေးပေါ်တုန့်ပြန်မှု အစီအစဉ် (CERP) နှင့် လူမှုရေးစီမံခန့်ခွဲရေးနှင့် စောင့်ကြည့်လေ့လာမှု အစီအစဉ်များဖြစ်သော - (၁၅) ရှေးဟောင်းပစ္စည်းများ တူးဖော်ရှာဖွေတွေ့ရှိမှု (၁၆) မြေပေးလျော်ခြင်း စီမံခန့်ခွဲမှုနှင့် စောင့်ကြည့်လေ့လာမှု အစီအစဉ် (၁၇) အသက်မွေးဝမ်းကြောင်းမှု ပြန်လည်တည်ထောင်မှု စီမံခန့်ခွဲမှုနှင့် စောင့်ကြည့်လေ့လာမှု အစီအစဉ် နှင့် (၁၈) လူထုဖွံ့ဖြိုးရေး စီမံခန့်ခွဲမှုနှင့် စောင့်ကြည့်လေ့လာမှု အစီအစဉ် တို့ဖြစ်ပါသည်။

ဇယား ၁.၇-၁ ဆောက်လုပ်ရေးလုပ်ငန်း၏ ကာလအမျိုးမျိုးတွင် ဖြစ်ပေါ်လာနိုင်သော ကြိုတင်ခန့်မှန်းရရှိသည့် သက်ရောက်မှုများ

ဆောက်လုပ်ရေးလုပ်ငန်းများ	လ	ကာလ (လ)	သက်ရောက်မှု
ကာလ - ဝ			
၁) ပြင်ဆင်မှုလုပ်ငန်း	၁	၁	ဖုန်မှုန့်၊ ဆူညံမှု
၂) ချဉ်းကပ်လမ်း	၁	၁	ဖုန်မှုန့်၊ ဆူညံမှု၊ လမ်းပန်းဆက်သွယ်ရေး
ကာလ ၁ - မြစ်ကြောင်းလွှဲခြင်း			
၁) Ring Coffer Dam	၁-၄	၄	ဖုန်မှုန့်၊ ဆူညံမှု၊ ရေအရည်အသွေး
၂) ရှင်းလင်းခြင်းလုပ်ငန်းများ	၅-၉	၅	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၃) ကန့်သတ်နံရံ	၆-၉	၄	ဖုန်မှုန့်၊ ဆူညံမှု၊ ရေအရည်အသွေး
၄) Ring Coffer Dam ဖယ်ရှားခြင်း	၉-၁၀	၂	ဖုန်မှုန့်၊ဆူညံမှု၊ရေအရည်အသွေး၊အမှိုက်စွန့်ပြစ်ခြင်း
ကာလ ၂ - ရေပိုလွှဲ			

ဆောက်လုပ်ရေးလုပ်ငန်းများ		လ	ကာလ (လ)	သက်ရောက်မှု
၁)	Coffer Dam	၉-၁၁	၃	ဖုန်မှုန့်၊ ဆူညံမှု၊ ရေအရည်အသွေး
၂)	ရှင်းလင်းခြင်းလုပ်ငန်းများ	၁၂-၁၃	၂	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၃)	အခြေခံအုတ်မြစ်ချခြင်းလုပ်ငန်းများ	၁၄-၁၈	၅	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၄)	ရေပိုလွှဲတည်ဆောက်ခြင်း	၁၇-၂၅	၉	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၅)	တာတမံနှင့် မြစ်ကြောင်းကာကွယ်ခြင်း	၂၂-၂၅	၄	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု၊မြေယာရယူခြင်း
၆)	HM ပစ္စည်းကိရိယာ	၂၃-၁၂	၂၄	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၇)	Coffer Dam ဖယ်ရှားခြင်း	၂၆-၂၈	၃	ဖုန်မှုန့်၊ဆူညံမှု၊ရေအရည်အသွေး၊အမှိုက်စွန့်ပြစ်ခြင်း
ကာလ ၃ - ဓါတ်အားပေးစက်ရုံ				
၁)	Coffer Dam	၂၆-၂၉	၄	ဖုန်မှုန့်၊ ဆူညံမှု၊ ရေအရည်အသွေး
၂)	ရှင်းလင်းခြင်းလုပ်ငန်းများ	၂၈-၃၀	၃	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၃)	ဓါတ်အားပေးစက်ရုံ ဖွဲ့စည်းပုံ	၃၀-၅၀	၂၀	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၄)	ဦးစားပေးမဟုတ်သည့် အလုပ်	၃၅-၅၈	၂၄	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၅)	ရေလက်ကြား	၃၆-၃၈	၃	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၆)	ဘယ်ဘက်ကမ်းတွင် မြစ်ကြောင်းကာကွယ်ခြင်း	၃၆-၃၈	၃	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု၊မြေယာရယူခြင်း
၇)	တာတမံလုပ်ငန်းများ	၃၆-၃၈	၃	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု၊မြေယာရယူခြင်း
၈)	EM & HM ပစ္စည်းကိရိယာ	၃၅-၅၅	၂၀	ဖုန်မှုန့်၊ ဆူညံမှု၊ တုန်ခါမှု
၉)	Coffer Dam ဖယ်ရှားခြင်း	၄၈-၅၀	၃	ဖုန်မှုန့်၊ဆူညံမှု၊ ရေအရည်အသွေး၊အမှိုက်စွန့်ပြစ်ခြင်း
၁၀)	လျှပ်စစ်ပိုင်းဆိုင်ရာလုပ်ငန်းများ			
-	ဓါတ်အားခွဲရုံ	၄၄-၄၉	၆	ဖုန်မှုန့်၊ ဆူညံမှု၊ မြေယာရယူခြင်း
-	ဓါတ်အားလိုင်း	၃၂-၄၃	၁၂	ဖုန်မှုန့်၊ ဆူညံမှု၊ မြေယာရယူခြင်း

မှတ်ချက် - ဆောက်လုပ်ရေးလုပ်ငန်းကြာချိန်များသည် ဖြစ်နိုင်ချေလေ့လာမှုအစီရင်ခံစာတွင်ဖော်ပြထားသော စီမံကိန်းဆောက်လုပ်ရေး လုပ်ငန်းအချိန်ဇယားအပေါ်မူတည်၍ ဖော်ပြထားပါသည်။ ၂၀၁၅ခုနှစ်၊ ဂျူလိုင်လ

(၂) စောင့်ကြပ်ကြည့်ရှုခြင်း၊ အကဲဖြတ်ခြင်းနှင့် အစီရင်ခံခြင်း

ကန်ထရိုက်တာ၏ ပတ်ဝန်းကျင်ဆိုင်ရာလုပ်ဆောင်မှုများဖြစ်သော စောင့်ကြပ်ကြည့်ရှုခြင်း၊ အကဲဖြတ်ခြင်းနှင့် အစီရင်ခံခြင်းတို့သည် စောင့်ကြပ်ကြည့်ရှုခြင်း အချိန်ဇယားတွင် ပါဝင်သောညွှန်ပြချက်များနှင့်

ဆက်စပ်၍ ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း အပြီးသတ် အစီရင်ခံစာ အတွဲ (၂)တွင် ဖော်ပြထားပါသည်။ ထို့အပြင် ကန်ထရိုက်တာ၏ HSE မန်နေဂျာနှင့် စီမံကိန်းပိုင်ရှင်၏ HSE မန်နေဂျာတို့သည် နေ့စဉ်၊ အပတ်စဉ်၊ လစဉ်တွေ့ဆုံကာ ဆောက်လုပ်ရေးလုပ်ငန်းခွင်၏ ပတ်ဝန်းကျင်ဆိုင်ရာ လုပ်ဆောင်မှုများကို ကြည့်ရှုစစ်ဆေးခြင်း ကဏ္ဍအဖြစ် အမြဲလေ့လာနေရပါမည်။ ကန်ထရိုက်တာသည် စောင့်ကြပ်ကြည့်ရှုခြင်းအစီရင်ခံစာကို နှစ်လလျှင်တစ်ကြိမ် ရေးသားပြီး ဌာနတွင်းဖတ်ရှုရန် တစ်စုံ၊ သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာနသို့ တစ်စုံပို့ဆောင်ရပါမည်။ ၎င်းအစီရင်ခံစာ ၂မျိုးအကြောင်းကို CEMP တွင် အသေးစိတ်ရှင်းလင်းဖော်ပြထားပါသည်။

MER ၏ အခြားသော အချိန်ဇယားတွင် ပတ်ဝန်းကျင်ဆိုင်ရာ အဖြစ်အပျက်များဖြစ်ပေါ်လာပါက မှတ်သား၊ စာရင်းပြုစုကာ အစီရင်ခံရမည် ဖြစ်ပါသည်။

၁. ၇. ၂ လုပ်ငန်းလည်ပတ်ဆောင်ရွက်သည့်ကာလပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် အကျဉ်းချုပ်

အခန်း (၆)တွင် ဖော်ပြသကဲ့သို့ ရေအားလျှပ်စစ်စီမံကိန်း၏ လုပ်ငန်းလည်ပတ်ဆောင်ရွက်ခြင်းတွင် မြစ်ရေမြင့်တက်ခြင်းနှင့် ပတ်သက်၍ဖြစ်ပေါ်လာနိုင်သော လူမှုရေးထိခိုက်မှုမှလွဲ၍ အခြားသိသာထင်ရှားသော ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများမရှိပါ။ ထို့ကြောင့် လုပ်ငန်းလည်ပတ်ဆောင်ရွက်သည့်ကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်တွင် လုပ်ဆောင်မှုများနည်းပါးပြီး တည်ဆောက်ဆဲကာလ ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ်၏ EMS နှင့်နှိုင်းယှဉ်ပါက ပိုမိုရိုးရှင်းလွယ်ကူပါသည်။ စီမံကိန်းပိုင်ရှင်၏ လုပ်ငန်းလည်ပတ် ဆောင်ရွက်သည့်ကာလ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်အကျဉ်းချုပ်ကို အောက်တွင်ဖော်ပြထားပါသည်။

(၁) လျော့နည်းစေသောဆောင်ရွက်မှုများနှင့် အစီအစဉ်များ

စီမံကိန်းလည်ပတ်မှုကာလရှိ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်းနှင့် စောင့်ကြည့်လေ့လာခြင်း အစီအစဉ်၏ စီမံကိန်းနေရာ သို့မဟုတ် အသေးစိတ်နေရာချထားမှု အစီအစဉ်တွင် အောက်ဖော်ပြပါတို့ ပါဝင်ပါသည်။ (၁) ရေကာတာဆောက်လုပ်ရေးနေရာ စီမံခန့်ခွဲမှု အစီအစဉ် (၂) အသက်မွေးဝမ်းကြောင်းမှု ပြန်လည်ထူထောင်ရေး စီမံခန့်ခွဲမှုနှင့် စောင့်ကြည့်လေ့လာမှု အစီအစဉ်နှင့် (၃) လူထုဖွံ့ဖြိုးရေး စီမံခန့်ခွဲမှုနှင့် စောင့်ကြည့်လေ့လာမှု အစီအစဉ်တို့ကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း အပြီးသတ်အစီရင်ခံစာ အတွဲ (၂)တွင် ဖော်ပြထာပါသည်။ လူထုဖွံ့ဖြိုးတိုးတက်ရေးအစီအစဉ်တွင် လူမှုစီးပွားပူးပေါင်းတာဝန်ခံမှု (CSR) ကိုထည့်သွင်းစဉ်းစားသွားမည် ဖြစ်ပြီး အသက်မွေးဝမ်းကြောင်း ပြန်လည်ထူထောင်ရေးအစီအစဉ်သည် မြေယာရယူခြင်းကြောင့် အသက်မွေးဝမ်းကြောင်းမှု တွင် ထိခိုက်မှုဖြစ်ပေါ်ခြင်းကို လျော့ချခြင်း သို့မဟုတ် စီမံကိန်းမတိုင်မီ ရေလွှမ်းကမ်းနားမြေများကို စိုက်ပျိုးရေး အတွက်အသုံးပြုခြင်းတို့ ပါဝင်သည်။

(၂) ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုစနစ် (EMS)

ဓါတ်အားပေးစက်ရုံ စီမံခန့်ခွဲမှုအဖွဲ့သည် O & M လုပ်ဆောင်မှုများအတွက် ရှိရှင်းသော ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုစနစ်ကို အကောင်အထည်ဖော်ရပါမည်။ EMS သည် အယောက် ၈ဝခန့်ရှိသော ဓါတ်အားပေးစက်ရုံ ဝန်ထမ်းများ၏ ကျန်းမာရေးနှင့် လုပ်ငန်းခွင်ဘေးအန္တရာယ် ကင်းရှင်းရေးအပြင် ရေကာတာမြစ်အပေါ်ပိုင်း၏ မြစ်ရေ အရည်အသွေး၊ အမြင့်နှင့် အဏ္ဏဝါ ဂေဟစနစ်ပြောင်းလဲခြင်းတို့ကို အလေးပေးဆောင်ရွက်ပါသည်။

(၃) စောင့်ကြပ်ကြည့်ရှုခြင်း၊ အကဲဖြတ်ခြင်းနှင့် အစီရင်ခံခြင်း

MER တွင် မြစ်ရေအရည်အသွေး၊ မြစ်အထက်ပိုင်းရှိ ရေမြေအမြင့်၊ အကွာအဝေး၊ အစမ်းအနေဖြင့် မီတာ ၅၀၀၊ ရေကာတာ၏ မြစ်အောက်ပိုင်း စသည်တို့၏ စောင့်ကြပ်ကြည့်ရှုခြင်း အချိန်ဇယားတို့

ပါဝင်ပါသည်။ ရေကာတာ၏ မြစ်အထက်ပိုင်း မြစ်ရေအမြင့်ကို နေ့စဉ်တိုင်းတာခြင်း သို့မဟုတ် ဓါတ်အားပေးလုပ်ငန်းလည်ပတ်ချိန်၏ အလိုအလျောက်မှတ်သားခြင်းများ ပြုလုပ်ရပါမည်။ ရေကာတာ၏ မြစ်အောက်ပိုင်း မြစ်ရေအမြင့်ကို နေ့စဉ် ဝန်းထမ်းဖြင့် တိုင်းတာခြင်းစနစ်ကို အသုံးပြု၍ တိုင်းတာရပါမည်။ ရေနမူနာကို အပတ်စဉ်ကောက်ယူကာ အဓိက ပါရာမီတာများဖြစ်သော ပျော်ဝင်နေသော အောက်ဆီဂျင်၊ ပုံ့နှံ့အမှုန်၊ Biological oxygen demand, nitrate နှင့် phosphate တို့ကို တိုင်းတာ စစ်ဆေးရပါမည်။ ရေမျော်အပါအဝင် ငါးများ စစ်တမ်းကောက်ယူခြင်းကို ရေစီးငြိမ်နေသော အချိန်တွင်မြစ်အထက်ပိုင်း၌ နှစ်စဉ် စစ်ဆေးရပါမည်။ နှစ်စဉ် ပတ်ဝန်းကျင်ဆိုင်ရာအစီရင်ခံစာကို ပြင်ဆင်ကာ သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာနနှင့် အခြားသော အာဏာပိုင်အဖွဲ့အစည်းများကို တင်ပြရမည် ဖြစ်ပါသည်။

၁. ၈ လူထု ဆွေးနွေးညှိနှိုင်းတိုင်ပင်ခြင်းနှင့် ပွင့်လင်းမြင်သာမှု

၁. ၈. ၁ စီမံကိန်းသက်ရောက်မှုတွင် ပါဝင်ပတ်သက်သူများနှင့် အုပ်စုများအား ဖော်ပြချက်

စီမံကိန်းပါဝင်ပတ်သက်သူများကို အုပ်စု ၃စုသတ်မှတ်၍ ခွဲခြားဖော်ပြမည် ဖြစ်ပါသည်။

(၁) EIA အုပ်ချုပ်ရေးပိုင်းတွင် ပါဝင်သော အစိုးရအာဏာပိုင်များ

စီမံကိန်းအတွက် သက်ဆိုင်ရာအမျိုးသားအဆင့်ရုံးများမှာ (၁) သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာန (၂) ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာန (၃) လျှပ်စစ်နှင့် စွမ်းအင် ဝန်ကြီးဌာန (၄) လူမှုဝန်ထမ်းကယ်ဆယ်ရေးနှင့် ပြန်လည်နေရာချထားရေး ဝန်ကြီးဌာနတို့ဖြစ်ပါသည်။

သက်ဆိုင်ရာ တိုင်းဒေသကြီးအဆင့်ရုံးများမှာ (၁) မန္တလေးတိုင်းဒေသကြီးအစိုးရအဖွဲ့ရုံး (၂) မန္တလေးတိုင်းဒေသကြီး ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန (၃) မန္တလေးတိုင်းဒေသကြီး လူမှုဝန်ထမ်းကယ်ဆယ်ရေးနှင့် ပြန်လည်နေရာချထားရေး ဦးစီးဌာန (၄) မန္တလေးတိုင်းဒေသကြီး စီမံကိန်းနှင့် ဘဏ္ဍာရေး ဦးစီဌာန (၅) မန္တလေးတိုင်းဒေသကြီး ငါးလုပ်ငန်းဦးစီးဌာန (၆) ရေအားလျှပ်စစ်အကောင်အထည် ဖော်ရေး ဦးစီးဌာန (DHPI) တို့ဖြစ်ပါသည်။

သက်ဆိုင်ရာ ဒေသတွင်းအဆင့်ရုံးများမှာ (၁) ပြင်ဦးလွင်မြို့နယ်အစိုးရအဖွဲ့ရုံး နှင့် (၂) ကျောက်ဆည်မြို့နယ်အစိုးရအဖွဲ့ရုံး တို့ဖြစ်ပါသည်။

(၂) အခြားစိတ်ပါဝင်စားသောအဖွဲ့အစည်းများ

ဤကဏ္ဍ၌ စီမံကိန်းပါဝင်ပတ်သတ်သူများသည် ဖွံ့ဖြိုးတိုးတက်ရေးကဏ္ဍပေါင်းစုံကို တာဝန်ယူကြသော အစိုးရဌာနအသီးသီးမှ တာဝန်ရှိ ပုဂ္ဂိုလ်များနှင့် အောက်ဖော်ပြပါ လူထုအခြေခံအဖွဲ့အစည်းများ တို့ဖြစ်ပါသည်။

- ကျန်းမာရေးဦးစီးဌာန
- စီမံကိန်းဦးစီးဌာန
- သစ်တောဦးစီးဌာန
- စိုက်ပျိုးရေးဦးစီးဌာန
- ငါးလုပ်ငန်းဦးစီးဌာန

- လျှပ်စစ်ဓါတ်အားဦးစီးဌာန
- မြေယာပိုင်ဆိုင်မှုဦးစီးဌာန တို့ဖြစ်ပါသည်။

(၃) သက်ရောက်မှုအလားအလာရှိသောလူထု

ဤကဏ္ဍ၌ စီမံကိန်းပါဝင်ပတ်သတ်သူများသည် ကျေးရွာလူထု၊ စီမံကိန်းလေ့လာမှုပြုလုပ်သည့် စုစုပေါင်း ရွာ ၈ရွာဖြစ်သော ပြင်ဦးလွင်မြို့နယ်မှ ဌက်ကြီးသိုက်ရွာ၊ မန်ကျည်းအင်းရွာ၊ ဝါးနက်ရွာ၊ ငွေပင်ရွာနှင့် ပိန်းရွာအပြင် ကျောက်ဆည်မြို့နယ်မှ သရက်ပင်ရွာ၊ ရဲရွာ၊ကျောင်းရွာ တို့မှ တသီးပုဂ္ဂလ ကျေးရွာသူ/သားများ ပါဝင်ပါသည်။ ၎င်းကျေးရွာများတွင်နေထိုင်သူများသည် စီမံကိန်းတည်ဆောက်မှု၊ လုပ်ငန်းလည်ပတ်မှုကြောင့် ဖြစ်ပေါ်လာနိုင်သော အမျိုးမျိုးသော ထိခိုက်မှုများဖြစ်သည့် ဆူညံမှု၊ ဖုန်မှုန့်၊မြစ်ရေနောက်ကျိမှု၊ ပို့ဆောင်ဆက်သွယ်ရေးလုံခြုံမှု၊ ရေကြောင်းပို့ဆောင်ဆက်သွယ်ရေး၊ မြစ်ကမ်းနံရံများ ပြိုကျပျက်ဆီးခြင်းနှင့် သဘာဝသယံဇာတများ ပျက်စီးခြင်းကို သိရှိလိုကြပါသည်။

၁. ၈. ၂ ဆွေးနွေးမှုဆောင်ရွက်ချက်များအကျဉ်းချုပ်

(၁) နယ်မြေသတ်မှတ်ခြင်းအဆင့်တွင် PCD ပြုလုပ်ခြင်း

အစည်းအဝေးရက်စွဲ၊ အဖွဲ့အစည်းအုပ်စုများ၊ တက်ရောက်သူအရေအတွက်တို့ကို အောက်ဖော်ပြပါ ဇယားတွင်ဖော်ပြထားပါသည်။

အစည်းအဝေးရက်စွဲ	အဖွဲ့အစည်း/နာမည်	တက်ရောက်သူအရေအတွက်
၂၀၁၅ခုနှစ် ဧပြီလ ၂၃ရက်	ကျောက်ဆည်မြို့နယ်	
	၁။ အစိုးရဌာနများ	၂၄
	၂။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ကိုယ်စားလှယ် (HTCT)	၃
	၃။ EIA အကြံပေး (TEAM)	၄
၂၀၁၅ခုနှစ် ဧပြီလ ၂၇ရက်	ပြင်ဦးလွင်မြို့နယ်	
	၁။ အစိုးရဌာနများ	၁၈
	၂။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ကိုယ်စားလှယ် (HTCT)	၃
	၃။ EIA အကြံပေး (TEAM)	၅
၂၀၁၅ခုနှစ် ဧပြီလ ၂၉ရက်	မန္တလေးတိုင်းဒေသကြီး ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန	
	၁။ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာနရုံးများ	၃
	၂။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ကိုယ်စားလှယ် (HTCT)	၁
	၃။ EIA အကြံပေး (TEAM)	၄
	ယေဘူယျလူထု - ဒေသခံလူထုအဖွဲ့အစည်း	
၂၀၁၅ခုနှစ် ဧပြီလ ၂၅ရက်	၁။ သရက်ပင်ရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့်

အစည်းအဝေးရက်စွဲ	အဖွဲ့အစည်း/နာမည်	တက်ရောက်သူအရေအတွက်
		ကျေးရွာသူ/သားများ (စုစုပေါင်း ၈၄ဦး)
၂၀၁၅ခုနှစ် ဧပြီလ ၂၆ရက်	၂။ ငှက်ကြီးသိုက်ကျေးရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၇၂ဦး)
၂၀၁၅ခုနှစ် ဧပြီလ ၂၈ရက် (နံနက်)	၃။ မန်ကျည်းအင်းကျေးရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၃၅ဦး)
၂၀၁၅ခုနှစ် ဧပြီလ ၂၈ရက် (ညနေ)	၄။ ဝါးနက်ကျေးရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၇၃ဦး)

အခြားပါဝင်အကြံပေးသူများ၏ ဆွေးနွေးချက်အကျဉ်းချုပ်ကို အပိုင်းများခွဲ၍ ဖော်ပြထားပါသည်။

(က) အစိုးရအာဏာပိုင်များ

- ကျောက်ဆည်မြို့နယ်

- အစိုးရရုံးများမှ စီမံကိန်းအား ကန့်ကွက်ရန် အကြောင်းပြချက်မရှိပါ။ သို့သော် စီမံကိန်းအနီးအနားရှိ ကျေးရွာလူထုနှင့် ကျောင်းသားကျောင်းသူများအပေါ် ပတ်ဝန်းကျင်နှင့် ကျန်းမာရေးဆိုင်ရာ ထိခိုက်မှုများအကြောင်း သိရှိလိုပါသည်။

- မြစ်ငယ်မြစ်၏ လက်ရှိ ၈ အဆင့်သည် မြင့်တက်လျက်ရှိပြီး စီမံကိန်းလုပ်ငန်းလည်ပတ်မှု ကာလတွင်လည်း ပိုမိုမြင့်တက်မှုဖြစ်ပေါ်မှု ရှိ/မရှိကို သိရှိလိုပါသည်။

- စီမံကိန်းကြောင့် ကျေးရွာဖွံ့ဖြိုးတိုးတက်ခြင်း၊ လမ်းပန်းဆက်သွယ်ရေးတိုးတက်ခြင်း၊ လျှပ်စစ်မီး ထောက်ပံပေးခြင်းနှင့် ခရီးသွားလုပ်ငန်းဖွံ့ဖြိုးတိုးတက်စေခြင်းတို့ကို ထောက်ပံ့ပေးရန် မျှော်လင့် ပါသည်။

- တည်ဆောက်ရေးလုပ်ငန်းများကြောင့် ပုဂ္ဂလိကမြေများ အသုံးပြုရန်လိုအပ်လာပါက မြေပိုင်ရှင် များအား ကြိုတင်ပြီး စနစ်တကျအကြောင်းကြားရန် လိုအပ်ပါသည်။

- ပြင်ဦးလွင်မြို့နယ်

- အစိုးရရုံးများမှ စီမံကိန်းအားကန့်ကွက်ရန် ရည်ရွယ်ချက်မရှိပါ။

- မြန်မာနိုင်ငံတွင် မြေယာပေးလျော်မှုကဏ္ဍမှာ ပြဿနာကြီးတစ်ရပ်ဖြစ်ပါသည်။ စီမံကိန်းမှ ၎င်းမြေယာပေးလျော်မှုကို အထူးဂရုပြုရန်နှင့် စီမံကိန်းကြောင့်ထိခိုက်ခံရသော မြေပိုင်ရှင်ကျေးရွာလူထုအား စနစ်တကျအကြောင်းကြားပြီး ပွင့်လင်းမြင်သာမှုရှိပြီး တရားမျှတစွာ ပေးလျော်မှုများ ပြုလုပ်ရပါမည်။

(ခ) ဒေသခံကျေးရွာလူထုများ

- အစည်းအဝေးတက်ရောက်သူများမှ စီမံကိန်းနှင့်ဆက်စပ်နေသောကျေးရွာများအပေါ် အပြုသဘောမြင်ကြပါသည်။

- ၎င်းတို့သည် စီမံကိန်းတည်ဆောက်ခြင်းနှင့် လုပ်ငန်းလည်ပတ်မှုကြောင့်ဖြစ်ပေါ်လာနိုင်သော အောက်ဖော်ပြပါ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာထိခိုက်မှုများအပေါ် သိရှိလိုသည်များရှိပါသည်။

- လယ်ယာမြေများအပေါ်ထိခိုက်မှု (ရေကြီးရေလျှံခြင်းနှင့် မြေယာရယူခြင်း)

- ဖုန်မှုန့်၊ ဆူညံမှုနှင့် တုန်ခါမှု၏ ထိခိုက်မှု

- မြစ်ရေအရည်အသွေးနှင့် နောက်ကျိမှုအပေါ်ထိခိုက်မှု

- ရေကာတာကျိုးပျက်ခြင်း ထိခိုက်မှု

- သင့်တော်သော လျော့ချမှုနည်းလမ်းများ အသုံးပြုခြင်းနှင့် တရားမျှတသော မြေယာပေးလျော်မှုများ ပြုလုပ်ရပါမည်။

- ဒေသခံများအတွက် အလုပ်အကိုင် အခွင့်အလမ်းများရရှိခြင်းနှင့် အခြေခံလိုအပ်ချက်များကို စီမံကိန်းထောက်ပံ့ခြင်း (လျှပ်စစ်မီးနှင့် ရေထောက်ပံခြင်းစနစ်)တို့ကို ပြုလုပ်ပေးစေလိုပါသည်။

(၂) EIA အစီရင်ခံစာပြင်ဆင်နေချိန်တွင် ပြုလုပ်သော PCD

အစည်းအဝေးရက်စွဲ၊ အဖွဲ့အစည်းအုပ်စုများ၊ တက်ရောက်သူအရေအတွက်တို့ကို အောက်ဖော်ပြပါ ဇယားတွင်ဖော်ပြထားပါသည်။

အစည်းအဝေးရက်စွဲ	အဖွဲ့အစည်း/နာမည်	တက်ရောက်သူအရေအတွက်
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၁ရက်	ကျောက်ဆည်မြို့နယ်	
	၁။ အစိုးရဌာနများ	၂၀
	၂။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ကိုယ်စားလှယ် (DHPI နှင့် HTCT)	၅
	၃။ EIA အကြံပေး (TEAM)	၃
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၅ရက်	ပြင်ဦးလွင်မြို့နယ်	
	၁။ အစိုးရဌာနများ	၁၄
	၂။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ကိုယ်စားလှယ် (DHPI နှင့် HTCT)	၅
	၃။ EIA အကြံပေး (TEAM)	၅
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၇ရက်	မန္တလေးတိုင်းဒေသကြီး ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန	
	၁။ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာနရုံးများ	၆
	၂။ စီမံကိန်းအကောင်အထည်ဖော်သူ၏ကိုယ်စားလှယ် (DHPI နှင့် HTCT)	၂
	၃။ EIA အကြံပေး (TEAM)	၅
	ယေဘူယျလူထု - ဒေသခံလူထုအဖွဲ့အစည်း	

အစည်းအဝေးရက်စွဲ	အဖွဲ့အစည်း/နာမည်	တက်ရောက်သူအရေအတွက်
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၃ရက် (နံနက်)	၁။ သရက်ပင်ရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၁၀၂ဦး)
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၃ရက် (ညနေ)	၂။ ဌက်ကြီးသိုက်ကျေးရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၂၂ဦး)
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၄ရက် (နံနက်)	၃။ မန်ကျည်းအင်းကျေးရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၅၆ဦး)
၂၀၁၅ခုနှစ် အောက်တိုဘာလ ၄ရက် (ညနေ)	၄။ ဝါးနက်ကျေးရွာ	ကျေးရွာအုပ်ချုပ်ရေးမှူး၊ ကျေးရွာကော်မတီ၊ လူထုခေါင်းဆောင်များနှင့် ကျေးရွာသူ/သားများ (စုစုပေါင်း ၆၀ဦး)

အခြားပါဝင်အကြံပေးသူများ၏ ဆွေးနွေးချက်အကျဉ်းချုပ်ကို အပိုင်းများခွဲ၍ ဖော်ပြထားပါသည်။

(၁) အစိုးရအာဏာပိုင်များ

- ကျောက်ဆည်မြို့နယ်
  - စီမံကိန်းဆောက်လုပ်ရေး မည်သည့်အချိန်တွင် စတင်မည်နည်း။
  - ထိခိုက်သူများအား ပေးလျော်ခြင်း
  - ဒေသခံများ ရေအသုံးပြုမှု ထိခိုက်ခြင်း
  - မြစ်အောက်ပိုင်းဧရိယာ၏ မြစ်ရေအရည်အသွေးထိခိုက်ခြင်း
  - စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့် ရေလွှမ်းခံရမည့် ဧရိယာများ
  - မြစ်ရေတွင် ဆားငန်ဝင်ရောက်လာနိုင်မှုကို မည့်သို့ထိန်းချုပ်မည်နည်း။
  - ရေကြောင်းသွားလာမှုကို မည်သို့စီမံခန့်ခွဲမည်နည်း။
- ပြင်ဦးလွင်မြို့နယ်
  - ဆောက်လုပ်ရေးကန်ထရိုက်တာမှ လျော့ချရေးနည်းလမ်းများ လုပ်ဆောင်မှုကို သေချာစွာ အကောင်အထည်ဖော်ရန်လိုအပ်ပါသည်။
  - ဆောက်လုပ်ရေးကန်ထရိုက်တာမှ ဒေသခံကျေးရွာလူထုနှင့် အမြဲမပျက် ဆက်သွယ် နေရပါမည်။
  - မြေယာပေးလျော်မှု ပြဿနာကို အစိုးရအုပ်ချုပ်ရေးရုံး၊ စီမံကိန်း အကောင်အထည် ဖော်သူနှင့် ဒေသခံကျေးရွာလူထုအကြားတွင် ဆွေးနွေးညှိနှိုင်းမှုများ ပြုလုပ်ရန် လိုအပ်ပါသည်။

- ဒေသခံကျေးရွာလူထုသည် အမှန်တကယ်မြေယာမပိုင်သော်လည်း ၎င်းတို့တွင် အသုံးပြုပိုင်ခွင့်ရှိပါသည်။ နိုင်ငံပိုင်မြေဖြစ်ပြီး အစိုးရမှ စီမံကိန်းဖွံ့ဖြိုးတိုးတက်မှု အတွက် မြေအသုံးပြုမည်ဆိုပါက မြေပိုင်ဆိုင်သူကို ပေးလျော်ရမည် ဖြစ်ပါသည်။
- စီမံကိန်းလည်ပတ်မှုကာလတွင်လည်း ရေရှည်လျော့ချရေးနည်းလမ်းများ ရှိသင့် ပါသည်။
- စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့် ထိခိုက်သော မြေယာနှင့် ပိုင်ဆိုင်မှုတို့ကို အသေးစိတ်စာရင်းစစ်တမ်း ထားရှိသင့်ပါသည်။

(၂) ဒေသခံကျေးရွာလူထုများ

- ၄က်ကြီးသိုက်ကျေးရွာ
  - စီမံကိန်းကြောင့်ထိခိုက်သောဧရိယာနှင့် ပိုင်ဆိုင်မှုများ၏ မည်သည့် ပေးလျော်မှု နှုန်းနှင့် ပေးလျော်မည်နည်း။
  - စီမံကိန်းအကောင်အထည်ဖော်သူမှ အခြေခံဖွံ့ဖြိုးမှုများဖြစ်သည့် စာကြည့်တိုက် ဆောက်လုပ်ပေးခြင်း၊ ဆရာမ၊ ဆရာဝန်များ နေထိုင်ရာ ဝန်ထမ်းအိမ်ယာများ တည်ဆောက်ပေးခြင်းတို့ကို ထောက်ပံ့ပေးရပါမည်။
  - စီမံကိန်းတည်ဆောက်မှုတွင် ဒေသခံလူထုနှင့် ဒေသခံယာဉ်များ အလုပ်အကိုင် အခွင့်အလမ်းရရှိအောင်ဆောင်ရွက်ပေးရန်
  - ဒေသခံ ၃ဦး၏ မြေယာအကုန်လုံးသည် ရေကြီးရေလျှံခြင်းခံရမည်ဖြစ်ပြီး အခြားသော ဒေသခံ ၃ဦး၏ မြေယာ တစ်စိတ်တစ်ပိုင်းသည် ရေကြီးရေလျှံခြင်း ခံရမည်ဖြစ်ပါသည်။

- သရက်ပင်ကျေးရွာ

- စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့် ရေကြီးရေလျှံမှုအဆင့် မည်သို့ရှိမည်နည်း။
- မြစ်ငယ်မြစ်ကမ်း ၂ဖက်လုံး၏ မြေယာပေးလျော်မှုနှုန်းမှာ တူညီသင့်ပါသည်။
- မြစ်ဖြတ်ကူးရာတွင် weir crest ကို အသုံးပြုလိုပါသည်။
- ကျေးရွာလူထုသည် ရဲရွာရေကာတာ လုပ်ဆောင်မှုများ၏ မကောင်းသော အတွေ့အကြုံများရရှိဖူးပါသည်။ ဥပမာ- ကျောက်မိုင်းတူးဖော်ခြင်းမှ ထိခိုက်မှုများ၊ ပေါက်ကွဲမှုများမှ တုန်ခါမှုများနှင့် ရေနောက်ကျိမှုများ ဖြစ်ပေါ်ခြင်းတို့ဖြစ်ပါသည်။

- မန်ကျည်းအင်းကျေးရွာ

- စီမံကိန်းအကောင်အထည်ဖော်မှုကို သဘောမတူပါ။
- ရေကြီးရေလျှံမှုဖြစ်ပေါ်မည့်ဧရိယာကို ပိုင်းခြားသတ်မှတ်သင့်ပါသည်။
- မြစ်ငယ်မြစ်ကမ်း ၂ဖက်လုံးတွင် ရေကြီးရေလျှံမှုဖြစ်ပေါ်မည်ကို စိုးရိမ်ကြပါသည်။

- ဝါးနက်ကျေးရွာ

- စီမံကိန်းထိခိုက်မှုဧရိယာနှင့် ပိုင်ဆိုင်မှုများအတွက် ပေးလျော်ခြင်းနှုန်းထား မည်သို့ရှိသနည်း။
- ဒေသခံများအတွက် အလုပ်အကိုင်အခွင့်အလမ်းများရရှိစေခြင်း
- ကျေးရွာလူထုသည် ရဲရွာရေကာတာ လုပ်ဆောင်မှုများ၏ မကောင်းသော အတွေ့အကြုံများရရှိဖူးပါသည်။ ဥပမာ- ကျောက်မိုင်းတူးဖော်ခြင်းမှ ထိခိုက်မှုများ နှင့် ရေအတက်အကျ ဖြစ်ပေါ်မှုကြောင့်ထိခိုက်မှုတို့ဖြစ်ပါသည်။

၁. ၈. ၃ EIA သုံးသပ်နေသည့်ကာလတွင် တွေ့ဆုံဆွေးနွေးခဲ့သည့် ရလဒ်များ

EIA ကိုသုံးသပ်နေသည့်ကာလတွင် စီမံကိန်း အကောင်အထည်ဖော်သူမှ လူထုတွေ့ဆုံဆွေးနွေးပွဲကို ၂၀၁၈ခုနှစ်၊ ဧပြီလ ၂၃ရက်နေ့တွင် ပြုလုပ်ခဲ့ပြီး ဒေသခံလူထု တွေ့ဆုံပွဲအခမ်းအနားတွင် အောက်ဖော်ပြပါ မေးခွန်းများကို မေးကြားခဲ့ပါသည်။

- မြေယာ ရယူခြင်းဆိုင်ရာ ထိခိုက်မှုများ၊
- ရဲရွာ ရေကာတာ၏ ဆက်စပ်သက်ရောက်မှုများပါဝင်သော ရေ အရည်အသွေး ထိခိုက်မှုများ၊
- အကျိုးသက်ရောက်မှုများ ခွဲဝေခြင်းဆိုင်ရာ အစီအစဉ်များ ပါဝင်ခြင်း၊
- ဘေးအန္တရာယ် စီမံခန့်ခွဲခြင်း အစီအစဉ်/ ရေကာတာ ဘေးကင်းရေး အစီအစဉ်
- တည်ဆောက်ရေးကြောင့် ဖြစ်ပေါ်လာသော လူမှုရေးနှင့် ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများ (ဖုန်မှုန့်၊ ကျန်းမာရေး၊ ဆူညံသံ စသည်)
- ကျန်းမာရေးဆိုင်ရာ စစ်တမ်းကောက်ယူခြင်းနှင့် ဖြစ်ပေါ်လာနိုင်သော ကျန်းမာရေး ထိခိုက်မှုများ၊
- အလုပ်သမားများ ဝင်ရောက်လာမှုကြောင့် ထိခိုက်မှု တို့ဖြစ်ပါသည်။

၁. ၈. ၄ ဆက်လက်လုပ်ဆောင်နေသော ဆွေးနွေးမှုများအတွက် အကြံပြုချက်များ

စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့်သက်ရောက်မှုခံရသည့်လူထု (PAPs)၊ ပါဝင်ပတ်သက်သူ များနှင့် စီမံကိန်းအကောင်အထည်ဖော်ခြင်းကို စိတ်ပါဝင်စားသူများထံမှ အပြည့်အဝနားလည်မှုနှင့် ထောက်ခံမှုရရှိရန် လိုအပ်ပြီး ၎င်းတို့သည် စီမံကိန်းဖွံ့ဖြိုးမှုအစီအစဉ်များကို စတင်လုပ်ဆောင်သည့်အချိန်မှစ၍ အပြည့်အဝပူးပေါင်းဆောင်ရွက်ရန် အရေးကြီးပါသည်။ ၎င်းလုပ်ရှားမှု အစီအစဉ်များမှာ

(၁) သတင်းအချက်အလက်များဖြန့်ဝေခြင်း

စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့်သက်ရောက်မှုခံရသည့်လူထု(PAPs) ထံသို့ အောက်ဖော်ပြပါ သတင်းအချက်အလက်များ ဖြန့်ဝေခြင်း

- စီမံကိန်းအစိတ်အပိုင်းများ
- စီမံကိန်းစတင်လုပ်ဆောင်မည့်အချိန်ဇယား
- စီမံကိန်းပေါ်လစီနှင့် လုပ်ထုံးလုပ်နည်းများ အကောင်အထည်ဖော်မှု အသေးစိတ် သတင်းအချက်
- ပေးလျော်ခြင်းအစီအစဉ်နှင့် ရပိုင်ခွင့်များ
- The grievance mechanism နှင့် အယူခံဝင်မှုအစီအစဉ်
- ပါဝင်ဆောင်ရွက်မှုနည်းလမ်းနှင့် တိုင်ပင်မှု
- ဘဝနေထိုင်မှုတိုးတက်စေရန် နှင့်လူမှုရေးဆိုင်ရာ ဖွံ့ဖြိုးတိုးတက်မှုအစီအစဉ်
- အဖွဲ့အစည်းများ၏ တာဝန်ယူမှုများတို့ဖြစ်ပါသည်။

(၂) စီမံကိန်းအကောင်အထည်ဖော်မှုကြောင့်သက်ရောက်မှုခံရသည့်လူထု (PAPs) နှင့် ဆွေးနွေး တိုင်ပင်ခြင်း

(က) ပေးလျော်ခြင်းငွေပေးချေမှု သတင်းအချက်အလက်များကို စီမံကိန်း အကောင် အထည်ဖော်မှုကြောင့် သက်ရောက်မှုခံရသည့်လူထု(PAPs)အား အကြောင်းကြားစာထုတ်၍ အကြောင်းကြားဆောင်ရွက်ဖြစ်ပါသည်။ PAPs သည် မြေယာပိုင်ဆိုင်ကြောင်း အထောက်အထားများ (ဥပမာ - မှတ်ပုံတင်၊ မြေအမျိုးအစား စသည်ဖြင့်) နှင့်အတူ ကြိုတင်အကြောင်းကြား၍ ပေးလျော်ခြင်းငွေပေးချေမှုအတွက် ယူဆောင်လာရန်လိုအပ်ပါသည်

(ခ) ပြန်လည်ထူထောင်ရေးနှင့်လူသားချင်းစာနာမှုအကူအညီပေးရန်အတွက် PAPs များနှင့်ဆွေးနွေးကာ ဦးစားပေးအတည်ပြုရပါမည်။

(ဂ) ဆောက်လုပ်ရေးလုပ်ငန်းများစတင်ရန် စီမံကိန်းနေရာကြိုတင်ရှင်းလင်းခြင်း သတင်း အချက်အလက်များကို PAPs ထံသို့ အကြောင်းကြားရပါမည်။

(ဃ) ရုပ်ပိုင်းဆိုင်ရာအလုပ်များ စတင်လုပ်ဆောင်ခြင်းနှင့် ဆက်လက်လုပ်ဆောင်ခြင်း အချိန်ဇယားကို PAPsများ သိရှိစေရန် အကြောင်းကြားရပါမည်။

(င) PAPs များပါဝင်သော ဝင်ငွေပြန်လည်ထူတောင်ရေးလုပ်ဆောင်မှုများအတွက် ဆွေးနွေးခြင်းနှင့် အတည်ပြုခြင်းတို့ ပြုလုပ်ရပါမည်။

(စ) လူထု/လူမှုရေးဖွံ့ဖြိုးတိုးတက်မှုဆိုင်ရာအစီအစဉ်ကို ဏာပဏျ များနှင့်ဆွေးနွေးတိုင်ပင် ရပါမည်။

(ဆ) စီမံကိန်းအကောင်အထည်ဖော်စဉ်ကာလတွင် စောင့်ကြပ်ကြည့်ရှုခြင်းလုပ်ဆောင်မှု များကို PAPs များထံသို့ အကြောင်းကြားရပါမည်။

CHAPTER 1

EXECUTIVE SUMMARY

1.1 BACKGROUND ON PROJECT DEVELOPMENT AND THE EIA

1.1.1 Project Origin and Preparation

On 20 November 2014, the Ministry of Electricity and Energy (MOEE) of the Government of Myanmar, signed a memorandum of understanding (MOU) with ANDRITZ Hydro GmbH of Austria (ANDRITZ), on the development of the Deedoke Hydropower Project (the Project) on the Myitnge River in Mandalay Region. The Project will construct and operate a run-of-river, low head hydropower scheme with a generation capacity of about 66 MW[1]. The Deedoke dam site will be located at about 21.1 km (13.18 miles) downstream of the existing Yeywa hydropower scheme. The Project will be implemented through a JV or BOT arrangement by a consortium consisting of ANDRITZ as the lead partner and national and international partners.

The feasibility study (FS) of the Project, including its environmental and social impact assessment (EIA), was prepared by the consortium Gruner GmbH/Stucky Ltd. with TEAM Consulting Engineering and Management Co., Ltd., Thailand (TEAM), and Total Business Solution Co., Ltd., Myanmar (TBS) as sub-consultant (EIA Consultant) for the EIA. Technical investigation under the FS was carried out from December 12, 2014 to July 2015. The EIA was carried out in parallel with the technical study, from 1 January to 16 November 2015, to ensure that environmental and social aspects of the Project would receive due attention in the site selection and technical design of the Project. The technical study and EIA studies were carried out in close cooperation with MOEE and concerned environmental agencies at the national, regional and district levels.

1.1.2 MONREC's Comments on Scoping Report

As required in the EIA process, ANDRITZ submitted the Scoping Report prepared by the EIA Consultant to the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) in August 2015. MONREC had recommendations on compensation concept for agricultural land to be lost, job opportunities for project affected persons (PAPs), concerns of PAPs on project impacts and safety. The recommendations from MONREC have been duly considered and incorporated in the EIA report.

Subsequently, the EIA study was carried out according to the TOR for the EIA presented in the Scoping Report and the comments received from MONREC.

[1] All project related figures in this report are still tentative and subject to confirmation by the detailed design study.

1.1.3 Related Project and Development

The related project and development is Yeywa Hydro Power Project (commissioned in 2010) which is located on Myitnge River approximately 50 km. southeast of Mandalay in Central Myanmar, about 21.1 km upstream of Deedoke dam site. The main component of Yeywa Hydro Power Plant includes the Yeywa 134 m high RCC Dam with a reservoir of 2,630 million cubic meters and a 790 MW capacity Power Station (4 Francis turbines, each with design discharge 210 m^3/s).

Deedoke low-head HPP is to supplement energy production from Yeywa HPP, particularly during the dry season. The water available at Deedoke HPP is the outflow from Yeywa reservoir, i.e., the controlled releases from the powerhouse and spillways.

1.2 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

1.2.1 Corporate Environmental and Social Policies

The Project Proponent is committed to the sustained protection of the environmental in parallel with economic growth and social progress.

The Andritz Hydro has its own Health, Safety and Environmental policies put in force through Regulations R HY QM 003 and R HY QM 004 and applied to all locations.

It also has the integrated environment management system based on the following principles:

(1) Avoiding of negative environmental effects (prevention)
(2) Reduction of negative environmental impacts.
(3) Recycling of materials and substances
(4) Disposal of unavoidable residuals.

Being one of the first major players in energy sector in Myanmar, High Tech Construction Trust Co., Ltd. (HTCT), a subsidiary of Shwe Taung Group, is a leading project management and construction company, known for the ability to deliver high-quality infrastructure projects on time and budget. With a strong commitment to health and safety, HTCT provides innovative and industry-leading project management, construction and design services across the Country.

(1) Human Rights and Labour Rights Policy
(2) Transparency
(3) Workplace Health and Safety Policy
(4) Community and Environment; Sustainability Policy
(5) Community and Environment: Environmental
(6) Health and Safety
(7) Environment

KANSAI Electric Power (KANSAI) defines and practices the five items outlined right as our Action Standards for Procurement Activities. KANSAI furthermore utilizes business negotiations, plant visits and the like to explain and promulgate CSR Procurement Policy to partners.

Action Standards for Procurement Activities

(1) Highest priority to the safety, maintenance and improvement of quality and technical strength
(2) Being environmentally friendly
(3) Establishment of fiduciary partnership
(4) Transparent, open business activities
(5) Strict enforcement of compliance

1.2.2 Policy and Legal Framework

(1) Foundation of Environmental Management

The National Environmental Policy (1994) establishes the foundation for environmental management in socio-economic development by advocating the principle of sustainable development through integrating environmental management with economic development. Implicitly, the Policy covers not only the physical environment but also the biological environment, the socio-economic environment, and cultures and heritage. The Policy supports Articles 37, 42 and 390 of the new Constitution (2008) and is translated into actions by the Environmental Conservation Law (2012). The Environmental Conservation Law and the associated Environmental Conservation Rules are comprehensive legal document which provide the legal framework for environmental management of the country.

(2) EIA Process and Environmental Management Requirements

The EIA Procedure is the key legal instrument for environmental management of development activities. It prescribes requirements that a Project Proponent has to comply with, covering the conduct of EIA, issuance of an environmental compliance certificate upon approval of an EIA report or environmental management plans, and monitoring and reporting environmental management performance during the project construction and operational phases.

(3) Environmental and Social Management Standards and Criteria

National environmental and social criteria and standards are still in the development stage to make them in line with international practices. Therefore, impact assessment and formulation of impact mitigation measures in this EIA study were based on applicable criteria and standards advocated by the World Bank Group.

(4) International Conventions, Treaties and Agreements

Myanmar has signed several international conventions, treaties and agreements related to the environment;

a. Plant Protection Agreement for the South-East Asia and the Pacific Region, Rome, 1956

b. United Nations Framework Convention on Climate Change, New York, 1992 (UNFCCC)

c. Convention on Biological Diversity, Rio de Janeiro, 1992

d. The Convention for the Protection of the World Culture and Natural Heritage, Paris, 1972

e. ASEAN Agreement on the Conservation of Nature and Natural Resources, Kuala Lumpur, 1985

f. Catagena Protocol on Biosafety, Cartagena, 2000

g. Kyoto Protocol to the Convention on Climate Change, Kyoto, 1997

The Project will support the Government to reduce greenhouse gas emission in power generation as required in the Kyoto Protocol.

(5) International Policies, Guidelines and Standards

International policies, guidelines and standards relevant to environmental and social impacts of projects that are referred to by most countries are those issued by the World Health Organization (WHO), the U.S. Environmental Protection Agency (EPA), the World Bank, and the International Finance Corporation (IFC).

1.2.3 Myanmar Government Institutional Framework

1.2.3.1 Arrangement at the National and Sector Level

At the national level, the Environmental Conservation Committee (ENCC) serves as mechanism for inter-ministerial coordination. Authorities and functions of ENCC are prescribed in Articles 7 to 13 of the EC Rules.

One of ENCC's main functions related to this Project is to oversee the management of the EIA process by MONREC through ECD. ECD will serve as coordinator among various concerned sector departments to ensure that the EIA and implementation of EMP will address environmental and social issues of concerns of relevant sector departments.

The EIA process for this Project will be administered by the central ECD in coordination with the regional ECD and various government organizations at the regional, township, and district levels.

1.2.3.2 Sectorial Framework/Mechanism

Governmental organizations and their prime environmental issues are National Commission for Environmental Affairs, Ministry of Natural Resources and Environmental Conservation, Ministry of Agriculture and Irrigation, Ministry of Livestock and Fisheries, Ministry of Industry, Ministry of Health, Ministry of Energy, Ministry of Electric Power, Ministry of Transport, Ministry of Home Affairs, Ministry of Labor, Ministry of Science and Technology, Ministry of Education, Ministry of National Planning and Economic Development, Ministry of Progress of Border Areas, National Races and Development Affairs, Myanmar Investment Commission, National Commission for Water and Sanitation, Industrial Development Central Committee.

1.3 PROJECT DESCRIPTION

1.3.1 Presentation of the Project and Description of Alternatives

The Deedoke Hydropower Project is planned as a Run of River (ROR) type hydropower project on Myitnge River 21 km downstream from Yeywa HPP, 30 km southeast of Mandalay City, and 82 km upstream from the confluence of Myitnge River with Irrawaddy River. The left bank area is within in Kyaukse Township and the right bank area within Pyin Oo Lwin Township of Mandalay Region.

One of characteristics of a ROR hydropower project is that flow rates (m3/s) of inflow and outflow of the project are similar through a year. The reason is that generally a ROR hydropower project has only a pond of which volume is too small to regulate river inflow, unlike a reservoir type hydropower project such as the Yeywa HPP. Therefore, as Deedoke's inflow is depending on Yeywa's outflow, it could be said that the Project will not significantly change the present river flow regime of the Myitnge River downstream reaches of the Yeywa HPP even in rainy seasons and dry seasons.

Facilities	Salient Features
Dam	Submerge rounded crest weir with a slope on both side, crest elevation 65 m.asl, total length 150 m
Gates	Seven tainter (radial) gates, each 17 m width
Stilling basin	Length about 50 m
Power house	Location on the left side of the dam Three bulb turbine generators, generator output 29 MVA each,
Access road	Two access roads to the project site from the existing roads, one on the left bank about 430 m and another on the right bank about 570 m, both branching out from the existing roads, total length 1,000 m
Transmission lines	One 132 kV 2 circuits line to Belin Substation on the left bank, length 20 km
Substations	Belin Substation 132 kV 2 bays (extension in the substation compound)
Support buildings	-

For a ROR hydropower project, the selected dam site and power house arrangement will have environmental and social implications. If the power house is separated and located downstream of the dam with a waterway as shown in ***Figure 4.1-5***, a required minimum flow will be an issue in the river section between the dam and tailrace of the powerhouse. However, for the Project, the powerhouse is planned at an integral part of the dam. Therefore, there will be no dry river section downstream of the dam.

The technical study identified four alternative dam sites downstream of Yeywa Dam: (i) site upstream of the rapids; (ii) site at cross section 44; (iii) site at cross section 46; and (iv) site at cross section 54.

1.3.2 Comparison and Selection of Alternatives

The dam site selection was made in two steps. The first step was an initial screening to screen out unsuitable sites. The second step was detailed evaluation of the remaining candidate sites.

The first step of evaluation was based mainly on following criteria:

External constraints:

- Settlements;
- Agricultural areas;
- Religious structures (pagodas);
- Sacred Tree.

Technical assessment criteria:

- Foundation;
- Environmental and social impact;
- Hydraulics and energy production.

The second step evaluated the remaining sites in terms of general layout, energy production, geotechnical conditions, and environmental and social impacts.

The section at cross section 54 was selected as the most preferred alternative for a detailed optimization and for carrying out the preliminary design.

1.3.3 Description of the Selected Alternative

(1) Layout of Project Facilities

The layout of project facilities at the selected dam site is already presented in ***Figure 4.3-1*** in ***Chapter 4***.

(2) Access Roads

There will be two access roads to the project site, one on the right bank and another on the left bank.

The access road on the right bank will take off from the existing road to the project site. The total length will be about 570 m. The road will be constructed on an embankment at 84 m.asl to be above the maximum flood level of about 82 m.asl.

A section of the existing road on the left bank will be realigned and elevated to serve as the access road to the project site on the left bank. The length of the upgrade road will be about 430 m and its elevation will be at about 84 m. asl above the maximum flood level of about 82 m.asl.

(3) Dam

The dam will be designed as gated submerged weir structure adjoining the power house.

The spillway section will be about 141. 5 m long and 26 m high. The spillway will be submerged weir structure with tainter (radial) gates for flow control. The spillway is designed to handle a flood discharge of 7,300 m^3/s based on a flood return period of 10,000 years.

The spillway structure will raise and keep water level at the dam at a maximum operating level of 80 m. asl. The volume of river water between the Deedoke Dam and Yeywa Dam will be about 23 million m^3.

The free board at the dam will normally be about 4 m decreasing to 1 m during flood peaks.

(4) Power House

The power house section is separated from the spillway section by a partition wall. It has a length of about 67 m. It accommodates three bulb turbine generators.

(5) Stilling Basin

The stilling basin serves to dissipate energy and prevent river bed erosion. It will be designed as Type IV with a length of about 50 m.

(6) Seepage Control

The seepage control will be achieved through a combination of a grout curtain of about 33 m and an extended drainage at the immediate downstream of the grout curtain. This design can significantly reduce the uplift pressure and hence improve the stability condition of the dam.

(7) Switchyard

A switchyard will be located at the west side of the power house on a 40x50 m land plot.

(8) Transmission Line

A transmission line (T/L) of 132 kV with double circuits and 20 km length is presently planned as instructed by MOEE in 2017 that the Deedoke T/L should be connected to the existing Belin substation.

(9) Flood Warning System

A flood warning system in case of critical flood is planned for warning to immediate upstream and downstream peoples and communities.

1.3.4 Construction Plan and Activities

The construction schedule covered 4 to 4.5 years will be carried out in four phases comprising;

- Phase 0 - Site Preparation and New Access Roads is covered about one month.
- Phase 1 - Construction of the Separation Wall and River Diversion Channel is covered about 1 to 1.5 years.
- Phase 2 - Construction of Spillway and Power House Structure is covered about 2 to 2.5 years.
- Phase 3 - Mechanical and Electrical Works at the Power House is covered about 1.5 to 2 years.

1.3.4.1 Method of Work

The general construction methodology of the main project component would be the following;

(1) Spillway

(2) Power house

(3) Switchyard

(4) Temporary Facilities

- Quarry
- Borrow pit
- Spoil bank
- Crushing plant
- Batching plant
- Turbid water treatment plant
- Temporary water supply
- Temporary power supply
- Permanent access road
- Base camp and worker camp
- Water treatment system in base camp and worker camp

1.3.5 Construction Inputs

Materials

All materials are available in sufficient quantity and quality in close distances. Based on the selected site option of C 700/ 3, in the Feasibility Report, required quantities of the construction materials are tentatively estimated as indicate in ***Table 4.3-10***.

Workers

The construction would require about 300 workers on average. The workers will be recruited locally as many as possible. Workers from other areas will stay on site in the provided camps.

1.3.6 Decommissioning/Closure/Post Closure Activities

As the contractor is responsible for environmental conservation, in accordance with the contract, the contractor shall restore the construction site to original conditions before handing over the site to the Project Proponent as follows;

(1) Site cleaning
(2) Erosion and sediment control
(3) Removal of materials from site

1.4 DESCRIPTION OF THE ENVIRONMENT

1.4.1 Setting the Study Limits

A. Study Area and Scope of Environment

The study areas covers project affected area as below.

Main Impact Study Area: This study area covers an area within 5 km radius from the river centerline at the proposed dam site. The area covers the entire construction areas on both banks of the river and outlying areas downstream and upstream of the dam.

Fishery Impact Study Area: This study area covers Myitnge River from Yeywa Dam to the proposed Deedoke Dam site and the downstream reach from the Deedoke Dam to the point where Myitnge River joins Irrawaddy River.

Transmission Line Impact Study Area-Left Bank: This study area covers a corridor of about 50 m width along the alignment of the left bank transmission line (25 m strips on both sides of the center line of the alignment).

Quarry Site Impact Study Areas: The impact study area for each quarry site covers an area within 1 km from the quarry site.

The scope of the Environment is prescribed in the EIA Procedure to cover physical, biological, socio-economic, cultural and visual components.

Information on environmental settings of the study area was collected from field investigation and literature review.

1.4.2 Physical Components

Climate

The climate of the Mandalay Region is influenced by southwest monsoon, which brings rain from June to October, and the dry north-east monsoon from November to May. The latter monsoon brings cooler weather at first, but temperatures rise during March, April and May and often exceed 40°C. Annual rainfall averages 1,000-1,800 mm. the climate of the project area is similar to that of Mandalay. The mean temperature in Mandalay is 27.8°C, with a maximum of 38.5°C in April and minimum of 13.8°C in January.

Geography

From Yeywa Dam, Myitnge River meanders to drain into the Irrawaddy River at Amarapura, about 93 km from Yeywa dam. Mountains along the river define broad river terraces with varying widths along both banks. The river terraces have no forest cover and are mainly used for agriculture. Most common fruit trees include mango, banana, and lemon. Some cash crops are also seen such as cotton, pea, and corn. The river banks are covered with reeds, shrubs, bushes, and weeds. River bank erosions are visible indicating the effect of high river flows during the wet season.

Geology

The general geological conditions of the project site can be characterized by Permo-Triassic dolomitic limestone, covered by river deposits.

Due to the limited damage potential of the Deedoke dam, SEE is taken as a PGA with a mean annual exeedance probablity of 1/2,475. Based on the conditions, stability of the Deedoke dam was studied, and safety against sliding, overturning and bearing capacity were confirmed.

Features	PGA	Seismic load*
OBE (Operational Basis Earthquake)	0.2 g (475 years)	0.13 g
SEE (Safety Evaluation Earthquake)	0.32 g (2,475 years)	0.21 g

Note: To compensate the quasi-static application of the dynamic loads in the stability analyses, a correction factor of 2/3 is applied to the peak ground accelerations according to the international standard (USACE).

Hydrology

The incremental catchment area between Yeywa reservoir and the proposed Deedoke HPP was estimated at 489 km^2 which is about 1.7% of Yeywa reservoir catchment area. The total catchment area of Deedoke HPP is therefore at 28,695 km^2. Outflows from Yeywa reservoir can be considered as inflows to Deedoke HPP. Also, the outflow design flood peaks from Yeywa reservoir can be considered as the inflow design flood peaks to Deedoke HPP. The water available at Deedoke HPP is the outflow from Yeywa Reservoir, i.e., the controlled releases from the Yeywa powerhouse and spillways.

Mineral Resources

The project area, particularly the main construction site, has no known valuable mineral resources apart from limestone and rock for construction materials.

Ambient Environmental Quality

Air Quality

The values of TSP and PM-10 both dry season and wet season were much below the permissible maximum values prescribed in Myanmar National Environmental Quality (Emission) Guidelines due to lack of industrial activities and low traffic loads on the nearby roads.

Noise

The maximum background noise level expressed in LAeq-1 hr. both dry season and wet season at all stations were exceeded the limit set by Myanmar National Environmental Quality (Emission) Guidelines during both daytime and nighttime while the average background noise levels expressed in L_{90} were significantly below the maximum limit set by IFC Standard.

Vibration

The magnitudes of background vibration levels at all stations both dry season and wet season were still much below the perceptible level of 2.0 mm/s prescribed in German Vibration Guideline Values (Din4150-3, 1999).

Surface Water Quality

Surface water quality in Myitnge River both dry and wet season was very clean as inferred from its high levels of DO, low levels of BOD_{5}, high transparency, low SS, low turbidity and low coliform counts. The water was however relatively high in TDS, total hardness, carbonate alkalinity, and Magnesium. These would be the products of leaching from the limestone geological structure of the river.

Surface water quality in Irrawaddy River was also clean although its Coliform was higher than the Myitnge River water. The water was slightly more turbid than that of Myitnge River. The river could be considered slightly polluted and the sources of pollution may be Sagaing City on the right banks of this river, about 1 km from the sampling station.

Groundwater Quality

Overall water qualities of the groundwater samples at all stations both dry season and wet season were met with the WHO's groundwater standards except conductivity which is higher than the WHO standard. It is noted that the concentrations of TDS and total hardness are quite high but still within suitable allowance value. The high concentrations of TDS and total harness would be due to the limestone geological structure in the project area.

1.4.3 Biological Components

Terrestrial Ecosystem

The study area has no forest cover both on land and on the mountains. The area is vegetated by bamboo, shrubs, bushes and weeds. Trees of various species scatter over the area, except fruit trees in agricultural areas. The area is characterized by dry and thinly vegetated land with no perennial water course. This type of land would not be able to support a rich terrestrial ecosystem. Large wildlife, especially animals would not exist. The study area does not seem to be rich in bird species. Some bird species were found on sand islands in the river sections far downstream from the alternative dam sites. Apparently, sand islands with thick vegetation are bird habitats.

The above observations suggest that terrestrial ecosystem would not be an issue subject to confirmation in a field survey to be made. The impacts on birds are not relevant as the bird habitats in the river are far downstream and would not be adversely effected by the Project operation.

Aquatic Ecosystem

It should be noted that the existing river ecosystem in the study area is the result of changes in flow regimes caused by the Yeywa hydropower project. Aquatic weeds were found to extensively grow on the river bed. This phenomenon was also found in rivers in Thailand after the operation of storage-dam hydropower schemes. Literature will be searched to find scientific explanation of this aquatic weed phenomenon.

Fishing activities in the river were not seen during the site visit. The village headmen confirmed that subsistence fishing was not commonly practiced. This suggests that the river in the study area is poor in fishery resources. The same village headman informed that fishing was practiced in the Yeywa dam reservoir, and that fish is abundant in the Irrawaddy River.

1.4.4 Socio-Economic Components

Land Use

The study area for project construction site of about 173.66 acre, in total. Mostly, 29.92% is forest area. Field crop area covers 22.71%, 21.63% of the study area is Mixed Orchard Plantation area, Natural Water Reservoir covers 12.02%, Perennial Crop covers 7.31%, Idle land covers 5.18% and Pasture Orchard Plantation covers 1.23%.

The study area of quarry site, it covers 36.32 acres is characterized by two types of land use: (i) idle land and (32.65%) (ii) rock pit (67.35%).

The study area of within 25 m strips of the proposed transmission line alignment, it covers 247 acres is characterized by nine types of land use: (i) road (0.72%); (ii) cantonments (0.79%); (iii) governmental institute (0.98%); (iv) fallow land (3.03%); (v) field crop (25.02%); (vi) virgin land (20.92%); (vii) mixed orchard plantation (0.98%); (viii) forest area (47.43%); and (ix) quarry site (0.13%).

Socio-Economic Conditions around the Hydropower Component

Information about socio-economic conditions of the study area was derived mainly from interviewing village headmen and key informants in the four villages of the study area; namely Hnget Gyi Thaik, Magyi Inn and War Net of Pyin Oo Lwin Township and Thayet Pin village of Kyaukse Township, Mandalay Region. Key findings on socio-economic conditions of these communities are summarized below:

- The study area has a total population is 2,018 people living in 435 households with an average household size of 4-5 persons.
- Out of the total 2,018 persons, 331 persons (about 16%) still attend school and university. Most of the remaining populations have finished school.
- The majority of vulnerable groups in study area are household heads who are over sixty year old. There is no special program or activity to support these vulnerable people in this area.
- Only one family in Thayet Pin village is ethnic Mon. The remaining villagers are Burmese, practicing Buddhism and speaking Burmese language.

- There are no gender issues within the study area. Roles, work division and decision making between men and women are determined by physical conditions, social structure and norms. Decision making on some aspects are on a joint or sharing basis by both male and female.

- Agriculture is the main occupation for most households in the four villages, varying from 50% of households in Hnget Gyi Thaik and 100% in Thayet Pin. Other occupations are trading or small businesses, working with the government, and wage labor.

- The villagers used conventional practice in agriculture. However, they use cows in threshing harvested Pea. In non-agricultural production, weaving of baskets from bamboo is still practiced in most households.

- The four villages are not significantly different in average annual household incomes, varying from the lowest 2,045 USD equivalent for War Net to the highest 2,258 USD equivalent for Thayet Pin. In all the villages, the off-farm income was higher than the farm income, accounting for 53% to 58% of the total household income.

- The average annual household expenditure was slightly less than the average annual household income in all four villages, varying from the lowest 1,940 USD equivalent for War Net and the highest 2,064 USD equivalent for Ma Gyi Inn.

- Most households in the villages would have no saving and households with debt would be common.

- Land in the four villages is used for farming and housing. Farm land accounts for three quarters of the total land area while residential area accounts for the remaining quarter. The average land holding per household is around 2.55 to 3.33 acres.

- No households in the four villages engage in fisheries or aquaculture. After completion of the Project, the expanded river behind Deedoke Dam may open up opportunities in fisheries and aquaculture.

- Communicable diseases in the four villages appear to be common cold, gastro-enteritis, TB, *malaria*, and dengue hemorrhagic fever (DHF).

- Ground water and river water are two water supply sources for domestic consumption.

- Only Thayet Pin has one health center. The four villages rely on a private clinic in Ong Jor, about 12.17 miles away, a small hospital in Kyaung Mee, about 17.21 miles away, and Mandalay Hospital, about 36 miles away.

- All four villages have kindergarten and primary schools. Secondary school however exist only in May Gyi Inn. All four villages have 1 temple with cemetery.

Socio-economic Condition in the Village along Transmission Line

There are 2 villages locate along the transmission line: Inn Kone and Hpa Lan Pin villages, the two villages are under administration of Sintgaing Township.

Inn Kone Village was established 70 years ago and is made up of 78 households. There are no different ethnic groups in the village and all people are Bamar who practice Buddhism. Soonyeiin Lake, which is one of the tourist attractions in the area, is situated very near to Inn Kone village. In this village, fishing is households' main occupation. There is a primary school in Inn Kone and the nearest secondary school is located in Soonye village, which is less than 1 km away.

Hpa Lan Pin Village is located to the north of Inn Kone village and the proposed transmission line will pass near the village area. The current village population number and household number is 400 and 71, respectively. All households living in this village are Bamar and their religion is Buddhist. Bamboo and firewood collection is households' major occupation and there are only about 10 households who own farmland, growing sesame, peas and cotton. Pigs and chickens are raised mostly for consumption, while goats are for selling and oxen for agricultural labor.

Hpa Lan Pin village is located far from services. There is no river near the village and water for irrigation is collected from Soonyeiin Lake which is 6.5 km away. While there is one primary school in the village, the nearest secondary school is in Soonyeinn village about 5 km away. The nearest health care center is located in Nat Yae Kan village, about 3 km away.

Transportation

Two small roads exist along the banks from Yeywa dam. The road on the right bank is a narrow concrete road providing access to Mandalay. The left bank road is mostly unpaved connected with Kyaukse-Mandalay highway at Sintgaing town. Villagers living on the left bank prefer to cross the river by boat to use the right bank road. No regular bus services exist in the study area.

1.4.5 Cultural Components

Within the project study area of dam site, there is a monastery (temple) near Hnget Gyi Thaik village. The temple is approximately 970 years old. Within the temple there are pagodas of King Anawrahta's reign, temple assemble hall, and monks' residence.

1.4.6 Visual Components

Major visual components of the project area consist of mountains, river, agricultural land, vacant marginal land, and natural vegetation on islets and along the banks of Myitnge River.

1.5 IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURES

1.5.1 Scope of Assessment

The impact area of each issue is defined in ***Table 1.5-1***.

TABLE 1.5-1

DEFINITIONS OF THE IMPACT AREAS

ES Issue	Impact Area
Noise	Area from the noise source to a point at which the noise will attenuate to an acceptable level
Vibration	Area from the vibration source to a point at which the energy wave will attenuate to an acceptable level
Fugitive dust on the construction site	Area around the construction site to a point at which the dust level returns to the level before the construction
Fugitive dust caused by materials transportation	Area along the road to a point at which the dust level returns to the level before the construction
River excavation or dredging	The river reach downstream of the excavation site to a section where the suspended solid plume is not visible
Quarrying operation	Area around the quarry site to be determined by noise or vibration, whichever is greater.
Sites for disposal of construction wastes	The area covering the disposal site area and the sensitive receptors
Fish ecosystem	The entire river reach from the Deedoke Dam to Yeywa Dam. The impact assessment may extend to cover areas believed to be ecologically linked to the impact area.
Terrestrial ecosystem	The entire area acquired for project facilities and construction laydown areas. For the hydropower scheme, the area will cover the head works, the hydropower plant, and support facilities. For the transmission line, the area is about 25 m from both side of center line of the alignment or construction corridor.
Water quality	The entire river reach from the Deedoke Dam to Yeywa Dam.
Background ambient air quality	In the villages near the construction sites
Background ambient noise level	In the villages near the construction sites
Land acquisition	The entire areas of affected land due to project implementation.
River bank agriculture	The planting areas found along the river banks.
Visual quality degradation	The entire river reach and its terraces.
Archeological impacts	The entire river reach and its terraces.
Cultural impacts	In the villages near the construction sites
Environmental management areas	The entire construction site during construction. The entire river reach during operation.

The assessment of impacts of each ES issue is based on the temporal scope presented in ***Table 1.5-2***.

TABLE 1.5-2

TEMPORAL SCOPE

ES Issue	Impact Area
Noise	Over the construction duration, hourly and daily average noise level
Vibration	Over the construction duration, peak particle velocity mm/s
Fugitive dust on the construction site	Over the construction duration, hourly and daily average dust level
Fugitive dust caused by transport of materials	Over the construction duration, hourly and daily average dust level
Turbidity caused by river dredging or excavation	Over the dredging or excavation duration, hourly and daily average turbidity level
Soil contamination	Over the project life
Fish ecosystem	Over the construction and operation periods
Terrestrial ecosystem	Over the construction and operation periods
Water quality	Over the construction and operation periods
Background ambient air quality	Over the construction period, hourly and daily averages of air quality parameters
Land acquisition	During the site preparation period
River bank agriculture	Over the construction and operation periods
Visual quality degradation	Over the construction and operation periods
Archeological impacts	Over the construction and operation periods
Cultural impacts	Over the construction and operation periods
Environmental management areas	Over the construction and operation periods

Each environmental issue will have an impact area. Receptors in the impact area could be people, ecosystem, and properties depending on the nature of the issue. Impacts on the receptors are consequences of the impacts on ambient environment.

- **Key Issues and Selection of Valued Environmental Components**

Valued Environmental Components (VECs) for the Project are those environmental and social attributes associated with the development of the proposed Project which have been identified to be of concern by the public, government or professional community. The EIA will cover VECs to be identified based on consideration of Government's EIA requirements, nature of the Project, construction activities, existing environmental and socio-economic and cultural settings of the areas impacted by the Project, and ongoing and future developments of hydropower projects in the region. The identified VECs and issues of concern will need to be presented to stakeholders and finalized based on comments from the stakeholders.

The environmental impact assessment has identified key issues and VECs to be covered in the ESIA as presented below in ***Table 1.5-3***. For each VEC, one or more parameters will be selected to facilitate quantitative or qualitative measurement of potential project impacts and cumulative impacts. Results of the measurement will be used to determine the level or magnitude of incremental change in the VEC. If possible, thresholds or standards will be identified for each measurable parameter.

The EIA will cover direct impacts of the Project on these VECs and also on direct impacts of the Project coupled with future impacts of planned projects on the VECs, or cumulative impacts.

TABLE 1.5-3

VECS DURING CONSTRUCTION AND OPERATION PHASES

VEC	Main Concern During Construction and Operation
Construction Phase	
Air quality	Increases in air pollutants caused by fugitive dust from rock blasting, site excavation, quarrying operation and emissions from operation of trucks and heavy construction equipment.
Noise	Increase ambient noise level at the construction site, quarry site and communities near the material transport routes.
Vibration	Increase vibration at the construction site, quarry site and communities near the material transport routes.
Surface water quality	Increased turbidity of river water due to in-river construction activities and river bed excavation.
Aquatic ecology and fishery	Loss of benthic organisms and impeding fishing activities due to in-river construction activities and river bed excavation.
Boat traffic	Impeding boat traffic due to in-river construction activities and river bed excavation.
Traffic and Road Safety	Increases in traffic load and safety along the material transport routes
Land use	Change in land use and land ownership due to land acquisition for project construction and quarry sites.
Waste	Degradation of the disposal sites due to inappropriate management of construction wastes at disposal site.
Operation Phase	
Livelihoods	Loss of river bank agriculture due to back water effect of project
Fishery	Impacts on fish ecology and fisheries upstream and downstream due to changes in river flow regimes upstream of the dam
Groundwater	Increased groundwater tables in areas along the river banks upstream due to project operation

1.5.2 Project Phases Covered in the EIA

The EIA results for each key valued environmental component will be presented for each project phase as follows: pre-construction phase, construction phase, and operational phase.

The decommissioning/closure/post closure phase is not covered in the EIA as explained in the Scoping Report.

1.5.3 Subjects Covered in Each Project Phase

For each key valued environmental component the EIA results for each project phase are presented in four subjects: (i) potential impacts; (ii) proposed mitigation measures; (iii) residual impacts; and (iv) proposed monitoring. The proposed monitoring for each key valued environmental component will have to be consolidated and presented in the environmental management plans in ***Chapter 8***.

1.5.4 Identification of Environmental and Social Issues/Impacts

The Project is considered to consist of two components; (i) the hydropower component which is the major component; and (ii) the transmission line component which is the associated smaller component. Environmental and social (ES) issues of the two components are different in nature, magnitude and spatial scope. In overall, the hydropower component is much more significant than the transmission line component in ES management of the Project.

(1) Construction Phase

The construction of the hydropower component is considered major construction, involving various types of civil works (CW), electrical-mechanical/ hydraulic-mechanical works (EHMW), and the transmission line works (TLW). The construction will be carried out within a clearly defined area referred to as the project site. Typically, the construction activities will disturb the physical environment of the project site which may have adverse consequences on the ecosystem and/or people living near the construction sites (sensitive receptors).

In contrast, the construction of the transmission line is considered rather smaller scale construction, involving construction of a number of foundations for supporting steel towers. TLW will involve installation and erection of steel towers from prefabricated tower elements, and stringing the cables. As the transmission line is a linear structure, the construction will take place at several small areas along the long and narrow corridor, about 50 m wide. The construction will create only minor disturbances to the environment and people living along the transmission line corridor. However, the transmission line will limit land use along the corridor, and may have adverse ecological consequences if the corridor traverses a sensitive terrestrial ecosystem.

(2) Operational Phase

During the operation of hydropower plant, the major issue will be the backwater effects. At the design operating level of 80 m a.s.l, the backwater effects will be manifested in: (i) increased water levels in the river section between Yeywa dam and Deedoke dam by about 7 m at the Deedoke dam; and (ii) increased water volume upstream of about 23 million m^3 above the natural volume without Deedoke dam. The backwater effects could create adverse and beneficial consequences.

The operation of the transmission line will not create new adverse consequence. The adverse consequences on land use, if any, created during the construction phase will remain throughout the operational phase. Maintenance of the transmission line and its corridor would create only minor environmental disturbances.

(3) Decommissioning Phase

Decommissioning is not assumed in the Deedoke project because the plant will be transferred to MOEE on a BOT basis after the concession period. There is only Construction Supporting Structures Dismantling activities will occur after project implementation.

1.5.5 Summary of Identified Issues

Summary of identification of environmental and social issues anticipated during project construction and operation based on technical information in the final feasibility study report is presented in ***Table 1.5-4***.

TABLE 1.5-4

IDENTIFICATION OF ES ISSUES OF THE PROJECT

Project Activities	Disturbances on Physical Environment	Generic Impacts on Receptors	Likely Level of Significance in this Project
Construction of Dam and Hydropower Plant			
On-site Activities			
1. Rock blasting and site excavation,	- Noise, vibration and dust	- Discomfort and health risks to communities near the construction site	- Medium, 1 community exists near construction site
2. Operation of trucks and heavy construction equipment	- Noise, vibration and dust	- Discomfort and health risks to communities near the construction site	- Medium, 1 community exists near construction site
3. In-river construction, including river bed excavation	- Increased turbidity of river water, loss of benthic organisms - Impeding boat traffic - Impeding fishing activities	- Impacts on fish ecosystem, decreased fish catch - Impacts on water users - Public inconveniences, livelihood of boat operators - Impacts on livelihood	- Insignificant, poor fishery resource - Medium, villagers use river water - Insignificant, no regular boat traffic in the river apart from river crossing - Insignificant, no fishing activities in the river
4. Disposal of construction wastes	- Degradation of the disposal sites	- Soil contamination, impacts on terrestrial ecosystems (depending on characteristics of the disposal sites)	- Low, would not be difficult to find poor land for disposal site.
5. Land acquisition	- Change in land use and land ownership	- Affected communities, loss of properties and livelihood, relocation	- Low, small part of agricultural land would be taken for construction site, no relocation.
Off-site Activities			
1. Quarrying operations	- Noise, vibration and dust	- Discomfort and health risks to community near the quarry site	- Low, 1 community near the planned quarry site
2. Transport of materials into and out of the construction site and the quarry sites	- Noise, vibration, dust, and emissions Increased truck traffic on the roads	- Discomfort and health risks to communities along the transport routes - Traffic safety and community safety	- Significant, communities exist along the access road - Significant, communities exist along the access road
Construction of Transmission Line			
Activities Along the Corridor			
1. Vegetation clearing along the alignment (50 m corridor)	- Land use change	- Impacts on terrestrial ecology	- Insignificant, deteriorated dry dipterocarp forests exist along the alignment route
2. Disposal of waste vegetation	- Noise and dust	- Discomfort and health risks to communities near the alignment	- Insignificant, only 2 communities near the end of alignment
3. Construction of foundations for towers	- Noise and dust	- Discomfort and health risks to communities near the alignment	- Insignificant, only 2 communities near the end of alignment
Operation of the Hydropower Scheme			
1. Maintain water level behind the dam	- Changes in river water level upstream of the dam without change in the present river regime - Increased groundwater tables in areas along the river banks upstream - Obstruction to boat navigation	- Impacts on fish ecology and fisheries upstream and downstream - Loss of river bank land for cropping, impacts on livelihoods of people - Water logging in cropping areas - Increased time and cost for boats having to use the navigation lock	- Low, poor fishery resource and no change in present flow regime - Low, few small cropping areas - Low, high ground level - Insignificant, no regular boat traffic in the river apart from river crossing
Operation of the Transmission Line			
1. Maintenance of transmission line and the corridor	- Noise in cutting vegetation	- Nuisance to people living near the corridor	- Insignificant, only 2 communities near the end of alignment, vegetation under the transmission line would not be dense.

1.6 CUMULATIVE IMPACT ASSESSMENT

The EIA Procedure requires an EIA investigation to consider cumulative impact (Article 53).

The EIA Procedure gives the following definition of cumulative impacts:

Cumulative impacts can be defined as "*the impact or impacts of a project that in itself or themselves may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse projects or undertakings in the same geographic area or region.*"

In general, cumulative impacts can be defined as

" the changes to the environment caused by a proposed project in combination with other past, present, and reasonably foreseeable projects or human activities".

It should be noted that baseline environmental quality of the EIA study area, such as baseline ambient air quality, is the results of existing economic activities and projects already in operations. Therefore, the impacts of this Project discussed in Chapter 6 are actually cumulative impacts of the Project and other existing economic activities or projects in the study area.

In this Project, Yeywa dam is the only major existing project related to this Project. The existing water quality and aquatic ecosystem in the river downstream are the impacts of Yeywa dam. The anticipated impacts in the river section between Yeywa dam and Deedoke Dam are therefore cumulative impacts.

As this Project will not have impacts on environmental quality, such as air and water quality, it will not have cumulative impacts related to future industrial and infrastructure development projects in the nearby areas. The cumulative impacts will be related to only new hydropower projects upstream or downstream of Deedoke Dam. However, the Project could have induced impacts since electricity and water behind the dam could open up opportunities for other development projects with environmental impacts.

At present, Yeywa dam, the largest dam in Myanmar, is the only major existing hydropower scheme in the Myitnge River Basin. The Upper Yeywa dam is currently under construction. In addition to this proposed Deedoke Hydropower Project, two other hydropower projects, Namtu and Middle Yeywa projects, are being conceptualized. A new hydropower project downstream of the proposed Deedoke Dam would be unlikely due to topographical constraints. For the same reason, a new hydropower project between the existing Yeywa dam and the proposed Deedoke Dam would also be unlikely. Therefore, at this stage, the five hydropower projects could be considered as the full development of the Myitnge River Basin, and will be the framework for the cumulative assessment.

For further assessment of CIA which need to be completed with involvement of all others hydropower development on the Myitnge River. Other sectors including forestry, road and transport, agriculture and mining which need to be stakeholder in CIA. Therefore, Deedoke project committed that the Project will participate in CIA process which may be initiated by DEPP in cooperation with other hydropower developers and existing hydropower stations on the Myitnge River to carry out CIA and cooperation in management of such impacts.

1.7 ENVIRONMENTAL MANAGEMENT PLANS

For convenience in the use of EMPs during Project implementation and as prescribed in the EIA Procedure 2015, the construction phase EMP and the operational phase EMP are presented in Volume 2 of this Final EIA Report. This Chapter presents the conceptual framework of EMPs and a summary of each EMP.

The results of EIA investigation will not lead to any results if they are not translated into two implementable environmental management plans (EMPs): one EMP for implementing in the construction phase of the Project and another EMP for implementing in the operational phase of the Project. Recognizing this fact, the EIA Procedure requires the Final EIA Report to include two environmental management plans - a construction phase environmental management plan (CEMP) and an operational phase environmental management plan (OEMP).

1.7.1 Summary of CEMP

As discussed in ***Chapter 6***, the Project is not expected to have major environmental impacts during construction apart from environmental disturbances normally experienced in dam construction. Nevertheless, the Project Proponent will ensue that the Contractor will make best efforts to minimize the impacts during the construction phase despite their insignificant levels. In this regard, the Project Proponent will ensure that the Contractor-CEMP will incorporate all mitigation measures as prescribed in the Owner-CEMP in preparing detailed designs of the dam, powerhouse, and its associated facilities, construction methods, and specifications.

The content of the Owner-CEMP presented in ***Volume 2*** follows the basic elements of environmental management as discussed in ***Section 8.1.3***. Major aspects of the Owner-CEMP are summarized as follows:

(1) Impacts and Management Plans

The construction activities will cause some environmental disturbances which will be transient and will not have significant irreversible impacts. Types, magnitudes, durations, and locations of environmental impacts during the construction will vary as the construction progresses. ***Table 1.7-1*** shows anticipated environmental impacts at various months of the construction period.

The following issues will be managed during the construction phase for **Environmental Management and Monitoring Plan** as **Site or Area Specific Plans are** (i) Dam Construction Site, (ii) Material Storage Area; (iii) Excavated Soil Disposal Site; (iv) Rock Dumping Area; (v) Borrow Pits, (vi) Camp Site; (vii) Quarry Site, and **Thematic Plans and Programs are** (viii) Transportation Management Plan, (ix) Water Use Management Plan, (x) Solid Waste Management Plan, (xi) Hazardous Waste Management Plan, (xii) Biomass Clearing Management Plan, (xiii) Occupation Health Management Plan, (xiv) Construction Emergency Response Plan (CERP) and **Social Management and Monitoring Plan are** (xv) Chance Find, (xvi) Compensation Management and Monitoring Plan, (xvii) Livelihood Restoration Management and Monitoring Plan and (xviii) Community Development Management and Monitoring Plan.

TABLE 1.7-1

ANTICIPATED IMPACTS AT VARIOUS MONTHS OF THE CONSTRUCTION

Construction Activities	Month	Duration (Months)	Impacts
Phase 0			
1) Preparatory work	1	1	Dust, Noise
2) Access Road	1	1	Dust, Noise, Traffic
Phase 1-River Diversion			
1) Ring Coffer Dam	1-4	4	Dust, Noise, Water Quality
2) Excavation Works	5-9	5	Dust, Noise, Vibration
3) Separation Wall	6-9	4	Dust, Noise, Water Quality
4) Removal of Ring Coffer Dam	9-10	2	Dust, Noise, Water Quality, Disposal
Phase 2-Spillway			
1) Coffer Dam	9-11	3	Dust, Noise, Water Quality
2) Excavation Works	12-13	2	Dust, Noise, Vibration
3) Foundation and Grouting Works	14-18	5	Dust, Noise, Vibration
4) Concrete Spillway Structure	17-25	9	Dust, Noise, Vibration
5) Embankment and River Protection	22-25	4	Dust, Noise, Vibration, Land acquisition
6) HM equipment	23-34	12	Dust, Noise, Vibration
7) Removal Coffer Dam	26-28	3	Dust, Noise, Water Quality, Disposal
Phase 3-Power house			
1) Coffer Dam	26-29	4	Dust, Noise, Water Quality
2) Excavation Works	28-30	3	Dust, Noise, Vibration
3) Power house structure	30-50	21	Dust, Noise, Vibration
4) Secondary Work	35-58	24	Dust, Noise, Vibration
5) Tailrace Channel	36-38	3	Dust, Noise, Vibration
6) River Protection work on the left bank	36-38	3	Dust, Noise, Vibration, Land acquisition
7) Embankment Works	36-38	3	Dust, Noise, Vibration, Land acquisition
8) EM&HM Equipment	35-55	21	Dust, Noise, Vibration
9) Remove Coffer Dam	48-50	3	Dust, Noise, Water Quality, Disposal
10) Electrical Works			
:- Switchyard	44-49	6	Dust, Noise, Land acquisition
:- Transmission Line	32-43	12	Dust, Noise, Land acquisition

Note : Duration of activities based on project construction schedule presented in Feasibility Study Report, July 2015

(2) Monitoring, Evaluating and Reporting

Monitoring, evaluating, and reporting (MER) of the environmental performance of the Contractor will include scheduled monitoring of the indicators related to each impact issue as indicated in Volume 2 of this Final EIA Report. In addition, the Contractor's and the Owner's EHS managers will conduct daily, weekly, and monthly site inspection programs to observe environmental performance of the construction. The Contractor will submit two monthly monitoring reports-one for internal use and another for reporting to MONREC. These two types of reports are discussed in details in the CEMP.

In addition to the scheduled MER, environmental incidents, if occurred, will be recorded, registered and reported.

1.7.2 Summary of OEMP

As discussed in ***Chapter 6***, the operation of the hydropower plant will not create any significant environmental impacts apart from social impacts related to the backwater effect. Therefore, the OEMP will require much less activities and a much simpler EMS compared to those of the CEMP. A summary of the Owner-OEMP is presented below:

(1) Mitigation Measures and Plans

The following issues will be managed during the operation phase for **Environmental and Social Management and Monitoring Plans are** (i) Dam Construction Site Management Plan, (ii) Livelihood Restoration Management and Monitoring Plan; and (iii) Community Development Management and Monitoring Plan as presented in Volume 2 of this Final ESIA Report. While the community development plan could be considered within the context of corporate social responsibility (CSR), the livelihood restoration plan is to further mitigate the impacts on livelihood due to the land acquisition or the inundation of river bank land used for agriculture before the Project.

(2) Environmental Management System (EMS)

The power plant management organization will set up a simple EMS for its O&M activities. This EMS will focus more on occupational health and safety of power plant workers which are about 80 persons, and on monitoring of changes in water quality and levels and aquatic ecosystem upstream of the dam.

(3) Monitoring, Evaluating and Reporting

The MER will include scheduled monitoring of water quality and water level at the upstream side of the dam and at a distance, tentatively about 500 m, downstream of the dam. The water level upstream of the dam will be daily measured or automatically recorded as part of the power plant operations. The water level downstream of the dam could be daily measured using a staff gauge. Water samples will be collected weekly for analysis of key parameters including dissolved oxygen, suspended solids, biological oxygen demand, nitrate, and phosphate. Fishery surveys, including analysis of planktons, will be conducted annually in the upstream section in the low flow season. Annual environmental reports will be prepared for submission to MONREC and other concerned authorities.

1.8 PUBLIC CONSULTATIONS AND DISCLOSURE

1.8.1 Identification of Stakeholders and Groups Affected by the Project

The Project stakeholders could be identified and classified into three categories:

(1) Government Authorities Involved in EIA Administration

For this Project, relevant key offices at the national level are: (i) Ministry of Natural Resources and Environmental Conservation; (ii) Environmental Conservation Department and (iii) Ministry of Electricity and Energy; and (iv) Ministry of Social Welfare, Relief Resettlement.

Relevant key offices at the regional level are: (i) Mandalay Region Office of Administrative ; (ii) Mandalay Region Office of the Environmental Conservation Department; (iii) Mandalay Region Office of Social Welfare, Relief and Resettlement; (iv) Mandalay Region Office of Planning and Economic; and (v) Mandalay Region Office of Fisheries and (vi) Department of Hydropower Project Implementation of Mandalay Region (DHPI)

Relevant key offices at the local level are: (i) Pyin Oo Lwin Township Administration; and (ii) Kyaukse Township Administration.

(2) Other Interested Parties

The Project stakeholders in this category are various government departments responsible for development of various sectors, and community based organizations as listed below:

- Department of Health
- Planning Department
- Forestry Department
- Agriculture Department
- Fishery Department
- Electric Power Department
- Land Record Department

(3) Potentially Affected People

The Project stakeholders in this category are village committees and individual villagers in the eight villages in the study area in Pyin Oo Lwin and Kyaukse Townships; namely: Hnget Gyi Thaik village, Ma Gyi Inn village, War Net village, Gwebin village and Pein village in Pyin Oo Lwin Township and Thayet Pin village, Yeywa village and Kyaungywa village in Kyaukse Township. Residents in these villages had concerns on various potential impacts of the Project during construction and operations such as noise, fugitive dust, turbidity, traffic safety, boat transportation, riverbank erosion, and degradation of natural resources.

1.8.2 Summary of Consultation Activities Undertaken

(1) PCD during the Scoping Stage

The meeting dates, group of agencies, and number of participants are given in ***Table*** below;

Meeting Dates	Organization/Name	Number of Participants
23 April 2015	**Kyaukse Township**	
	1. Government officials	24
	2. Project Proponent's representatives (HTCT)	3
	3. EIA Consultant (TEAM)	4
27 April 2015	**Pyin Oo Lwin Township**	
	1. Government officials	18
	2. Project Proponent's representatives (HTCT)	3
	3. EIA Consultant (TEAM)	5
29 April 2015	**ECD of Mandalay Region**	
	1. ECD officials	3
	2. Project Proponent's representatives (HTCT)	1
	3. EIA Consultant (TEAM)	4
	The General Public : Local Community Groups	
25 April 2015	1.Thayet Pin village	Village headman, village committee, community leaders and villagers (total of 84 persons)
26 April 2015	2.Hnget Gyi Thaik village	Village headman, village committee, community leaders and villagers (total of 72 persons)
28 April 2015, a.m.	3.Ma Gyi Inn village	Village headman, village committee, community leaders and villagers (total of 35 persons)
28 April 2015, p.m.	4.War Net village	Village headman, village committee, community leaders and villagers (total of 73 persons)

Opinion of the persons consulted can be summarized by category as follows:

(a) Government Authorities

- **Kyaukse Township**

  - Government officials have no objection against the project but they have some concerns about environmental and health impacts on students and villagers in communities nearby the project site.

  - They also have concern about pH level of water in Myitnge River which is currently high and may increase during the project operation period.

  - They hope that the project would support community development, road improvement, and electricity supply and tourism promotion.

  - In case it is necessary to use private land for construction purpose, the land owners should be properly informed in advance.

- **Pyin Oo Lwin Township**

  - Government officials have no objection against the project.

  - Compensation for land is a big problem in Myanmar. The project should put special care and have proper arrangement for fair and transparent compensation for the project affected persons.

(b) Local Communities

- The meeting participants from the project related villages have positive views on the project.
- They have concerns **o**n the following environmental and social impacts that may be created from the project construction and operation:-
  - Impact on farmland (flooding and land acquisition)
  - Impact from dust, noise and vibration
  - Impact on water quality and turbidity
  - Impact from dam failure
- They hope for proper impact mitigation measures and fair compensation.
- They expect job opportunity for local people and project support on infrastructure (electricity and water supply system).

(2) PCD during the EIA Preparation

The meeting dates, group of agencies, and number of participants are given in ***Table*** below;

Meeting Dates	Organization/Name	Number of Participants
1 October 2015	**Kyaukse Township**	
	1. Government officials	20
	2. Project Proponent's representatives (DHPI and HTCT)	5
	3. EIA Consultant (TEAM)	3
5 October 2015	**Pyin Oo Lwin Township**	
	1. Government officials	14
	2. Project Proponent's representatives (DHPI and HTCT)	5
	3. EIA Consultant (TEAM)	5
7 October 2015	**ECD of Mandalay Region**	
	1. ECD officials	6
	2. Project Proponent's representatives (DHPI and HTCT)	2
	3. EIA Consultant (TEAM)	5
	The General Public : Local Community Groups	
3 October 2015, am.	1.Thayet Pin village	Village headman, village committee, community leaders and villagers (total of 102 persons)
3 October 2015, pm.	3.Ma Gyi Inn village	Village headman, village committee, community leaders and villagers (total of 22 persons)
4 October 2015, am.	2.Hnget Gyi Thaik village	Village headman, village committee, community leaders and villagers (total of 56 persons)
4 October 2015, pm.	4.War Net village	Village headman, village committee, community leaders and villagers (total of 60 persons)

Opinion of the persons consulted can be summarized by category as follows:

(1) Government Authorities

- **Kyaukse Township**
  - When will the project construction begin ?
  - Compensation rate for affected people.
  - Impact on water use of local people.
  - Impact on water quality on downstream area.
  - The exactly flooded area due to project implementation.
  - How to control about salinity in river water ?
  - How to manage about boat traffic ?
- **Pyin Oo Lwin Township**
  - Mitigation measures should be strictly implemented by construction contractor.
  - The construction contractor should contact closely with local people.
  - There should be consultation and negotiation on compensation issues among government administration office, developer and local people.
  - Local people do not actually own the land, they have only right to use it. Land belong to the country, if the government need to use the land for project development, the land holder will be compensated.
  - There should be long term mitigation measures during operation period.
  - There should be detailed inventory survey on project affected land and properties.

(2) Local Communities

- **Hnget Gyi Thaik village**
  - How about compensation rate for project affected area and properties ?
  - The Project Proponent should be support the infrastructure development e.g. library construction, teacher and doctor accommodation.
  - Job opportunity for local people and local vehicle for project construction activities.
  - There are 3 people whose all piece of farmland will be flooded and another 3 people will affected some part of farmland only.

- **Thayet Pin village**
  - How about flooded level due to project implementation ?
  - Compensation rate on both bank of Myitnge River should be equal.
  - They would like to use the weir crest for crossing river.
  - Villagers had bad experience from Yeywa Dam activities e.g. impact from quarry site, vibration from blasting and water turbidity.
- **Ma Gyi Inn village**
  - They do not agree with project development.
  - There should be demarcation of the area to be flooded.
  - They worried about flooded area along both bank of Myitnge River.
- **War Net village**
  - How about compensation rate for project affected area and properties ?
  - Job opportunity for local people.
  - Villagers had bad experience from Yeywa Dam activities e.g. impact from quarry site and impact from water fluctuation.

1.8.3 Results of Consultations during EIA Review

During the EIA review the Project Proponent organized another public consultation meeting on 23 April 2018.

Questions during the April Stakeholder Workshop included:

- Land acquisition impacts;
- Impacts to water quality, including cumulative impacts taking into account Yeywa dam;
- Whether there will be benefit sharing programs;
- Disaster Management Plan / Dam Safety Plan;
- Social and environmental impacts as a result of construction (dust, health, noise, etc.);
- Health surveys being conducted and potential health impacts, and
- Impact of worker influx.

1.8.4 Recommendations for Ongoing Consultations

In order to gain full understanding and support from PAPs and stakeholders and interested parties in project implementation, it is vital to have full participation from them at the beginning through the entire process of project development. The program activities are to;

(1) Dissemination of information

The information dissemination for PAPs are as follows;

- Project components.
- Schedule for start-up of the project.
- Detailed information on project policies and implementation procedures.
- Compensation Plan and Entitlements.
- The grievance mechanism and the appeals process.
- Rights to participate and be consulted.
- Program for the improve quality of life and social development plan.
- Organizational responsibilities.

(2) Consultation with PAPs

(a) Informing PAPs about Compensation Payment with letter of notification. The PAPs should also be informed in advance on the relevant documents (e.g. identification card, land title, etc.) that they are required to bring with them for compensation payment purpose.

(b) Consultation with PAPs to confirm preferences for rehabilitation assistances measures.

(c) Informing PAPs about site clearance prior to start-up to civil works.

(d) Informing PAPs about the beginning and ongoing schedule for physical works.

(e) Consultation and confirmation with PAPs on their participation in Income Restoration measures.

(f) Consultation with PAPs on Community/Social Development program.

(g) Informing PAPs on monitoring and supervision activities to be conducted during project implementation.

CHAPTER 2

INTRODUCTION

CHAPTER 2

INTRODUCTION

2.1 BACKGROUND ON PROJECT DEVELOPMENT AND THE EIA

2.1.1 Project Origin and Preparation

On 20 November 2014, the Ministry of Electric Power (MOEP) of the Government of Myanmar, signed a memorandum of understanding (MOU) with ANDRITZ Hydro GmbH of Austria (ANDRITZ), on the development of the Deedoke Hydropower Project (the Project) on the Myitnge River in Mandalay Region. ***Figure 2.1-1*** is a map of the Mandalay Region focusing on the Myitnge River and the project site. The Project will construct and operate a run-of-river, low head hydropower scheme with a generation capacity of about 66 MW[1]. The Deedoke dam site will be located at about 21.1 km (13.18 miles) downstream of the existing Yeywa hydropower scheme. The Project will be implemented through a JV or BOT arrangement by a consortium consisting of ANDRITZ as the lead partner and national and international partners. The MOU signing is the first concrete step toward realization of the Project after the completion of the project preliminary feasibility study (PFS)[2] conducted by AF-Colen Co., Ltd., for the Department of Hydropower Implementation under the Ministry of Electric Power.

The feasibility study (FS) of the Project, including its environmental and social impact assessment (EIA), was prepared by the consortium Gruner GmbH/Stucky Ltd. with TEAM Consulting Engineering Management Co., Ltd., Thailand (TEAM), and Total Business Solution Co., Ltd., Myanmar (TBS) as sub-consultant (EIA Consultant) for the EIA. Technical investigation under the FS was carried out from December 12, 2014 to July 2015. The EIA was carried out in parallel with the technical study, from 1January to 16 November 2015, to ensure that environmental and social aspects of the Project would receive due attention in the site selection and technical design of the Project. The technical study and EIA studies were carried out in close cooperation with MOEE and concerned environmental agencies at the national, regional and district levels.

2.1.2 MONREC's Comments on Scoping Report

As required in the EIA process, ANDRITZ submitted the Scoping Report prepared by the EIA Consultant to the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) in August 2015. MONREC had recommendations on compensation concept for agricultural land to be lost, job opportunities for project affected persons (PAPs), concerns of PAPs on project impacts and safety. The recommendations from MONREC have been duly considered and incorporated in the EIA report.

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[1] All project related figures in this report are still tentative and subject to confirmation by the detailed design study.

[2] Deedoke Hydropower Project, Preliminary Feasibility Study, Report No.DED-00-PFS-PREL/DEC2012

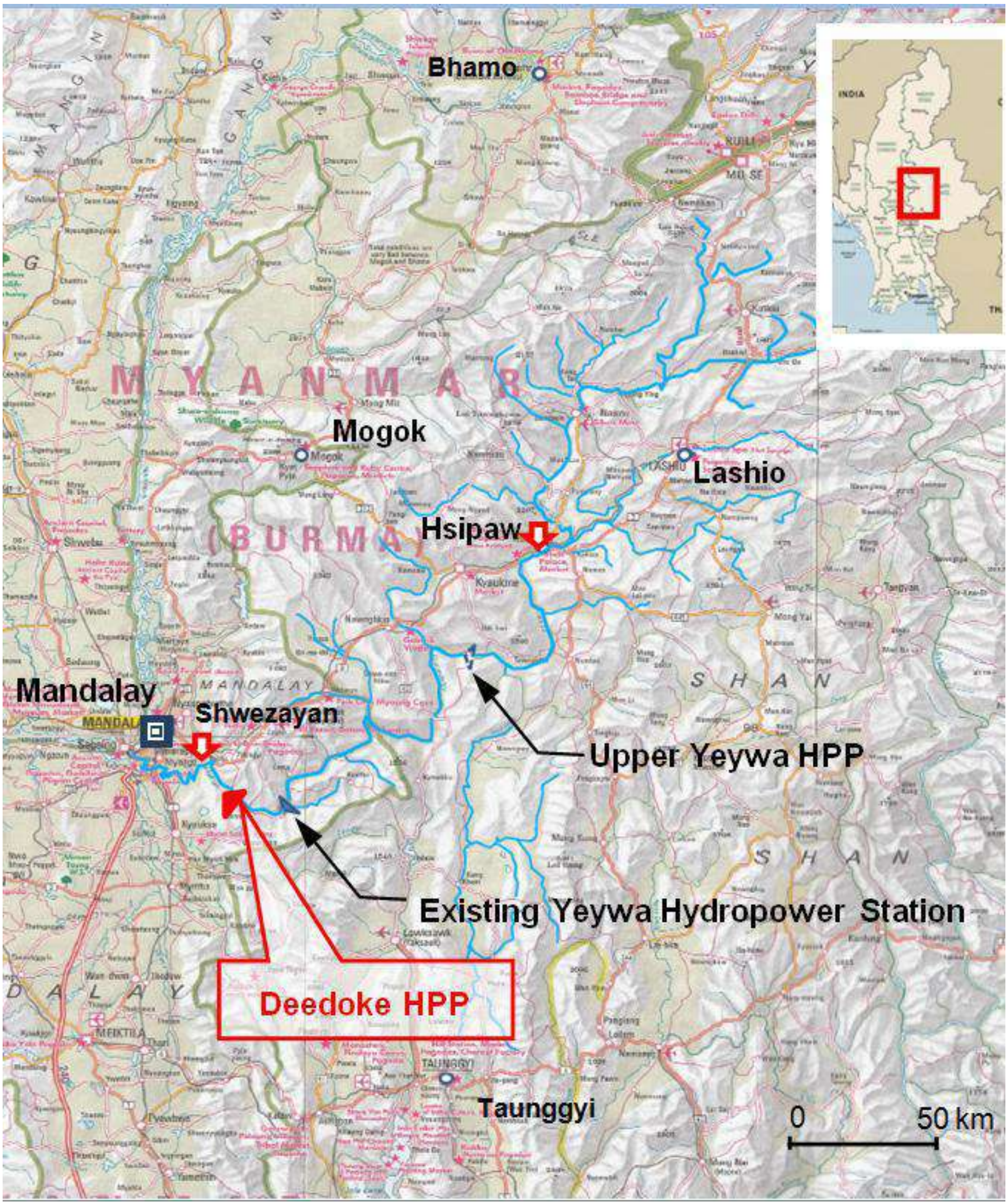


FIGURE 2.1-1 : THE PROPOSED PROJECT SITE

Subsequently, the EIA study was carried out according to the TOR for the EIA presented in the Scoping Report and given in ***Appendix 2A*** of this EIA report for ready reference.

This Final report has been structured following the EIA Table of Contents (Volume 1 EIA report) recommended in *Appendix 5* of the EIA Procedure 2015 developed by MONREC.

2.2 RELATED PROJECT AND DEVELOPMENT

The related project and development is Yeywa Hydro Power Project (commissioned in 2010) which is located on Myitnge River approximately 50 km, southeast of Mandalay in Central Myanmar, about 21.1 km upstream of Deedoke dam site. The main component of Yeywa Hydro Power Plant includes the Yeywa 134 m high RCC Dam with a reservoir of 2,630 million cubic meters and a 790 MW capacity Power Station (4 Francis turbines, each with design discharge 210 m^3/s). The Yeywa reservoir is operated to reach optimal energy production during the wet and dry seasons. During the wet season, the reservoir often spills and the target energy production is easily reached. During the dry season, however, the target energy production is constrained by the available inflows to the reservoir and subsequent lower reservoir levels.

Deedoke low-head HPP is to supplement energy production from Yeywa HPP, particularly during the dry season. The water available at Deedoke HPP is the outflow from Yeywa reservoir, i.e., the controlled outflow from the Yeywa powerhouse and spillways.

2.3 PRESENTATION OF THE PROJECT PROPONENT

The Deedoke Hydropower Project (the Project) will be developed by an international consortium of developers in collaboration with the Ministry of Electric Power (MOEP). The consortium comprises Andritz Hydro GmbH of Austria (ANDRITZ) as the leader, High Tech Construction Trust Co., Ltd. (HTCT) of Myanmar, and Kansai Electric Power Company of the Republic of Japan. ANDRITZ, the lead partner, is a global supplier of electromechanical systems and services ("from Water to Wire") for hydro power plants and also a leader in the world market for hydraulic power generation. Its headquarters is in Vienna, Austria. HTCT is a pioneer of Roller Compacted Concrete (RCC) in Myanmar, currently undertaking the construction of various RCC dams and a number of hydro power projects throughout Myanmar. It has headquarters in Yangon and a branch office in Mandalay, Myanmar. Kansai is a power utility company in Japan. Kansai has been supplying high-quality electric power to the Kansai region in Japan for over half a century and other countries worldwide for about 20 years and its headquarters in Osaka, Japan, Its current business covers conventional municipal and industrial water supply and hydropower development both in the country and overseas. Its overseas experience covers 32 projects in 21 nations, including the Partrind Hydroelectric Dam in Pakistan currently under construction.

The representative and address of the Project Proponent are given below:

Director General, Department of Electric Power Planning of Ministry of Electricity and Energy (MOEE)

Address: Building No. 27, Nay Pyi Taw, Myanmar.

Tel: +95 (67) 410203

Fax: +95 (67) 410219

www.moep.gov.mm

Mr.Christian Stobich, Vice President (Business Development) of ANDRITZ HYDRO GmbH.

ANDRITZ HYDRO GmbH

Lunzer Street 78

4031 Linz, Austria

Tel: +43 (732) 6986 4231

Fax: + 43 (732) 6980 2554

www.andritz.com

Mr. Ye Myint, Managing Director of High Tech Construction Trust Co., Ltd. (HTCT).

High Tech Construction Trust Co., Ltd. (HTCT)

Address: No. 584 Strand Road, Lanmadaw Township, Yangon, Myanmar.

Tel: +95 (1) 227705

Fax: + 95(1) 211957, 211696

www.htct-mm.com

www.shwetaunginfra-mm.com

Mr. Hidehiko Yukawa, Director, Managing Executive Officer, International Business and Cooperation Division of the Kansai Electric Power Co., Inc. (Kansai).

Address: 3-6-16, Nakanoshima, Kita-ku, Osaka, 530-8270. Japan

Tel: +81-6-6446-9638

Fax: +81-6-6441-9863

www.kepco.co.jp

2.4 PRESENTATION OF THE ENVIRONMENTAL AND SOCIAL EXPERT

TEAM is the lead firm for the EIA study. Background Information on TEAM and TBS are briefly presented below.

TEAM

TEAM is the key subsidiary company under of TEAM Group of Companies (TGC). TGC has 19 subsidiary companies providing consulting services in all phases of project cycle from project conception through project planning and feasibility study, detailed design, construction supervision, and project management. The services cover various categories of development projects, including road and highway, water resource development, power generation, housing, urban planning, port, urban mass transit system, water supply, wastewater management, port, environmental management, regional development planning, public event design and organizing, and management planning. TGC has completed assignments not only in Thailand but also in neighboring countries, particularly Lao PDR, Viet Nam, Cambodia, and Myanmar.

The EIA for this Project is undertaken by TEAM's Environmental Business Unit. The list of some relevant experienced undertaken in Myanmar and Lao PDR are presented in ***Appendix 2B***. There are about 19 projects are related to hydropower projects.

TBS

Total Business Solution Co., Ltd., (TBS) is registered and located in Yangon. Since its inception in 2012, TBS, in collaboration with TGC, has been providing consulting services to the private and public sectors in Myanmar. The two partners with their combined strengths provide one-stop service to assist investors in project development or in setting up and operating businesses in Myanmar. Their services have gained recognition from Myanmar and foreign investors involved in development projects including port, industrial estate, power transmission, flood control, drainage and sewerage system, environmental and social management, and business establishment.

The EIA Team

The EIA study for this Project is conducted by a multidisciplinary professional team consisting of a core study and planning group and a technical support group. The Team Leader manages technical aspect of the EIA study. The Team Coordinator assists the Team Leader in coordination among members of the EIA team, Project Proponent, Environmental Conservation Department, and other concerned government agencies, especially agencies in the concerned townships i.e., Pyin Oo Lwin township of Pyin Oo Lwin district and Kyaukse township of Kyaukse district.

The core study and planning group of the EIA study team consists of qualified and experienced professionals in various technical areas relevant to major environmental and social impacts of the project identified in the Scoping Report and the TOR, including (i) air pollution; (ii) noise and vibration; (iii) impact on terrestrial and aquatic ecology; (iv) water quality and water use; (v) waste management; (vi) social impact; (vii) public health; (viii) visual quality degradation; (ix) archaeological and cultural impacts; (x) public participation; and (xi) environmental management planning. The environmental planning expert will assist the Team Leader in ensuring that the final EIA report will meet all requirements prescribed in the EIA procedure, and the proposed environmental management plans will be practical and implementable.

The core study and planning group will be supported by a technical support group consisting of professionals in various disciplines relevant to the environmental and social contexts of the Project, including: (a) environmental sciences; (b) socio-economics; (c) public health; (d) terrestrial ecology; (e) civil engineering; and (f) hydropower engineering.

Name of members of the EIA Study team are given in ***Appendix 2C***

A simple organization Structure for Conducting and Managing the EIA study is shown in ***Figure 2.4-1***.

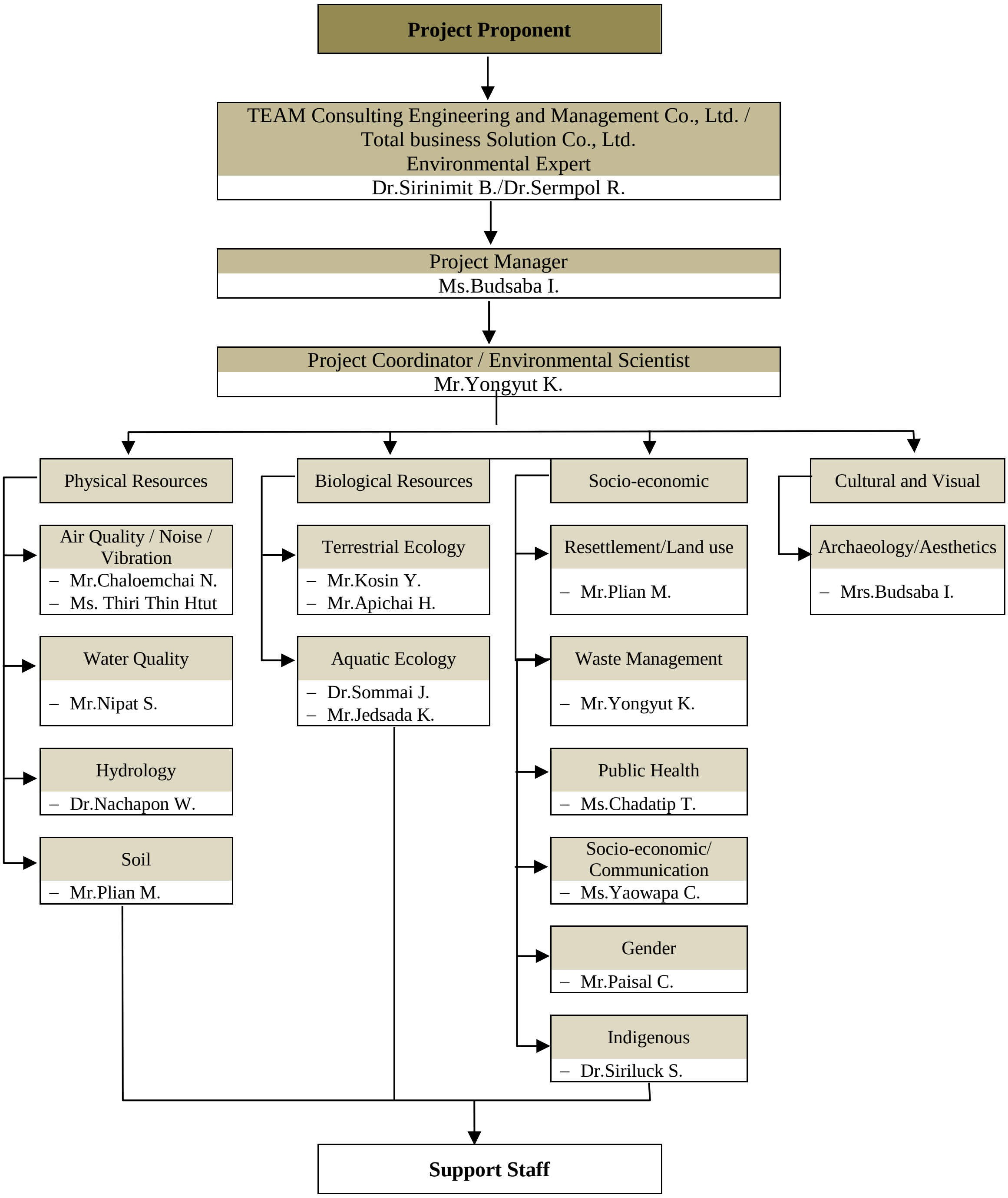


FIGURE 2.4-1 : ORGANIZATION CHART FOR THE EIA OF DEEDOKE HPP

2.5 PROJECT DEVELOPER'S ENDORSEMENT OF THE EIA REPORT

ANDRITZ on behalf of the project consortium gives full endorsement of this EIA Report and is fully committed to the implementation of all measures, including the provision of the necessary funds and human resources.

2.6 STRUCTURE OF THE EIA REPORT

This EIA Report is structured as recommended in ***Appendix 5***- EIA Table of Contents in the EIA Procedure. It consists of two Volumes- Volume 1- Main Report and Volume 2-Environmental Management Plan.

After the introductory chapter, the text in the main report is presented in 8 chapters.

Chapter 3- Policy, Legal and Institutional Framework. This chapter presents policy, legal and institutional framework, environmental and social standards and guidelines that are applicable to this Project. It also presents corporate policies on environmental and social management that the Project Developer is committed to implement during the construction and operational phases of the Project.

Chapter 4- Project Description. This chapter presents technical information on project plan, layout, design, construction approach and plan, and operating plan that are derived based on comparative analysis of various alternatives. Quantitative information on project construction activities and inputs are also given. The information in this chapter is the basis for identification of environmental and social changes that could have impacts on the environment during the construction and operation.

Chapter 5- Description of Environment. This chapter defines the study area and limits of the study, and describes various environmental components of the study area, including physical, biological, socio-economic, cultural and visual components. The information is the basis for assessing the magnitude and significance of environmental and social impacts of the identified environmental and social changes in Chapter 4.

Chapter 6- Impact and Risk Assessment and Mitigation Measures. This chapter proposes appropriate management and physical measures for mitigating the impacts identified in Chapter 6. Environmental and social compliance risk will be identified and measures will be proposed to manage the risks.

Chapter 7-Cumulative Impact Assessment. This chapter presents an assessment of cumulative impacts, i.e. combined impacts of the Project and other projects, existing and planned projects.

Chapter 8- Environmental Management Plan. This chapter summarizes the conceptual framework and principles of environmental management to be applied in the project construction and operation. The mitigation measures proposed in Chapter 6 will be consolidated into two environmental management plans- Construction Phase EMP and Operational Phase EMP. The two EMPs will be prepared following the basic management cycle. Details of each plan will be presented in Volume 2.

Chapter 9-Public Consultations and Disclosure. This chapter presents results of public consultation and disclosure conducted as part of the scoping study and as part of the EIA study. The presentation is focused on salient findings relevant to the design of mitigation measures proposed in Chapter 6 and development plans proposed in Chapter 10.

Appendixes: The main report has appendix in each chapter containing detailed information to support the presented findings in various chapters in the main text.

CHAPTER 3

POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

CHAPTER 3

POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 CORPORATE ENVIRONMENTAL AND SOCIAL POLICIES

The Deedoke Hydropower Project (the Project) will be developed by an international consortium of developers in collaboration with the Ministry of Electricity and Energy (MOEE). The consortium comprises Andritz Hydro GmbH of Austria (ANDRITZ) as the leader, High Tech Construction Trust Co., Ltd. (HTCT) of Myanmar, and the Kansai Electric Power Co., Inc. (Kansai) of Japan. ANDRITZ, the lead partner, is a global supplier of electromechanical systems and services ("from Water to Wire") for hydro power plants and also a leader in the world market for hydraulic power generation. Its headquarters is in Vienna, Austria. HTCT is a pioneer of Roller Compacted Concrete (RCC) in Myanmar, currently undertaking the construction of various RCC dams and a number of hydro power projects throughout Myanmar. It has headquarters in Yangon and a branch office in Mandalay, Myanmar. Kansai has been supplying high-quality electric power to the Kansai region in Japan for over half a century and other countries worldwide for about 20 years and its headquarters in Osaka, Japan.

3.1.1 Andritz Hydro

3.1.1.1 Policy Statements

ANDRITZ HYDRO has the following policy statement on hydropower development;

Hydropower: sustainable, renewable, environmental friendly

We are strongly committed to the sustained protection of the environment in parallel with economic growth and social progress. The tenet is meeting the needs of the present generation, without compromising the ability of future generations to meet their needs.

As ANDRITZ is the lead partner of the Joint Venture, environmental and social policies of the new corporate to be set up for operating the Project would follow the existing health, safety, and environmental (HSE) policies of ANDRITZ. ANDRITZ's corporate HSE policies were issued by its Management and are applied through its internal regulations R HY QM 003 and R HY QM 004 to all of its subsidiary business concerns.

The HSE policies are implemented through a Health, Safety and Environmental Management System (HSES), a sub-system of its corporate integrated management system. The HSES is described in more detail in the specific HSE-manuals and instructions. Particularly, the HSES's Environmental Management System receives ISO 14001:2004 certification.

3.1.1.2 Operational Principles

Health and Safety Management

The integrated health and safety management is based on the following principles:

(1) Providing safe workplaces and working methods.

(2) Avoiding of hazards by technical measures (prevention).

(3) Reduction of negative implications by means of organization and personal measures.

Potential hazards at workplaces and construction sites are identified and evaluated. Preventive actions are applied according to the TOP-Principle: Technical before Organizational and Personal.

Environmental Management

The integrated environment management system is based on the following principles:

(1) Avoiding of negative environmental effects (prevention)

(2) Reduction of negative environmental impacts

(3) Recycling of materials and substances

(4) Disposal of unavoidable residuals.

Health, Safety, and Environmental Management General Guidelines; Health, Safety and Environmental Risk Assessment for Site Activities and ISO14001:2004 Certificate of ANDRITZ HYDRO GmbH, Group Policy, Basic Health, Safety and Environmental Rules, Group Health and Safety Management Policy, GQS Guideline-Health and Safety Management Implementation and Example template of Health, Safety and Environmental Plan are described at ***Appendix 3A***.

3.1.2 High Tech Construction Trust Co., Ltd. (HTCT)

Being one of the first major players in energy sector in Myanmar, High Tech Construction Trust Co., Ltd. (HTCT), a subsidiary of Shwe Taung Group, is a leading project management and construction company, known for the ability to deliver high-quality infrastructure projects on time and budget. With a strong commitment to health and safety, HTCT provides innovative and industry-leading project management, construction and design services across the Country.

3.1.2.1 Human Rights and Labour Rights Policy

Shwe Taung Group (the Group) is committed to being a good corporate citizen and contributing to the society of Myanmar within which we operate. Shwe Taung fully support the United Nation's Universal Declaration of Human Rights, to which every human being is entitled. As a company, the Group utilizes the 30 articles from within the Universal Declaration of Human Rights as a common standard of achievement across all facets of his work. We acknowledge that the common understanding and compliance to these rights and freedoms are of the greatest importance.

Shwe Taung also understands and gives full support to the principles of the International Labour Organisation's (ILO) Core Conventions and Principles. These cover the areas of freedom of association and common bargaining, the elimination of all forms of forced or compulsory labour, the effective abolition of child labour and the elimination of discrimination in respect of employment and occupation.

3.1.2.2 Transparency

Shwe Taung believes that open and transparent communication and feedback are essential elements of enhancing our relationship with his stakeholders, reducing risk, sustainable development and improving management of our operational impact on others. The Group endeavors to provide a transparent, relevant and fair report on his activities. The Group dedicated time and manpower to provide accurate assessments of his procedures and actions. The Group communicate on both the progress of his projects and on his CSR activities.

3.1.2.3 Workplace Health and Safety Policy

The Group's philosophy is that the well-being of our company and clients is dependent on the health and safety or his workface. Every precaution reasonable in all circumstances shall be taken for the protection of all workers. The welfare of the individual is his greatest concern.

The Group is committed to providing a healthy and safe working environment for his employees and any visitors to his work sites, in order to protect people and property/physical assets, in accordance with industry standards and in compliance with legislative requirements.

3.1.2.4 Community and Environment; Sustainability Policy

Sustainability has always been at the core of the Group's strategy. His activities are guided by his corporate vision "Inspiring Lives. Sustaining Progress"

Shwe Taung are committed to being a good Corporate Citizen, contributing to the development of Myanmar. The Group's aim is to create value for stakeholders, while conducting sustainable business practices, caring for his community, and protecting his environment. Through or wide ranging corporate social responsibility (CSR) engagement, the Group aims to become a catalyst of positive change that will enhance the lives of Myanmar citizens.

Shwe Taung's objective is to achieve sustainable outcomes through private public ventures and shared value initiatives. The Group is invested in the communities the Group work beside, or consumers are our key stakeholders and the Group strive to support the communities he serves.

3.1.2.5 Community and Environment: Environmental

At Shwe Taung Group, he recognizes the need to respect the environment and be cautious when conducting projects that may adversely harm the eco-system and bio-diversity of Myanmar. The Group is actively working towards reducing his carbon footprint across all his operations and continues to develop tools to measure the outcomes of his progress in the direction of being more carbon neutral and environmentally sustainable.

The Group believes that businesses are fully responsible for achieving good environmental practices and operation in a sustainable manner. The Group are therefore committed to reducing our environmental impact and continually improving our environmental performance as an integral and fundamental part of his business strategy and operating methods.

3.1.2.6 Health and Safety

- Every company within The Shwe Taung Group commits to;

❖ Either be OHSAS 18001 certified or to implement a Safety Management System aligned with OHSAS 18001 practices.

❖ Collect and report publicly safety statistics annually according GRI (Global Reporting Initiative) Standards.

- All contracts with subcontractors and suppliers must include specific allocated budget for Safety (CSR cost).
- Specify composition of Stop Work Authority Team.

3.1.2.7 Environment

- Every company within The Shwe Taung Group commits to;

❖ Either achieve ISO 14001 certification or implement an Environmental Management System aligned with the ISO 14001 practices.

❖ Collect and report publicly Environmental KPIs according to relevant GRI (Global Reporting Initiative) Standards.

❖ Continue commitment to UN Global Compact annual reporting.

- All contracts with sub-contractors and suppliers must include specific allocated budget for environment protection (CSR cost).

- For any work site (either permanent or project-based) where community engagement is considered a relevant concern, there must be properly designed and managed Public Engagement activities.

The detail of Human Rights and Labour Rights Policy, Transparency, Workplace Health and Safety Policy, Community and Environment; Sustainability Policy and Environmental, Health and Safety and Environment are described at ***Appendix 3B***.

3.1.3 KANSAI ELECTRIC POWER GROUP (KANSAI)

KANSAI Electric Power Group has the policy statement on project development and KANSAI will contribute to sustainable development of communities through fair business activities.

Fundamental Responsibilities

- Give top priority to ensuring safety.
- Surely Implement CSR.
- Keep changing to accomplish our abiding mission.

KANSAI aiming at the best-suited configuration, maintenance and operation of equipment, the Purchasing Department of Kansai Electric Power timely and ecologically procures equipment, materials and services that excel in safety, quality and price.

KANSAI procurement activities are supported by all valued business partners, KANSAI believe that working to build mutual trust, conducting business in an open and transparent manner, and carrying out thoroughgoing compliance in procurement activities are vital in promotion of CSR.

KANSAI Electric Power defines and practices the five items outlined right as our Action Standards for Procurement Activities. We furthermore utilize business negotiations, plant visits and the like to explain and promulgate CSR Procurement Policy to partners.

Action Standards for Procurement Activities

1. Highest priority to the safety, maintenance and improvement of quality and technical strength
2. Being environmentally friendly
3. Establishment of fiduciary partnership
4. Transparent, open business activities
5. Strict enforcement of compliance

3.1.3.1 CSR Action Principles

Conducting all business activities based on KANSAI CSR Action Principles on following and presented at ***Appendix 3C***;

CSR Action Principles 1 - Safe and Stable Delivery of Products and Services As Chosen by Customers

CSR Action Principles 2 - Proactive Approach with a View to Creating Ever Better Environment

CSR Action Principles 3 - Proactive Contributions to Development of Local Communities

CSR Action Principles 4 - Respect for Human Rights and Development of Favorable Work Environment by Taking Advantage of Diversity

CSR Action Principles 5 - Highly Transparent and Open Business Activities

CSR Action Principles 6 - Strict Enforcement of Compliance

3.2 OVERVIEW OF POLICY AND LEGAL FRAMEWORK IN MYANMAR

National policy and legal framework relevant to environmental management of this Project can be divided into four categories:

(1) Policy and legal framework which provide the foundation for environmental management.

(2) Regulations which govern the EIA process, the processing of EIA documents for the issuance of environmental clearance certificate, and implementation of the environmental management plans.

(3) Laws and regulations related to environmental protection, environmental quality standards and social management requirements.

(4) Laws specific to the project site.

The national policy and legal framework will need to agree with international treaties and agreements which Myanmar is a signatory. In addition, they should be in line with international standards and guidelines.

3.2.1 The Foundation for Environmental Management

The Environmental Management in Myanmar is founded on the National Environmental Policy (1994), Environmental Conservation Law (2012), and Environmental Conservation Rules (2014).

A. National Environmental Policy (1994)

The National Environment Policy is a one-paragraph statement, which proclaims the government's commitment to the principle of sustainable development. It states; to establish sound environment policies, utilization of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy. The objective of Myanmar's environment policy is aimed at achieving harmony and balance between these through the integration of environmental considerations into the development process to enhance the quality of life of all its citizens. In essence, the National Environmental Policy calls for the integration of environment and development to achieve sustainable development in the country and to give environmental protection a priority in promoting economic development. The Policy has established the basis of Myanmar's environmental statutory framework.

The project proponent has to follow the National Environmental Policy on order to conserve the environment and prevent its degradation.

B. Environmental Conservation Law (2012)

Environmental Conservation Law is to enable to implement the Myanmar National Environmental Policy, and lay down the basic principles and give guidance for systematic integration of the matters of environmental conservation in the sustainable development process. Then, forms the environmental conservation committee, and determines the duties and powers of Minister. The Law specifies environmental emergency, environmental quality standards, environmental conservation, management of urban environment, conservation of natural resources and cultural heritage, prior permission, insurance, prohibitions, offences and penalties, and miscellaneous with the Environmental Conservation Committee (ECC), the Ministry of Natural Resource and Environmental Conservation (MONREC), and environmental quality standards issued by the Ministry.

The project proponent has to follow the Environmental Conservation Law which must be implemented through implementation rules, specific laws, and specific procedures and guidelines.

C. Environmental Conservation Rules (2014)

The Environmental Conservation Rules were prepared by MONREC for implementing the Environmental Conservation Law. In essence, the Environmental Conservation Rules prescribe:

1) Functions, duties, activities, and authorities of MONREC and the Environmental Conservation Department of MONREC related to the various work areas.

2) Responsibility of investors to have an EIA prepared for submission to MONREC.

3) Composition, functions and responsibility of the EIA Report Review Body which consists of experts from various relevant government organizations.

4) The need for investors to apply for a prior permission before executing investment plans. Institutional arrangements for cooperation and coordination between ECD and other government organizations at the national, region and state levels.

The project proponent has to follow the prescribed functions, responsibility, composition and the need for investors which conserves the environmental near the project area under the articles **69 (a) and (b)** said law.

3.2.2 Regulations Related to Environmental Impact Assessment and Management

Requirements related to environmental (and social) impact management for development projects are described in two related documents-EIA Procedure and Administration Instruction for Environmental Impact Assessment Procedure.

A. EIA Procedure (2015)

This project falls into the category of EIA type project. All EIA type projects will undergo three stages of the EIA process that are scoping stage, EIA investigation stage and EMP implementation stage. Therefore, the Project Proponent has to follow the EIA Procedure under section **102-110, 113, 115 and 117** of said law.

B. Administrative Instruction for Environmental Impact Assessment Procedure

The project proponents and their environmental study teams has to consider the Instruction in their preparation of environmental report documents, including scoping reports, IEE reports, EIA reports, and environmental management plans.

3.2.3 Laws and Regulations Related to Environmental Protection and Social Impact Management

Requirements for environmental protection and social impact management are mostly prescribed in various sector laws and regulations. However, the issuance and enforcement of environmental quality standards are normally based on specific national environmental law.

A. Law Related to Environmental Protection

Environmental Conservation Law (2012)

The project proponent has to follow the Environmental Conservation Law (2012) in Article **7(o), 15, 24 and 29** authorizes MONREC to establish the following environmental quality standards and guidelines.

National Environmental Quality (Emission) Guidelines (2015)

The objectives are to provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem health. These

Guidelines have been primarily excerpted from the International Finance Corporation (IFC), Environmental Health and Safety (EHS) Guidelines, which provide technical guidance on good international industry pollution prevention practice. The Guidelines are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of these Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The project proponent has to follow all the detail of the National Environmental Quality (Emission) Guidelines to prevent international/national pollution that might affect from the project activities.

B. Laws Related to Social Impact Management

(1) Community Health and Safety

The need for development projects to safeguard community health and safety is indicated in the **Public Health Law (1972),** and the **Prevention and Control of Communicable Diseases Law (1995)**.

Public Health Law (1972)

The purpose of this law is to promote and safeguard public health and to take necessary measures in respect of environmental health. The Project Proponent has to ensure that community and occupational health and safety of the project area is protected for safeguard public health law under section **3 and 5** of said law.

The Prevention and Control of Communicable Disease Law (1995)

The project proponent has to prevent the outbreak of Communicable Diseases, the Department of Health shall implement the following project activities: - under **section 3** of said law

(a) Immunization of children by injection or orally;

(b) Immunization of those who have attained majority, by injection or orally, when necessary

(c) Carrying out health educative activities relating to Communicable Disease.

The project proponent has to follow the steps when a Principal Epidemic Disease or a Notifiable Disease occurs:- under **section 4** of said law.

(a) Immunization and other necessary measures shall be undertaken by the Department of Health, in order to control the spread thereof:

(b) The public shall abide by the measures undertaken by the Department of Health under sub-section (a).

The project proponent has to ensure that the head of the household or any member of the household shall report immediately to the nearest health department or hospital when any of the events occurs such as rat fall, outbreak of a Principle Epidemic Diseases, and outbreak of a Notification Disease, under **section 9** of said law.

The project proponent has to prevent and control the spread of a Principal Epidemic Disease, the Health Officer may undertake the following measures, under **section 11** of said law:-

(a) Investigation of a patient or any other person required:

(b) Medical examination;

(e) Carrying out other necessary investigations.

(2) Occupational Health and Safety

The Explosive Act (1887)

Fine of punishment for explosive manufacturing, processing or importing described under **section 5 and 6** of said law.

The project proponent has to follow the explosive act for the transportation and import of explosive with any carriage or vessel, major hazard of static electricity sparks, gas leakage and internal explosions during construction phase which related with **section 7** of said law.

Explosive Substance Act (1908)

The project proponent has to implement under the **Section 3** of Explosive Substance Act (1908) of said law by using explosive substance in project.

The project proponent has to know the punishment and control of explosive substances under **section 4 and 5** of this law.

Social Security Law (2012)

The law presents the establishment for application of provisions for compulsory registration for social security system and benefits at difference kinds of sector under **section 11 (a)** of said law.

This law states clearly that employers have to take care of employees' benefits, security and welfare, especially benefit from injury and occupational diseases during pre-construction and construction phase. This law is therefore related to occupational health and safety (OHS) of employees under **section 15 (a)** of said law.

The project proponent has to deduct contributions to pay by employee from their wages together with contribution to be paid employee, and pay to the social security fund during construction phase of project. The employer has to incur the expense for such contribution under **section 18(b)** of said law.

The project proponent has to affect insurance during construction phase by registering at the relevant township social security office in order to get employment injury benefit by the workers applied to provisions of compulsory registration for employment injury benefit insurance system, and paying contribution to employment injury benefit fund, under **section 48 and 49** of said law.

The project proponent has to prepare and keep records and lists correctly of worker's daily attendance, appointment of new workers, employing worker by changing of work, termination, dismissal and resignation, promotion and paying remuneration, under **section 75(a)** of said law.

The project proponent has to inform the relevant township social security office if changes in number of workers and establishment, change of employer, change of business, suspension of work, and close-down of work, and employment injury, decease and contracting diseases during construction phase under **section 75(b)** of said law.

The Control of Smoking and Consumption of Tobacco Product Law (2006)

The project proponent has to ensure that the person in charge shall do the following: under **section 9** of said law:

(a) Keep the captain and mark referring that it is a non-smoking area at the place mentioned in section.

(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

(c) Supervise and carry out measures so that no one shall smoke at the non-smoking area

(d) Accept the inspection when the supervisory body comes to the place for which he is responsible

Factories Act (1951)

The Factories Act (1951) is relevant to the OHS issue of this Project. This Act describes about health, safety, welfare, special applications and extensions, working hours of adults, employment of young persons, punishments and procedure which related the project during construction and operation phase. The project proponent has to follow all of the section which is related with project as described in the factories act.

Myanmar Investment Law (2016)

The project proponent has to follow the details management of land or building owned by Union and land registration contract that: (a) The investor who obtains permit or endorsement has the right to obtain a long-term lease of land or building from the owner (private, the relevant government organization, or the Union) in order to do investment. Citizen investors may invest in their own land or building in accordance with relevant laws. (d) The investor shall register the land lease contract at the Office of Registry of Deeds, under **section 50(a) (d)** of said law.

The project proponent has to follow: (b) The investor may appoint of any citizen who is a qualified person as senior manager, technical and operational expert, and advisor in his investment within the Union. (c) The investor shall appoint only citizens for works which does not require skill. (d) The investor shall appoint skilled citizen and foreign workers, technicians, and staff by signing an employment contract between employer and employee, in accordance with the labor laws and rules, under **section 51(a), (b), (c) and (d)** of said law.

The project proponent has to follow the duties and responsibilities of investor that shall to do and comply with the customs, traditions and traditional culture of the ethnic groups in the Union, under labour law in order to investment, under **section 65(g) (i) (j) (k) (l) (m) (o) (p) and (q).**

The project proponent has to insure the types of insurance stipulated in the provision of the rules at any insurance enterprise which is entitled to carry out insurance businesses within the Union of under **section 73** of said law.

Protection of National Races Law (2015)

The project proponent has to explain the detail of project and cooperate with the national races who resided in the project area, under **section 5** of said law.

Myanmar Fire Brigade Law (2015)

The project proponent has to follow the directive of the Department of Fire Bridge to reserve fire brigade, and provide fire safety equipment to protect the emergency and accident plan for public who resided in the project area, under **section 25** of said law.

Myanmar Engineering Council Law (2013)

The project proponent has to follow law describes about any registered engineer, graduated technologist and technician should abide by the rules, procedures, orders, directives and should abide by the ethical principles that stipulated by the council under **section 31 (a) and (b)** of said law.

The project proponent has to follow that no one shall perform any engineering and technological work which are specified as being dangerous to the public by a rule enacted under this law, without having received a registration certificate issued by the council, except for engineers appointed in a government department or an organization in the performance of their duties, under **section 37** of said law.

The City of Mandalay Development Law (2002)

The project proponent has to follow the city of Mandalay Development Law for BOT contract and commit for transfer at exact period.

Electricity Law (2014)

This law states which related to the Project are described in **Section 18**, **21 (a), 22 (a)**, **26 (a, b)**, **27**, **40**, and **68** as follows:

The Project Proponent has to ensure that the license holder can engage in electric power generation and distribution only after having received the electrical hazards safety certificate from the chief inspector, under **Section 18** of law.

The Project Proponent has not to fails to comply with the following under **Section 21** of law for complying with the law, rules, regulations, procedures, orders and directions or the specified quality standards and norms, be responsible in accordance with the law if any person or organization is affected or suffers a loss as a result.

The Project Proponent has to hold the responsibilities with the following under **Section 22** of law.

The license holder shall be responsible in accordance with the law if any person or organization is affected or suffers a loss due to his negligence in performance

The Project Proponent has to ensure that the license holder must comply with under **Section 26** of law.

The project has to ensure that the license holder and the authorized person must inform the chief inspector and the relevant department in charge immediately if an electrical hazard has accidentally occurred when generating, transmitting, distributing or consuming electric power, under **Section 27** of law.

The Project Proponent has to ensure that the license holder comply with the rules, norms and procedures issued by the ministry and accept necessary inspections by the relevant government departments and organizations, under **Section 40** of law.

The Project Proponent has to ensure that, if the license holder negligent or irresponsible of persons who assigned by him has caused injury, disability or death by electrocution or fire, these aggrieved person has the right to request compensation from the license holder as follows: under **Section 68** of law.

Motor Vehicle Rules (1987)

The project proponent has to follow the detail section of motor vehicle rules to avoid the negative impact of air and noise pollution, occupation health and safety, and socio-safety for who lived near the project area, under this Law.

Motor Vehicle Law (2015)

The project proponent should announces local community to follow the law for road safety and should explain to workers, vehicle drives should follow the law of motor vehicle to avoid road accident, air and noise pollution during pre-construction and construction phases that described at **section 51, 52, 54, and 57** of said law.

The Petroleum and Petroleum Product Law (2017)

The project proponent has to follow all of the functions relating to any petroleum and petroleum product by issuing licence to vehicles, vessels and barges that carry any petroleum and petroleum product, determining period, form , conditions, means of applying for licence, permitting authority and fees to be assessed, determining and supervision on ports for vessels and barges that carry out import, export, and transport by water in accord with procedures, taking action, as necessary, in accordance with the existing laws if it occurs spill or accident in carrying out import, export, transport, and sale and distribution of petroleum and petroleum product by water and determining procedures and conditions to be abided by in carrying out transport business except transport by pipeline under **section 9** of said law.

The project proponent has to follow the issuing licence for the right to store for the storage tanks and warehouses, issuing transport permit for the vehicles, vessels and barges that shall carry any petroleum and petroleum product, determining the period, form and terms and conditions, manners of applying licence, permitting authority and fees to be assessed, for licence under subsection (a) and permit under subsection (b) and even 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 and also determining, in coordination with ministries concerned, procedures and conditions relating to standard and quality of storage tanks and warehouse, and tanks of vehicles, vessels and barges that carry any petroleum and petroleum product of under **section 10** of said law.

The project proponent has to control for 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 of under **section 11** of said law.

Petroleum Rules (1937)

The project proponent has to follow the descriptions of the Petroleum Rules which are related with Deedoke Hydropower project under **chapter 3 and 4** of said law.

Export and Import Law (2012)

The project proponent has to ensure that obtained any license shall not violate the conditions contained in the license of under section 7 of said law.

The Land Acquisition Act (1894)

The project proponent has responsibility for carrying out the acquisition and distributing compensation but the funds for compensation are to be provided by the company acquiring the land. Compensation must be paid at market value with adjustments, including for crops, The Land Acquisition Act 1894 provides the basis for the Government of Myanmar to acquire land for public and other purposes and addresses processes for required notice; procedures for objecting to acquisition; land valuation methods; the process for taking possession of land; the process for appeals; and rules for the temporary occupation of land. The Land Acquisition Act 1894 sets out a process for the acquisition of land as follows:

a. preliminary investigations on the land and procedure for notification of, and objections to be raised by, persons interested in the land (Article 5A);

b. agreement between the company and the Government is to be disclosed in the National Gazette;

c. notice is to be given to the public (Article 42);

d. notices are to be posted publicly in the locality of the land (Article 4 (1), Article 9 (1)).

e. notice to the occupier of the land must be given (Article 9 (3), but only once there is a declaration of intended acquisition.

Although there are provisions for objections to the land acquisition (Article 5A (1)), the President's decision on the objection is final (Article 5A. (2)), giving wide discretionary powers to the President. An 2011 amendment to the Land Acquisition Act 1894 changed the rate of compensation from 'market value' to ''the market value of the land or three years average value of a similar land which exists surrounding it; whichever is more.

The Land Acquisition Act 1894 permit the Government to use compulsory acquisition to acquire land for public purposes and for business purposes. The Land Acquisition Act 1894 defines neither purpose in detail, leaving landholders vulnerable to losing their land through arbitrary processes.

The Farmland Law (2012)

The project proponent has to follow Farmland Law by establishing a system of land registration for farmers that ostensibly provide land use certificates (LUCs) that, once secured, create rights to sell, exchange, access credit, inherit and lease the land over which they hold rights. The prevailing view is that this new law does not provide sufficient land tenure security for farmers as the law in fact fails to provide adequate protection against arbitrary and forced displacement or land confiscation. Tenure rights under the Farmland Act are not secure because Government retains the power to revoke the LUCs if any of the strict conditions of use are not complied with in full. The law sacrifices security of tenure for commercial interests.

The project proponent has to follow the rights available to those in rural areas in a limited manner in principle, it is important to reiterate that without either a deed of title or legal registration of rights in land, those residing or using the land in question are effectively without rights to the land concerned under statutory law. Because it is estimated that only 15% or less of all farmers can show a land registration document, and the fact that many in the rural sectors of the country live under customary land law arrangements that are not adequately protected under domestic laws, it is clear that farmers, shifting cultivators and villagers in rural, upland and ethnic areas are tremendously vulnerable to abuses of their land rights and to land acquisition and subsequent displacement.

Moreover, the project proponent has to understand the Farmland Act by setting up an ill-defined administrative scheme that lacks basic rule of law safeguards that are necessary for stable, rights protective land administration system, and further, denies access to independent judicial review. The law contains vague rules with respect to farmers 'obligations, a multi-layered appeals process with each appellate level appointed by the same central authority and unduly harsh penalties for non-compliance. All of this makes the process inordinately complex and the consequences of missteps disproportionately severe.

The Myanmar Insurance Law (1993)

The project proponent has to control motor vehicles which shall effect compulsory Third Party Liability Insurance with the Myanma Insurance of under **section 15** of said law.

The project proponent has to operate 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 pollution to the environment shall effect compulsory General Liability Insurance with the Myanma Insurance of under **section 16** of said law.

Leave and Holidays Act (1951) (No.58)

The project proponent has to follow and allow the leave and holidays act which is related with all employers.

Labour Organization Law (2011)

The project proponent has to follow the Labour Organization Law for protecting the rights of the worker, to have good relations among the workers between employer enable to form and carry out the labour organizations systematically and independently. The followings describe in the Labour Organization Law which is related with the Project under the section 17, 18, 19, 20, 21, and 22 of said law.

Settlement of Labour Disputes Law (2012)

The project proponent has to negotiate and coordinate in respect of the compliant within the prescribed period without sufficient cause for employee under **section 38** of said law.

The project proponent has to alter the conditions of service relating to employee concerned in such dispute at the consecutive period before commencing the dispute during construction phase under **section 39** of said law.

The project proponent has avoid to process to lock-out or strike without accepting negotiation, conciliation and arbitration by Arbitration Body in accord with this law in respect of a dispute under **section 40** of said law.

The project proponent has to follow the course of settlement of dispute, commits any act or omission, without sufficient cause, which by causing a reduction in production resulting so as to reduce the workers' benefits shall be liable to pay full compensation in the amount determined by the Arbitration Body or Tribunal. Such money shall be recovered as the arrear of land revenue under **section 61** of said law.

Minimum Wages Law (2013)

The project proponent has to follow the duties of the employer which specified that the minimum wages should to pay for the worker who works for the Project during pre-construction, construction and operation phases in **section 12 and 13 (a), (b), (c), (d), (e), (f) and (g)** of said law.

Payment of Wages Act (2016)

The project proponent has to recognize the currency of Central Bank of Myanmar. Moreover, pay can be in the means of totally in cash or half the cash and half in things set according to the local price to those employees working in trade, manufacturing, service sectors and local traditions or common agreement to those working in agriculture and livestock sectors under **section 3** of said law.

The project proponent has to coordinate with the payment of Wages Act (2016), the employer must pay for part-time, daily, weekly, other part-time, temporary, or piecework when the work is done or at the agreed time, and the time frame not exceed one month. Wages for the permanent work must pay per monthly basis, upon termination, within 2 days. If a resignation letter is submitted, wages must be paid at the ending day of the payment period. Wages must be paid to the legally recognized heir within 2 working days after the day he/she has died, under **section 4** of said law.

The project proponent has to negotiate when encounters difficulty to pay the wages because of significant happenings, including natural disaster, the employer must report to the Department with solid evidence that wages will be paid at the mentioned day upon the worker's agreement under **section 5** of said law.

The project proponent has to follow the deduction process of under **section 8, 9 and 10** of said law.

The project proponent has to fine the 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 of under **section 11** of said law.

The project proponent has to allow the presiding overtime rate as set by the law under **section 14** of said law.

Employment and Skill Development Law (2013)

The project proponent has to clearly describe about the detail information that must include in signing employment agreement under **section 5** of said law.

The project proponent has to carry out the training program in accord with the work requirement to develop skill relating to the employment for the workers who are proposed to appoint and working during pre-construction and construction phase described under **section 14** of said law.

The project proponent has to put the fund monthly as put in fees without fail for to total wages under **section 30** of said law.

The Workmen's Compensation Act (1923)

The project proponent has to describe the detail of the Workmen's Compensation Act (1923) for the employees who work in the project during pre-construction, construction and operation phase under **section 3(1), 12(1), and 14(1).**

(3) Cultural Impact Concerns

The Protection and Preservation of Cultural Heritage Regions Law (1998), Amended by Law No.1/2009

The project proponent has to minimize impacts of development projects on the local heritage and cultural settings. The purposes of this law are to implement the protection and preservation policy with respect to perpetuation of cultural heritage that has existed for many years, promote public awareness and participation in the protection and preservation of cultural heritage regions, and carry out protection and preservation of the cultural heritage regions in conformity with international conventions committed to by the State under **section 13 (a) and (b)** of said law.

The project proponent has to follow the law which prohibits destruction of ancient monuments, the willful altering of the original ancient form and structure or original ancient workmanship of an ancient monument, and excavations to search for antiques and exploration for petroleum, natural gas, precious stones or minerals in a cultural heritage site. It is also prohibited to plough and cultivate or carry out any activity that may cause damage to the cultural heritage under **section 22** of said law.

The Protection and Preservation of Antique Objects Law (2015)

The project proponent has to follow this law that the person who finds an object which has no owner or custodian, he shall promptly inform the relevant Ward or Village-Tract Administrator if he knows or it seems reasonable to assume that the said object is an antique object under **section 12** of said law.

The Protection and Preservation of Ancient Monuments Law (2015)

The project proponent has to follow, if a person who finds an ancient monument of over one hundred years old and above or under the ground or above or under the water which has no owner or custodian knows or it seems reasonable to assume that the said monument is an ancient monument, he shall promptly inform the relevant Ward or Village-Tract Administrative Office, under **section 12** of said law.

The project proponent has to ensure that a person desirous of any of the followings within the specified area of an ancient monument shall apply to get prior permission to the Department, constructing a building which is not consistent with the terms and conditions stipulated according to the region by the Ministry near and at the surrounding of an ancient monument under **section 15(h)** of said law.

The project proponent has to ensure that no one shall carry out any of the following acts which is assumed to cause damage to an ancient monument within the specified area of an ancient monument or of a listed ancient monument without a written prior permission; (f) discarding chemical substance and rubbish which can affect an ancient monument and the environment under **section 20(f)** of said law.

C. Law Related to Ecological Concerns

Myanmar Forest Policy (1995)

The project proponent has to follow Myanmar Forest Policy of land use, protection and management, forest regeneration and afforestation and identified strategies/actions in the short, medium and long term for developing Deedoke Hydropower Project.

The Forest Law (1992)

The project proponent has to ensure that whoever, within a forest land and forest covered land at the disposal Government is desirous of carrying out any development work or economic scheme shall obtain the prior approval of the Ministry of Forestry, and who is desirous of carrying out educational or research work or conducting a training course or a study tour shall obtain the prior sanction of the Director-General or the Forest Officer empowered by him, under **section 12** of said law.

The Farmland Law (2012)

The project proponent has to respect of application of use the farmland by other means for the interests of the public under **section 30 (a) and (b)** of said law.

D. Laws Related to Freshwater Environments

Laws related to freshwater environments are described in different sectoral laws under two ministries, the Ministry of Livestock and Fisheries and MONREC. For the Freshwater Fisheries Law (1991), the detail of laws can described as follow:

The Freshwater Fisheries Law (1991)

The project proponent has to ensure that no one shall erect, construct place, maintain or we any obstruction such as a dam, bank or weir in a freshwater fisheries waters without the permission of the Department under **section 36** of said law.

The project proponent has to ensure that no one cause harassment of fish and other aquatic organisms or pollution of the water in a freshwater fisheries waters under **section 40** of said law.

The project proponent has to ensure that no one shall alter the quality of water, volume of water or the water-course in a leasable fishery, reserved fishery and creeks contiguous thereto or in water-courses under **section 41** of said law.

The Conservation of Water Resources and Rivers Law (2006)

The project proponent has to avoid carrying out growing of garden, digging, filling, silt trapping, closing pond, dyke building or erecting spur in the river-creek boundary, bank boundary and waterfront boundary without the permission of the relevant government department and organization of under **section 12** of said law.

The project proponent has to avoid driving loading goods above the loaded draught or ply outside the demarcation channel of under **section 18** of said law.

The project proponent has to avoid violate the conditions relating to navigation of vessels in rivers and creeks prescribed by the Directorate for conservation of water resources, rivers and creeks of under **section 24 (a)** of said law.

TABLE 3.2-1

RELEVANT INTERNATIONAL TREATIES SIGNED BY MYANMAR

No.	International Environmental Conventions/ Protocols/ Agreements	Date of Signature	Date of Ratification	Date of Member	Cabinet Approval Date
1	Plant Protection Agreement for the South-East Asia and the Pacific Region, Rome, 1956		4-11-1959 (Adherence)	4/11/1959	
2	United Nations Framework Convention on Climate Change, New York, 1992 (UNFCCC)	11/6/1992	25-11-1994 (Ratification)		41/94 9-11-94
3	Convention on Biological Diversity, Rio de Janeiro, 1992	11/6/1992	25-11-1994 (Ratification)		41/94 9-11-94
4	The Convention for the Protection of the World Culture and Natural Heritage, Paris, 1972		29-4-1994 (Acceptance)		6/94 9-2-94
5	ASEAN Agreement on the Conservation of Nature and Natural Resources, Kuala Lumpur, 1985	16/10/1997			
6	Catagena Protocol on Biosafety, Cartagena, 2000	11/5/2001			13/2001 22-3-01
7	Kyoto Protocol to the Convention on Climate Change, Kyoto, 1997		13-8-2003 (Accession)		26/2003 16-7-03

3.2.4 International Policies, Guidelines and Standards

International policies, guidelines and standards relevant to environmental and social impacts of projects that are referred to by most countries are those issued by the World Health Organization (WHO), the U.S. Environmental Protection Agency (EPA), the World Bank, and the International Finance Corporation (IFC). The policies, guidelines and standards of the World Bank and IFC are cross referenced and complementary as the IFC is an organization of the World Bank Group. They are also adopted by most development organizations such as the Asian Development Bank. It should be noted that the guidelines and standards recommended by the World Bank and IFC, especially those related to environmental pollution, also gave due consideration to the guidelines and standards of the EPA and WHO.

Only those international policies, guidelines and standards relevant to this Project are discussed herein.

IFC's Standards and Guidelines

IFC's standards and guidelines relevant to this Project are described in two documents:

- Performance Standards on Environmental and Social Sustainability, January 1, 2012; and
- Environmental, Health, and Safety-General Guidelines, April 30, 2007; and

The first document describes eight performance standards on environmental and social sustainability which IFC requires its clients to apply throughout the project life cycle.

The second document provides general guidelines for environmental, health and safety (EHS) for development projects.

Essential requirements in the two IFC documents pertaining to this Project are summarized below.

A. Performance Standards on Environmental and Social Sustainability, January 1, 2012

IFC prescribes eight Performance Standards to which its clients will need to comply throughout the investment life of IFC. The eight performance standards (PS) are:

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 2: Labor and Working Conditions

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 7: Indigenous Peoples

Performance Standard 8: Cultural Heritage

The eight PSs cover all environmental and social aspects of development projects.

Major requirements of each PS are summarized as follows:

PS1-Asessment and Management of Environmental and Social Risks and Impacts

PS1 requires the client, in coordination with other responsible government agencies and third parties as appropriate; to conduct a process of environmental and social assessment, and establish and maintain an environmental and social management system (ESMS) *appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts*. The ESMS will incorporate the following elements: (i) policy; (ii) identification of risks and impacts; (iii) management programs; (iv) organizational capacity and competency; (v) emergency preparedness and response; (vi) stakeholder engagement; and (vii) monitoring and review. These requirements are explained in details in the PS document and associated guidelines.

PS2-Labor and Working Conditions

PS2 requires the client to: (i) formulate and implement human resources policies and procedures appropriate to its size and workforce that set out its approach to managing workers consistent with the requirements of this Performance Standard and national law; (ii) provide reasonable working conditions and terms of employment; (iii) treat migrant workers on substantially equivalent terms and conditions to non-migrant workers carrying out similar work; (iv) establish grievance mechanism; (v) refrain from using child labor and forced labor; and (v) provide a safe and healthy work environment, taking into account inherent risks in its particular sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women. These requirements will also be applied to workers of the contractors through effective contractual arrangements between the client and the contractors.

PS3-Resource Efficiency and Pollution Prevention

PS3 requires the client's project to: (i) efficiently use energy and water; and (ii) use best available techniques (BAT) in pollution control.

PS4-Community Health, Safety, and Security

This PS requires the client to: (i) evaluate the risks and impacts to the health and safety of the Affected Communities during the project life-cycle; and (ii) establish preventive and control measures consistent with good international industry practice (GIIP), such as in the World Bank Group Environmental, Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognized sources. The requirements are elaborated in the PS document. Some of the requirements, such as hazardous materials management, are similar to those in PS3. In essence, safety aspects to the communities and operators will need to be fully considered in engineering design, construction and operations of all Project facilities, including support facilities or infrastructure. Health risks will also be included.

PS5-Land Acquisition and Involuntary Resettlement

This PS requires the client to avoid land expropriation, physical displacement, and adverse impacts on livelihoods and ways of life of people in the project area. The process of land acquisition has to ensure community engagement, fair compensation for loss of land, properties, and livelihood; grievance mechanism, and appropriate resettlement and livelihood restoration planning and implementation.

PS6-Biodiversity Conservation and Sustainable Management of Living Natural Resources

PS6 requires the ESIA to consider direct and indirect project-related impacts on biodiversity and ecosystem services and identify any significant residual impacts. As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimize impacts and restore biodiversity and ecosystem services should be implemented. Given the complexity in predicting project impacts on biodiversity and ecosystem services over the long term, the client should adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the project's lifecycle.

PS7-Indigenous Peoples

PS7 requires the ESIA to identify all communities of Indigenous Peoples within the project area of influence who may be affected by the project, as well as the nature and degree of the expected direct and indirect economic, social, cultural (including cultural heritage), and environmental impacts on them. Adverse impacts on Affected Communities of Indigenous Peoples should be avoided where possible. Where alternatives have been explored and adverse impacts are unavoidable, the client will minimize, restore, and/or compensate for these impacts in a culturally appropriate manner commensurate with the nature and scale of such impacts and the vulnerability of the Affected Communities of Indigenous Peoples.

PS8-Cultural Heritage

PS8 requires the client to: (i) protect cultural heritage from the adverse impacts of project activities and support its preservation; and (ii) promote the equitable sharing of benefits from the use of cultural heritage. The ESIA will need to identify sites of cultural heritage and assess their value or importance at the community, provincial and national levels.

It should be noted that all the eight PSs are in line with the Government's policy and regulations. For this Project, PS7 is not relevant for the following reasons:

According to the field survey in April 2015, all villagers living within the project affected area are of Burmese ethnic. They are the majority of the country. Although only very few villagers are not Burmese, they are well integrated into the communities. Furthermore, the Project development will not create any impacts on cultural practices of the locals.

B. Environmental, Health, and Safety-General Guidelines, April 30, 2007

This publication provides general EHS guidelines covering the following subjects:

Environment covering: (i) air emissions and ambient air quality; (ii) energy conservation; (iii) wastewater and ambient water quality; (iv) water conservation; (v) hazardous materials management; (vi) waste management; (vii) noise; and (viii) contaminated land.

Occupational Health and Safety covering: (i) general facility design and operation; (ii) communication and training; (iii) physical hazards; (iv) chemical hazards; (v) biological hazards; (vi) radiological hazards; (vii) personal protective equipment; (viii) special hazard environments; and (ix) monitoring.

Community Health and Safety covering: (i) water quality and availability; (ii) structural safety of project infrastructure; (iii) life and fire safety (L&FS); (iv) traffic safety; (v) transport of hazardous materials; (vi) disease prevention; and (vii) emergency preparedness and response.

Construction and Decommissioning covering: (i) environment; (ii) occupational health and safety; and (iii) community health and safety.ng 89

3.3 MYANMAR GOVERNMENT INSTITUTIONAL FRAMEWORK

3.3.1 Arrangement at the National and Sector Level

At the national level, the Environmental Conservation Committee (ENCC) serves as mechanism for inter-ministerial coordination. Authorities and functions of ENCC are prescribed in Articles 7 to 13 of the EC Rules.

One of ENCC's main functions related to this Project is to oversee the management of the EIA process by MONREC through ECD. ECD will serve as coordinator among various concerned sector departments to ensure that the EIA and implementation of EMP will address environmental and social issues of concerns of relevant sector departments.

The EIA process for this Project will be administered by the central ECD in coordination with the regional ECD and various government organizations at the regional, township, and district levels.

3.3.2 Sectoral Framework/Mechanism

Different ministries involved in environmental issues also have their own policies, capacities, processes, legislations, and budgets for the environmental issues they have to deal with. For example, the Ministry of Forestry has its own budget for the reforestation component of the Land Degradation Programme. However, given close cooperation between different ministries, information on budgets, as well as on other matters, are shared between one another. Capacity and institution building in the short and medium term is being carried out by each ministry separately on their own budgets.

Governmental organizations and their prime environmental issues are summarized in ***Table 3.3-1***. Those relevant to this Project are highlighted.

TABLE 3.3-1

GOVERNMENTAL ORGANIZATIONS AND RELEVANT ENVIRONMENTAL ISSUES

Environmental Issues / **Governmental Organizations**	Air Pollution	Water Pollution	Banned Pesticides	Environment in Factory	Toxic chemicals	Solid Waste	Energy	Water Supply	Waste Water Treat	Forest and Desert	Biodiversity	Natural Resources	Natural Disaster	Environmental Education
National Commission for Environmental Affairs	○	na	na	na	na	na	-	na	na	na	○	na	-	○
Ministry of Forestry	○	na	na	-	na	na	-	-	-	○	○	○	na	○
Ministry of Agriculture and Irrigation	-	○	○	-	○	○	-	○	-	○	-	○	-	○
Ministry of Livestock and Fisheries	-	-	-	-	-	-	-	-	-	-	-	○	-	-
Ministry of Industry	-	○	na	-	○		-	na	○	-	-	-	-	-
Ministry of Health	na	○	na	na	○		-	○	-	-	-	-	-	○
Ministry of Energy	-	-	-	-	-	-	○	-	-	-	-	na	-	-
Ministry of Electric Power	-	-	-	-	-	-	○	-	-	-	-	na	-	-
Ministry of Transport	○	-	-	-	-	-	-	-	-	-	○	○	-	-
Ministry of Home Affairs	-	na	-	-	-	-	-	-	-	-	-	-	○	-
Ministry of Labor	○	○	-	○	-	-	-	-	○	-	-	-	-	-
Ministry of Science and Technology	na	na	na	-	○	○	○	-	-	-	-	-	-	○
Ministry of Education	-	-	-	-	-	-	-	-	-	-	-	-	-	○
Ministry of National Planning and Economic Development	-	-	-	-	-	-	○	-	-	-	○	○	-	-
Ministry of Progress of Border Areas, National Races and Development Affairs	-	-	-	-	-	-	-	○	-	○	-	-	na	-
Myanmar Investment Commission	-	○	-	-	-	-	-	-	-	-	-	○	-	-
National commission for Water and Sanitation	-	na	-	-	-	-	-	○	-	-	-	-	-	-
Industrial Development Central Committee	○	○	-	-	-	-	-	-	-	-	-	-	-	-
Disaster Prevention Central Committee	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note : 1) : ○ → Relevant Organization,- → Not responsible, na → Lack of information

3.4 GUIDELINES AND STANDARDS APPLICABLE TO THIS PROJECT

Environmental management of the Project during construction and operation will comply with the national or international environmental guidelines and standards as appropriate. The international guidelines and standards will be adopted as appropriate only when the national guidelines and standards do not exist.

Table 3.4-1 presents international ambient environmental quality standards to be adopted as the national ambient environmental quality standards have not yet been issued. ***Table 3.4-2*** presents national quality standards for effluents to be discharged from construction activities.

TABLE 3.4-1

RELEVANT ENVIRONMENTAL GUIDELINES AND STANDARDS

Subjects	Parameters	Values	References
Ambient Air Quality (24 hour average)	TSP PM10 NO_x as NO_2 SO_2	<230 mg/m^3 <150 mg/m^3 <150 mg/m^3 <150 mg/m^3	IFC, WB PPAH
Ambient Noise Levels - industrial and commercial area - residential areas	Leq (24 hrs) Leq (1 hr) L_{max}	70 dB(A) 55 dB(A)daytime 45 dB(A) nighttime 115 dB(A)	
Vibration - for industrial buildings and residential building	Peak Particle Velocity	5 mm/s	DIN4150
Sediment Quality	 Total Chromium Total Arsenic Total Lead Total Nickel Total Zinc Total Copper Total Mercury	Maximum limits 81 mg/kg 8.2 mg/kg 46.7 mg/kg 20.9 mg/kg 150 mg/kg 34 mg/kg 0.15 mg/kg	International Association for Impact Assessment (IAIA) NOAA Screen Quick Reference Table, 2004
Groundwater Quality	pH at 25°C Nitrate-Nitrogen Nitrite-Nitrogen Cadmium Lead Arsenic Copper Mercury	6.5-8.5 ≤ 11 mg/L ≤ 0.9 mg/L ≤ 0.003 mg/L ≤ 0.01 mg/L ≤ 0.01 mg/L ≤ 2 mg/L ≤ 0.006 mg/L	WHO's Guidelines for Drinking Water Quality, 2011

TABLE 3.4-2

NATIONAL EFFLUENT STANDARDS

Parameter	Maximum Concentration
5-day Biochemical oxygen demand	30 mg/l
Chemical oxygen demand	125 mg/l
Oil and Grease	10 mg/l
pH	6-9 S.U.[a]
Total coliform bacteria	400/100 ml
Total nitrogen	10 mg/l
Total phosphorus	2 mg/l
Total suspended solids	50 mg/l

Note : [a] Standard unit

Sources : National Environmental Quality (Emission) Guidelines, 29th December, 2015

CHAPTER 4

PROJECT DESCRIPTION

CHAPTER 4
PROJECT DESCRIPTION

4.1 PRESENTATION OF THE PROJECT AND DESCRIPTION OF ALTERNATIVES

4.1.1 Project Rationale and Background

The Myitnge River is a main tributary river of the Irrawaddy River. From its origin in the Shan State, the Myitnge River meanders through its 182 km length, which mostly lies in the Mandalay Region, to its confluence with the Irrawaddy River at Inwa, about 11 km from the Mandalay City. Its hydropower potential is presently harnessed by

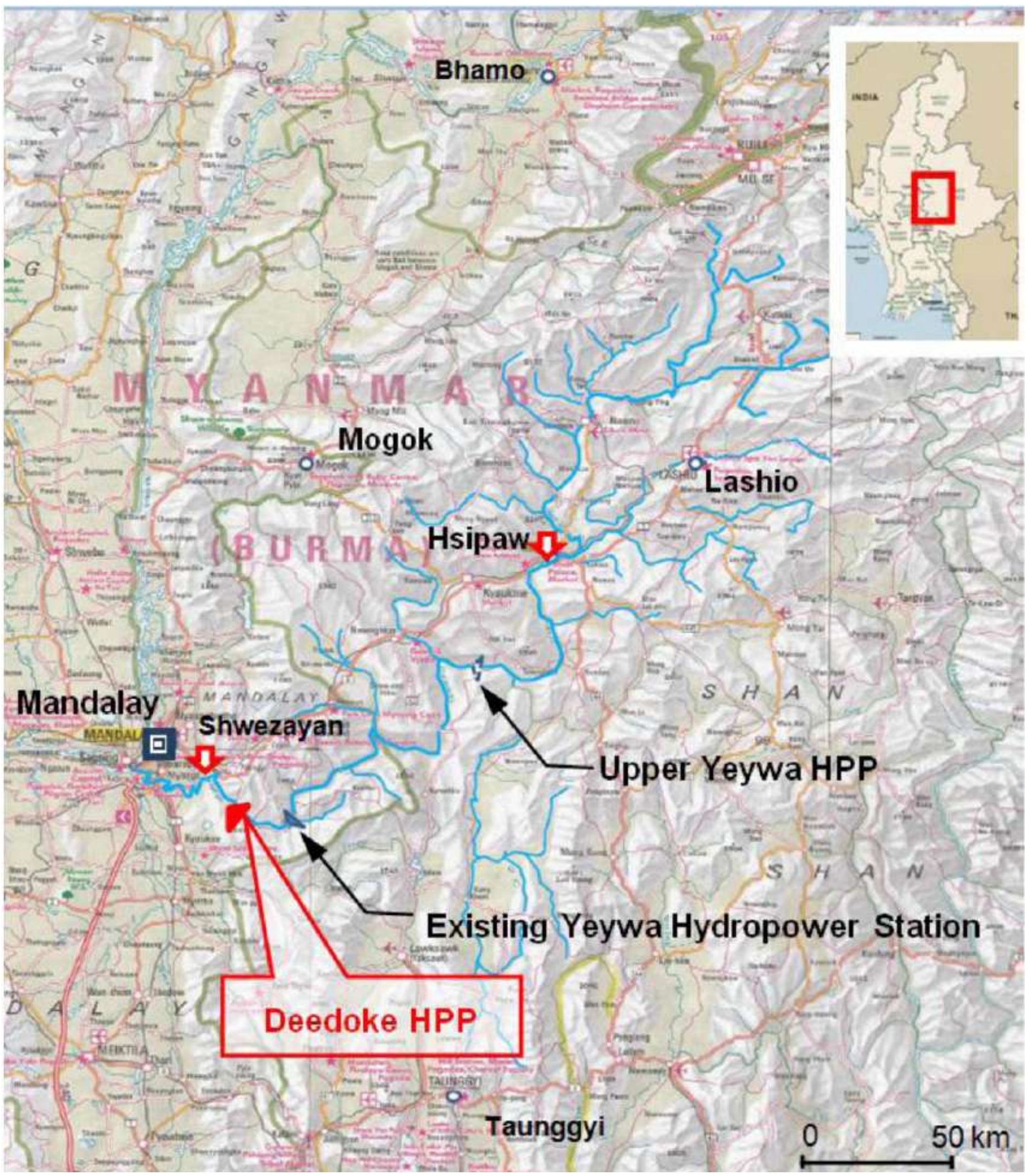


Figure 4.1-1 Project Location Map

a hydropower scheme at the Yeywa dam, a storage dam located at about 50 km from the Mandalay City. The Yeywa hydropower plant ("Yeywa HPP") has a rated generation capacity of 790 MW. The main components of the Yeywa HPP include the 134 m high RCC dam with a 2,630 million m^3 storage reservoir, and a 790 MW hydropower station (4 Francis turbines, each with a design discharge of 210 m^3/s). As for power operation, the Yeywa reservoir is planned to be full of water at the end of rainy season, and to release the reservoir water in addition to river inflow for power generation in dry seasons. In other words, the Yeywa HPP is operated with water regulated by its reservoir , especially in dry seasons.

As shown in ***Figure 4.1-***1 and ***Figure 4.1-2***, the Deedoke hydropower project ("Project") is planned as a Run of River (ROR) type hydropower project on the Myitnge River 21 km downstream of the Yeywa HPP, 30 km southeast of the Mandalay City, and 82 km upstream from the confluence of the Myitnge River with the Irrawaddy River. The left bank area is within the Kyaukse Township and the right bank area within the Pyin Oo Lwin Township of the Mandalay Region.

One of characteristics of a ROR hydropower project is that flow rates (m3/s) of inflow and outflow of the project are similar through a year. The reason is that generally a ROR hydropower project has only a pond of which volume is too small to regulate river inflow, unlike a reservoir type hydropower project such as the Yeywa HPP. Therefore, as Deedoke's inflow is depending on Yeywa's outflow, it could be said that the Project will not significantly change the present river flow regime of the Myitnge River downstream reaches of the Yeywa HPP even in rainy seasons and dry seasons. Namely, **Outflow (4) = Inflow(3) ≅ Outflow (2)** in ***Figure 4.1-3***.

This means that the Project can efficiently generate electricity without a high dam and a large reservoir, and it could lead to good economic performance in power generation.

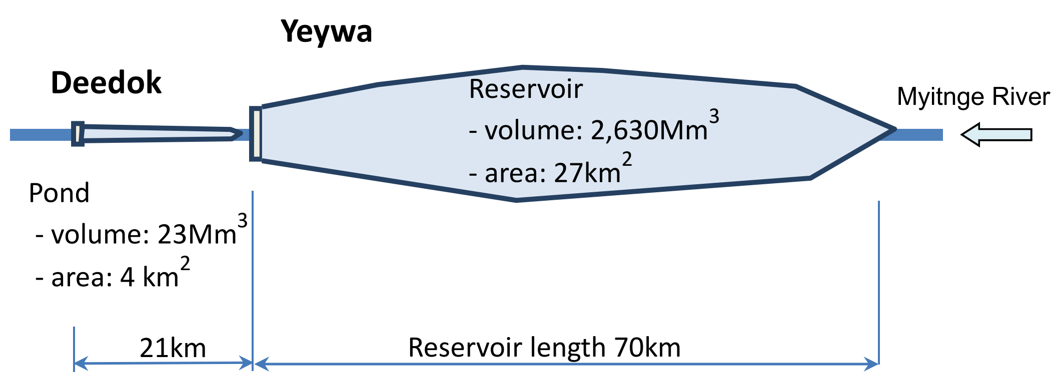


Figure 4.1-2 (1/2) Deedoke and Yeywa Hydropower (Plan)

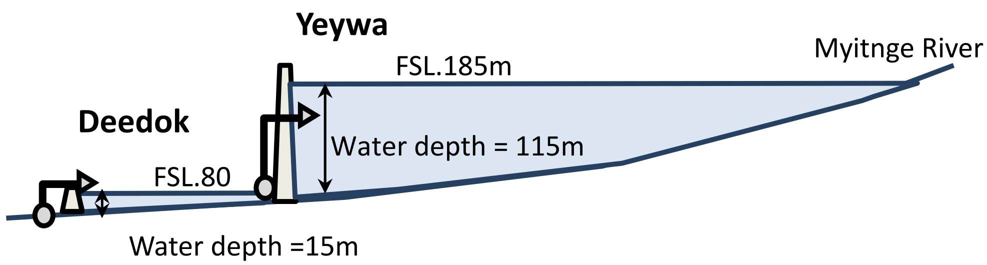


Figure 4.1-2 (2/2) Deedoke and Yeywa Hydropower (Profile)

Technical feasibility of the Project was initially investigated in 2012 through a preliminary feasibility study (PFS) conducted by AF-Colen Co., Ltd., for the Department of Hydropower Implementation under the Ministry of Electric Power. The Project development was realized through the MOU signed between MOEP and ANDRITZ in November 2014 followed by the feasibility study and this EIA as already described in **Section 2.1**. The technical and economic feasibility study report of the Project has been approved by MOEE and its environmental and social feasibility is elaborated in this EIA report.

4.1.2 Power Generation Plan

The Project is planned to generate power by the following mode.

1) Normal operation period

In normal period other than flood period, power will be generated with close or partial gate opening to keep the pond water level constant.

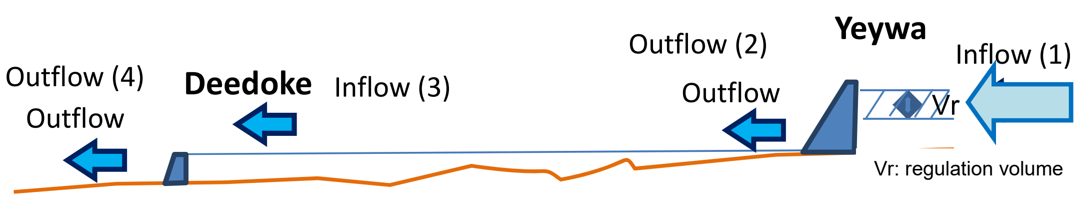


Figure 4.1-3 Profile of Normal Operation Period

2) Flood operation period

In flood period (of certain amount of flood, which should be determined in the detailed design stage), power generation will stop and all gates will fully be opened as inflow increases. The water level of the pond will go down and the pond becomes the same natural river flow condition as the river before construction of the Deedoke HPP.

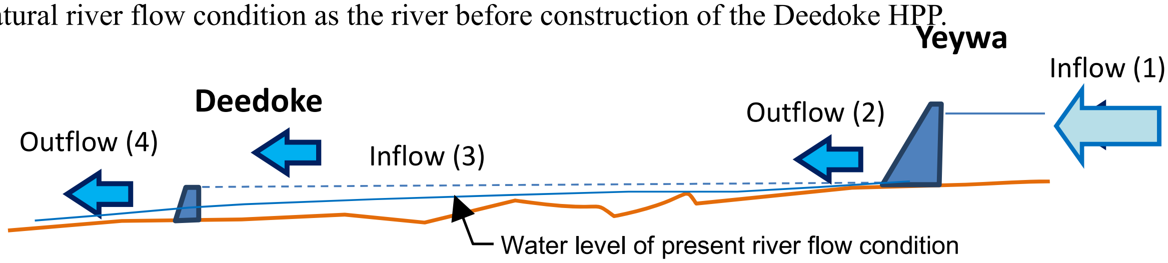


Figure 4.1-4 Profile of Flood Operation Period

4.1.3 Project Infrastructure

This section is based on results of preliminary designs of the Project presented in the final feasibility study report ("FSR") dated 10 July 2015. Salient technical information on main project facilities to be constructed at the selected dam site is presented in ***Table 4.1-1*** below.

Table 4.1-1 :Summary of Project Facilities to be Constructed

Facilities	Salient Features
Dam	Submerge rounded crest weir with a slope on both side, crest elevation 65 m.asl, total length 150 m
Gates	Seven tainter (radial) gates, each 17 m width
Stilling basin	Length about 50 m
Power house	Location on the left side of the dam Three bulb turbine generators, generator output 29 MVA each,
Access road	Two access roads to the project site from the existing roads, one on the left bank about 430 m and another on the right bank about 570 m, both branching out from the existing roads, total length 1,000 m
Transmission lines	One 132 kV 2 circuits line to Belin Substation on the left bank, length 20 km
Substations	Belin Substation 132 kV 2 bays (extension in the substation compound)
Support buildings	-

4.1.4 Project Alternatives

For a ROR hydropower project, the selected dam site and power house arrangement will have environmental and social implications. If the power house is separated and located downstream of the dam with a waterway as shown in ***Figure 4.1-5***, a required minimum flow will be an issue in the river section between the dam and tailrace of the powerhouse. However, for the Project, the powerhouse is planned at an integral part of the dam. Therefore, there will be no dry river section downstream of the dam.

The technical study identified four alternative dam sites downstream of the Yeywa dam: (i) site upstream of the rapids; (ii) site at cross section 44; (iii) site at cross section 46; and (iv) site at cross section 54, the four sites are indicated in a map in ***Figures 4.1-6***. ***Figures 4.1-7*** to ***4.1-10***, respectively show photograph of the four sites with maps only for cross sections 44 and 54.

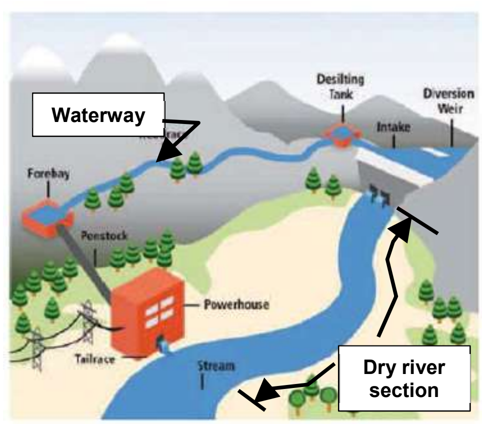


Figure 4.1-5 **ROR Scheme with Waterway**

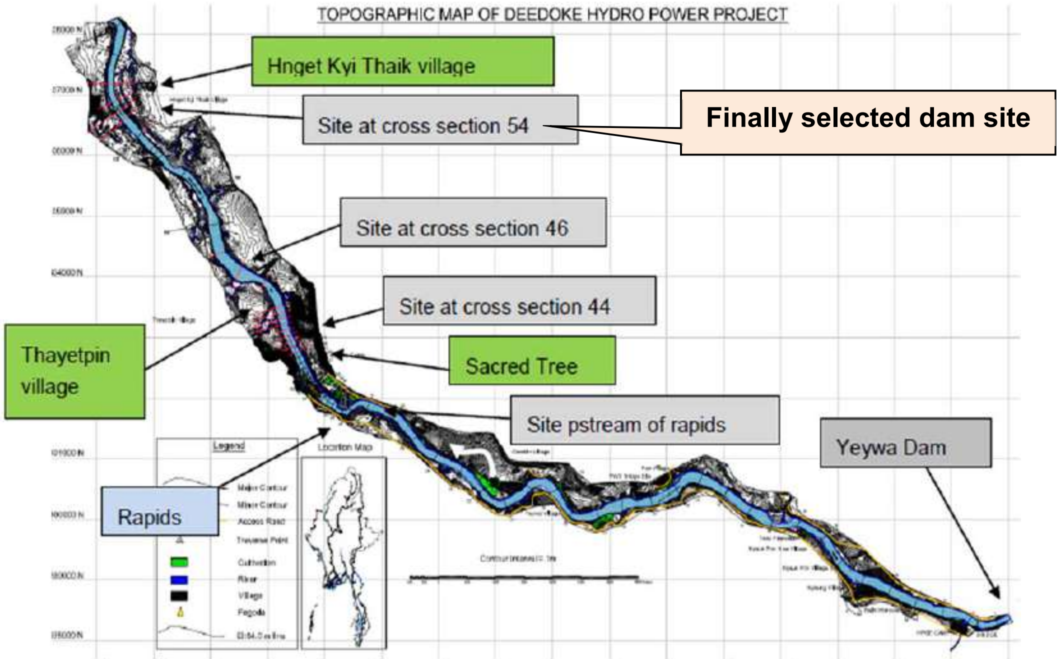


Figure 4.1-6 Potential Dam Sites

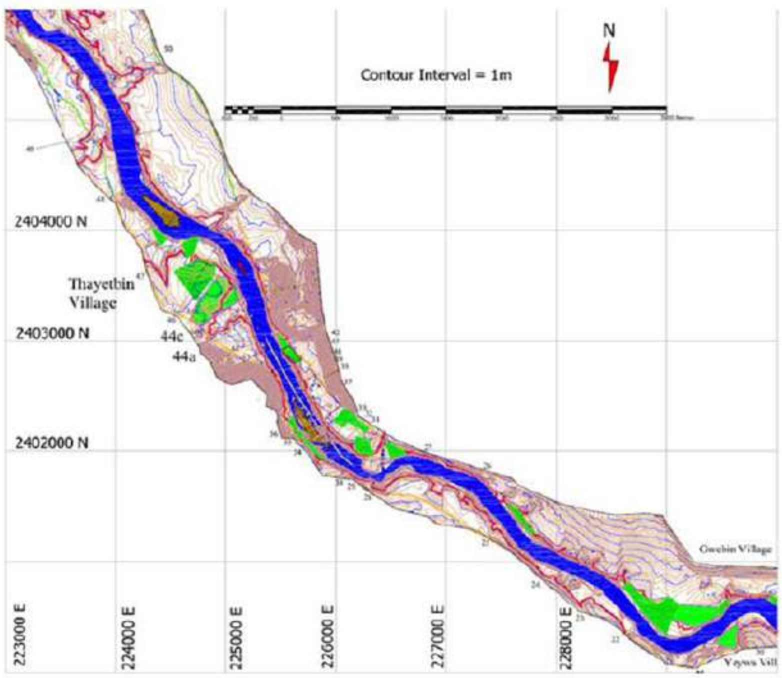


Figure 4.1-7 Potential Dam Site 44

Figure 4.1-8 (Cont'd)

Figure 4.1-8 View Downstream from the Left to Right Bank Side at Site at Cross Section 46

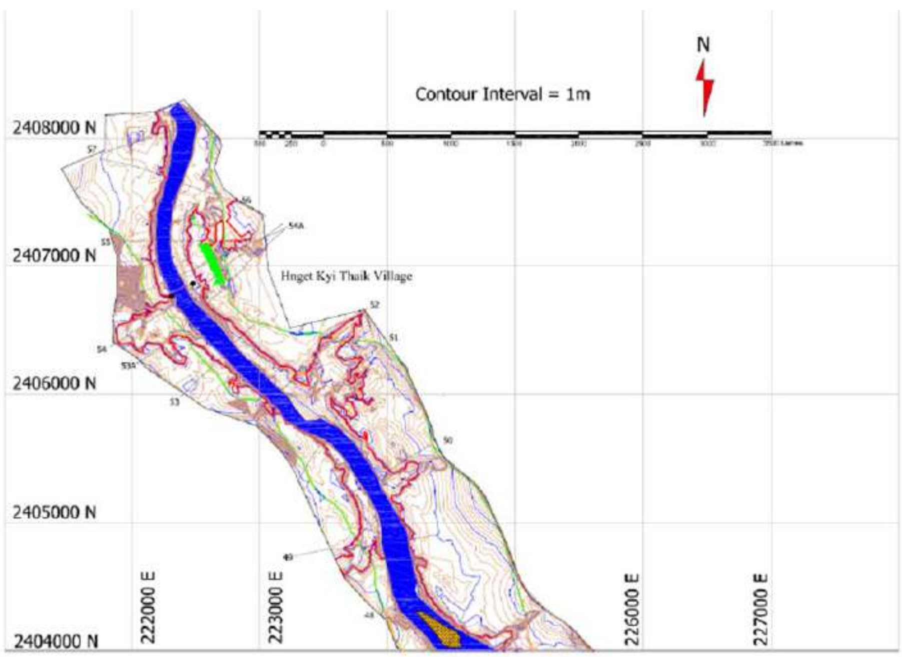


Figure 4.1-9 View Downstream from the Left to Right Bank Side at Site at Cross Section 54

Figure 4.1-10(Cont'd)

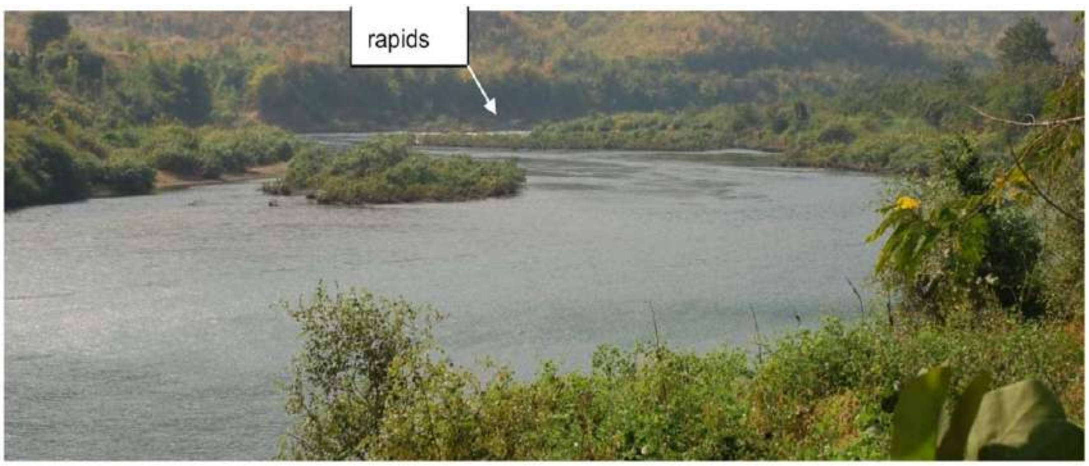


Figure 4.1-10 Potential Site Upstream of the Rapids (Looking Downstream)

4.2 COMPARISON AND SELECTION OF ALTERNATIVES

4.2.1 Methodology

The dam site selection was made in two steps. The first step was an initial screening to screen out unsuitable sites. The second step was detailed evaluation of the remaining candidate sites.

The first step of evaluation was based mainly on following criteria:

External constraints:

- Settlements;
- Agricultural areas;
- Religious structures (pagodas);
- Sacred Tree.

Technical assessment criteria:

- Foundation;
- Environmental and social impact;
- Hydraulics and energy production.

The second step evaluated the remaining sites in terms of general layout, energy production, geotechnical conditions, and environmental and social impacts.

4.2.2 Results of Evaluation

The first step of evaluation ruled out the potential sites at upstream of the rapids and at cross section 46 on geological and energy production grounds. Results of the first step evaluation taken from the feasibility study report are given in ***Appendix 4A.***

The second step of evaluation covered only the potential sites at cross section 44 and 54. Results of the final evaluation taken from the feasibility study report are also given in ***Appendix 4B***.The following conclusions were derived:

- The energy production is about 40 % higher at site 54.
- The investment cost are only about 15 % higher at site 54
- The site 54 is economically much more interesting.
- The overall geological and geotechnical soil-rock mass parameter and structures are more favorable at site 54, due to medium shallow bedrock line.
- Both sites require some compensation for the loss of agricultural land
- Both sites have some impact on the villages (temporary noise and vibration, water use during construction time).
- No major drawbacks or no-go's have been identified for both sites.

The section at cross section 54 was selected as the most preferable alternative for a detailed optimization and for carrying out the preliminary design.

4.3 DESCRIPTION OF THE SELECTED ALTERNATIVE

4.3.1 Technical Description of the Selected Alternative

The layout of project facilities at the selected dam site is presented in ***Figure 4.3-1***. Technical features of major project facilities and equipment are presented in **Section 4.1.3**. ***Figure 4.3-2*** shows a longitudinal section of the dam and power house. This section describes the technical nature of the layout.

(1) Layout of Project Facilities

The general layout at the selected site is governed by the following geological and hydraulic conditions at the site:

- favorable foundation of the power house on bed rock
- location of the spillway in the talweg[1] of the river
- closing embankment dams on left and right bank
- access roads on both sides
- switchyard on the left bank close to power house

[1] In geography and fluvial geomorphology, a **thalweg** or **talweg**is the line of lowest elevation within a valley or watercourse.

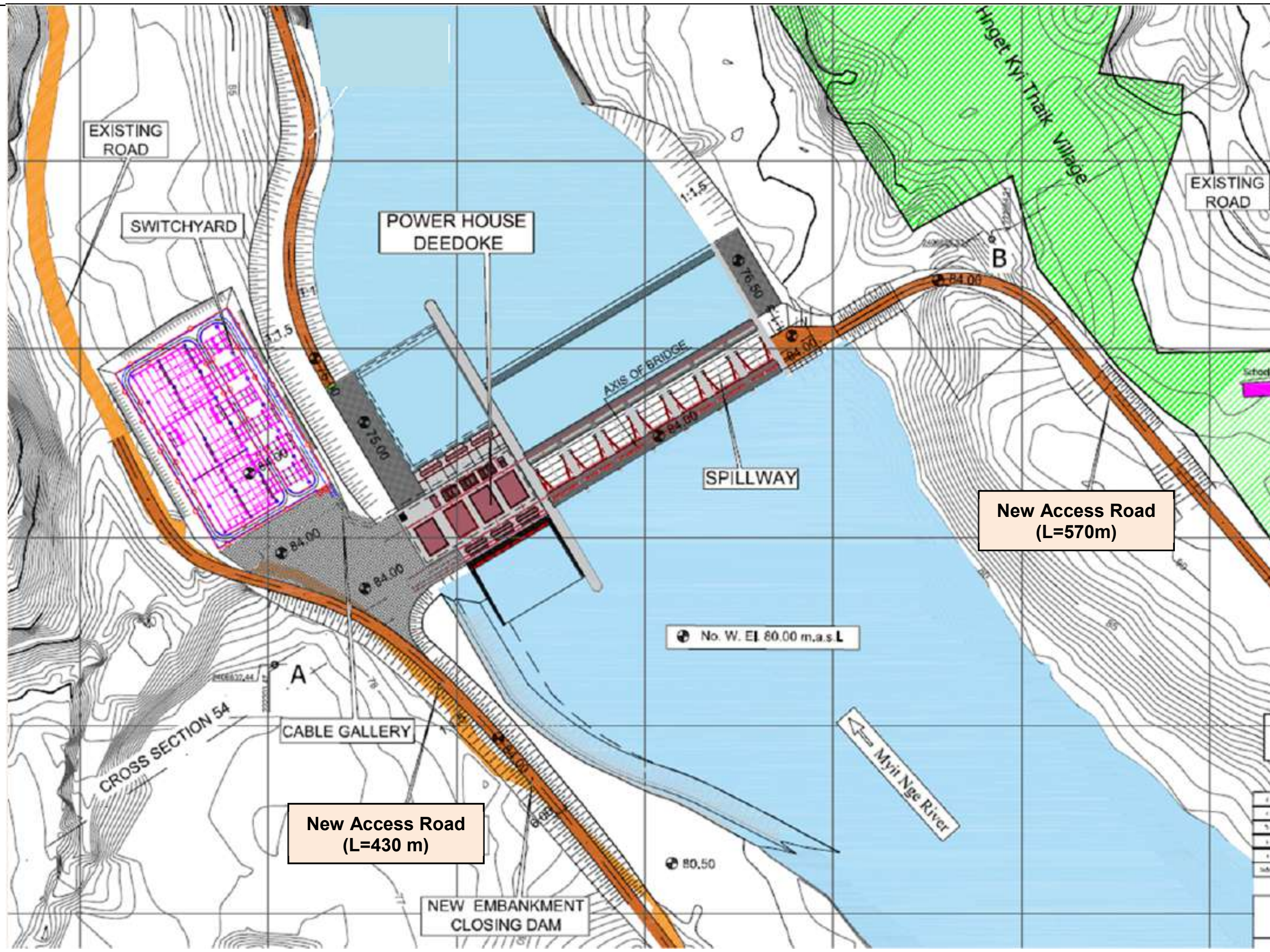


Figure 4.3-1: The Layout of Project Facilities at the Selected Dam Site

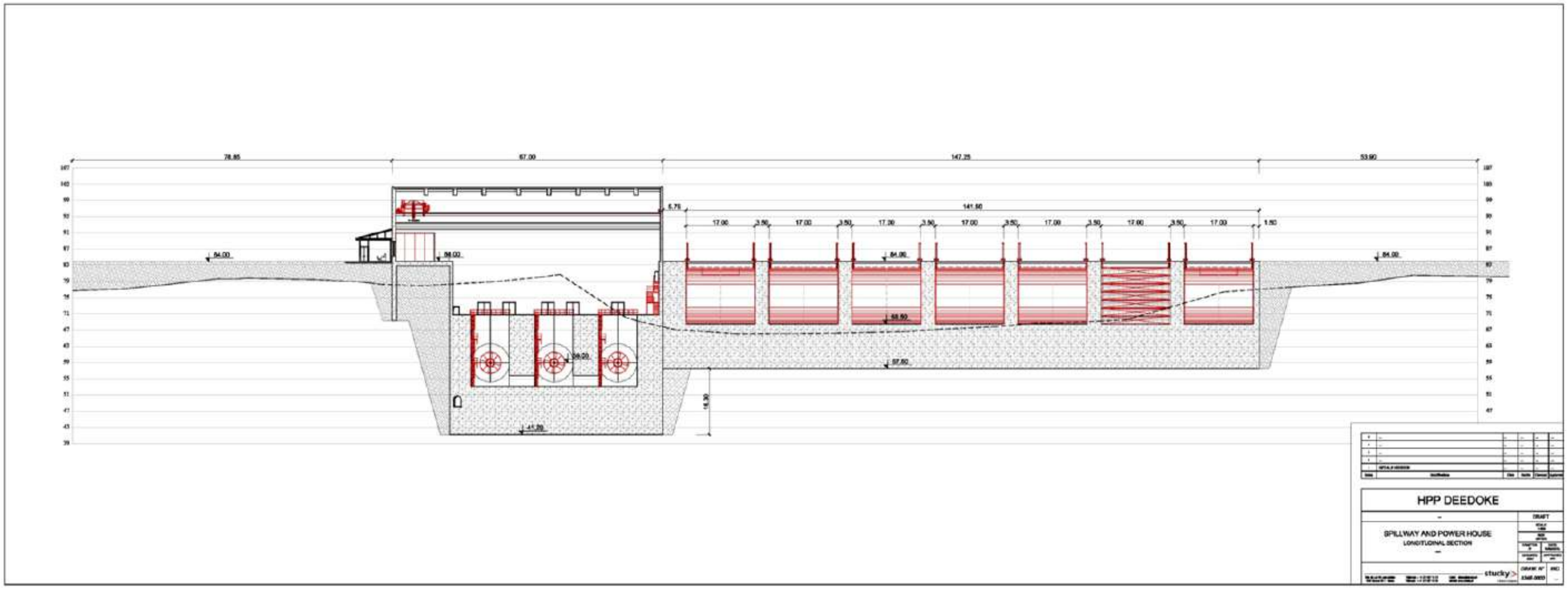


Figure 4.3-2: Cross Section of the Dam and Power House at the Selected Dam Site

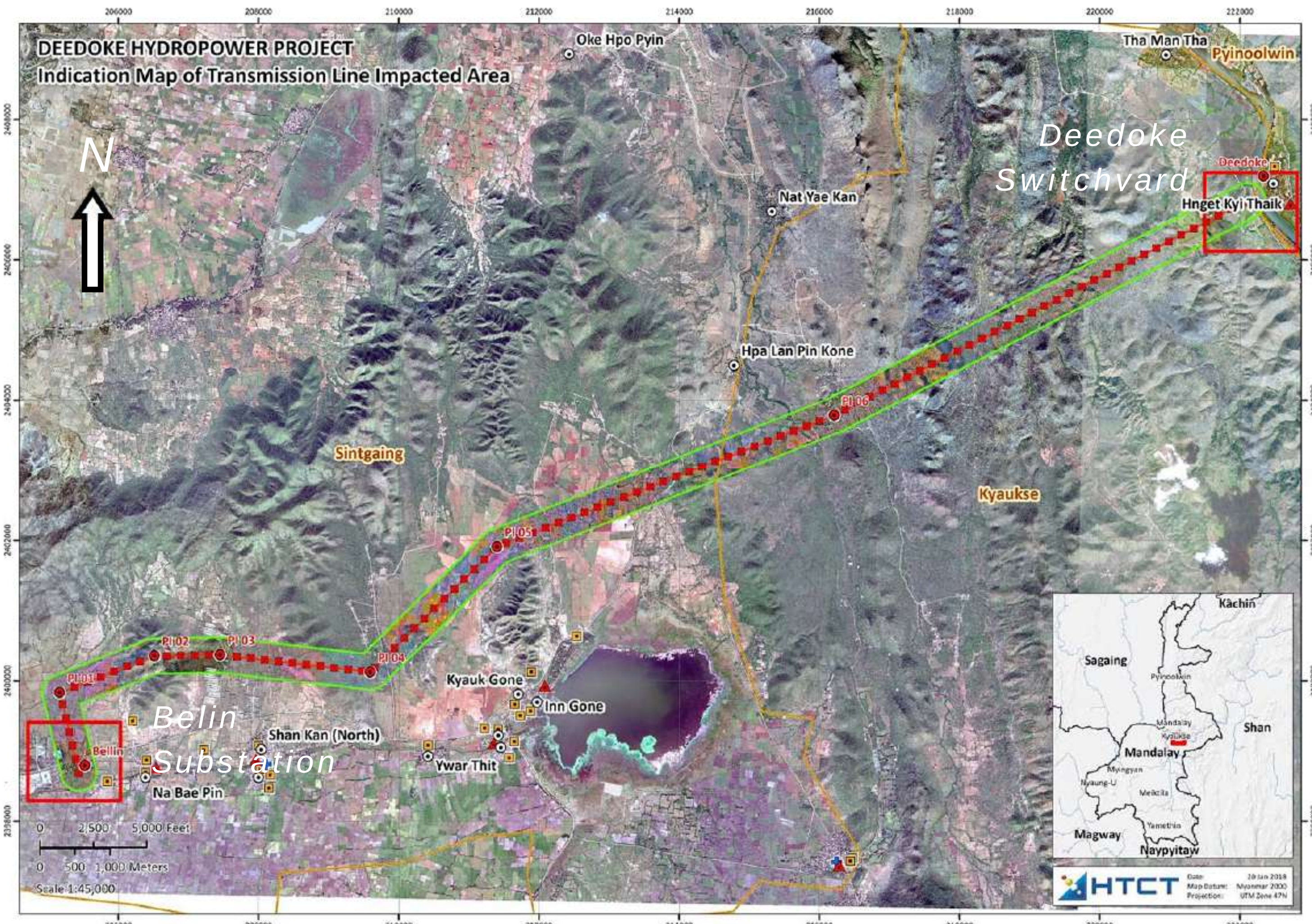


Figure 4.3-3 132kV Transmission Line Route

(2) Access Roads

Two (2) permanent access roads are planned to connect the project site to the existing roads, one on the right bank and another on the left bank.

The access road on the right bank will take off from the existing road to the project site. The total length will be about 570 m. The road will be constructed on an embankment at 84 m.asl to be above the maximum flood level of about 82 m.asl.

A section of the existing road on the left bank will be realigned and elevated to serve as the access road to the project site on the left bank. The length of the upgrade road will be about 430 m and its elevation will be at about 84 m.asl above the maximum flood level of about 82 m.asl.

(3) Dam

The dam will be designed as a gated weir structure adjoining the power house.

The spillway section will be about 141.5 m long and 26 m high. The spillway will be submerged weir structure with tainter (radial) gates for flow control. The spillway is designed to handle a flood discharge of 7,300 m^3/s based on a flood return period of 10,000 years.

The spillway structure will raise and keep water level at the dam at a maximum operation level of 80 m.asl. The volume of the Deedoke pond at the maximum operation level will be about 23 million m^3.

The free board at the dam will normally be about 4 m decreasing to 1 m during flood peaks.

(4) Power House

The power house section is separated from the spillway section by a partition wall. It has a length of about 67 m. It accommodates three bulb turbine generators.

(5) Stilling Basin

The stilling basin serves to dissipate energy and prevent riverbed erosion. The stilling basin was designed as Type IV with a length of about 50 m. ***Figure 4.3-4*** shows features of the stilling basin at the selected dam site.

Stilling basin length is determined based on results of hydraulic model test described in the USACE (United States Army Corps of Engineers) as shown in ***Table 4.3-1***. According to the table, the ratio of the basin length (L2) and tailwater level (d2) can be read about three (3) as marked with a red colored frame on the table.

Referring the above international design standard, for safety reason, the ratio of four (4) is finally adopted to determine the length of the stilling basin. And Type IV of the stilling basin for energy dissipation (to govern hydraulic jump) is selected based on the USBR. As the result, stilling basin length is set to be 50 m.

Hydraulic Design Data from Physical Model Studies for Low-Head Navigation Dam Spillways Based on Single-Gate Opening (Fully and/or Half) Criteria

Project Name	Item No.	Basin No.	Designed for What Gate Opening	Unit Dis-charge cfs/ft	Bay Width ft	Entering Froude No. F'*	d_2 ft	$\frac{TW}{d_2}$	$\frac{L_1}{d_2}$	Baffle Height d_2	$\frac{L_2}{d_2}$	End Sill Height d_2	d_{50}† ft
L&D 26	15	16	Full	775	110	2.5	44.5	0.81	1.08	0.27	2.6	0.25	3.8
Aliceville	13	6	Full	350	60	3.5	30.5	0.72	1.31	0.26	2.6	0.16	2.2
Columbus	16	5	Full	350	60	3.7	31.0	0.77	1.29	0.26	2.6	0.16	2.0
Red River No. 1	14	16	Full	484	50	3.9	39.6	0.81	1.26	0.25	2.8	0.43	1.7
Red River No. 2	10	13	Full	683	60	2.4	39.5	0.71	1.06	0.23	2.5	0.18	2.5
Red River No. 3	**	2	Full	817	60	2.75	47.9	0.79	1.15	0.21	3.0	0.15	2.6
L&D 26	15	30	Ice and Debris	382	110	3.7	32.8	0.91	1.58	0.24	3.0	0.15	2.6
Columbus	16	4	Half	242	60	4.4	26.2	0.84	1.53	0.31	3.1	0.19	1.7
Red River No. 1	14	9	Half	390	50	3.6	33.2	0.72	1.51	0.33	3.0	0.09	
Red River No. 1	14	17	Half	370	50	3.7	32.3	0.74	1.55	0.32	3.1	0.09	1.5
Red River No. 1	14	7	Half	370	50	4.1	33.7	0.71	1.48	0.34	2.7	0.27	1.1

Table 4.3-1 Hydraulic design data

(Source: EM 110-2-1605 Hydraulic design, U.S. Army Corps of Engineers)

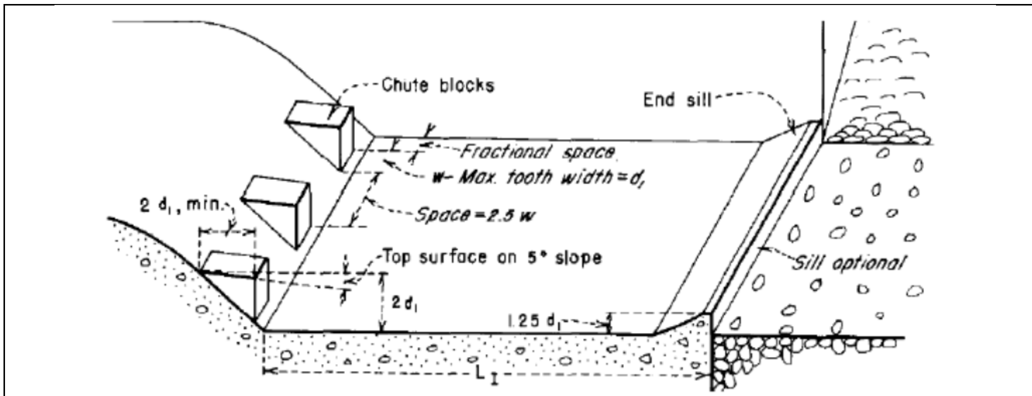


Figure 4.3-4: Stilling basin dimensions at the selected dam site

(6) Seepage Control

The seepage control will be achieved through a combination of a grout curtain of about 33 m and an extended drainage at the immediate downstream of the grout curtain. This design can significantly reduce the uplift pressure and hence improve the stability condition of the dam.

(7) Switchyard

A switchyard will be located at the west side of the power house on a 40 x 50 m land plot.

(8) Transmission Line

A transmission line (T/L) of 132 kV with double circuits and 20 km length is presently planned as instructed by MOEE in 2017 that the Deedoke T/L should be connected to the existing Belin substation instead of the Yeywa switchyard. T/L includes the transmission lines and associated control, protection and communication systems between the Deedoke switchyard and the Belin Substation, and the interconnection facility at the Belin Substation. For the connection, two (2) of 132 kV bus bay will be extent in the substation compound. The T/L route is shown in ***Figure 4.3-3***.

(9) Flood warning system

A flood warning system in case of critical flood is planned for warning to immediate upstream and downstream peoples and communities. The system should be designed in cooperation with the plant operator of the Yeywa HPP and government authorities responsible for monitoring water levels and meteorological data within the Lower Mytigne river basin. The system will include the possibility to raise alarms via a [illegible] inciation system.

4.3.2 Construction

The Project is planned to be constructed on the basis of separated contracts consisting of the civil works ("Civil Works") contract, the electrical and mechanical/hydraulic and mechanical works ("EM/HM Works") contract and the transmission line works ("TL Works") contract. The Project Proponent will ensure that all environmental and social impact mitigation measures recommended in the ESIA report and EMP report will be appropriately incorporated in those contracts. Therefore, the contract documents specify that the contractors shall submit the following documents related to environmental conservation for review or approval of the Employer (Project Proponent). Namely, the contractors are responsible for not only construction but also environmental conservation.

(1) ***Safety, Security and Health Programme***
The programme shall be prepared to secure safety, security and health for Contractor's Personnel, Employer's Personnel, and the local habitants near the Site. The programme shall be developed in accordance with specifications, and applicable law and consents.

(2) ***Contractor's Environmental and Social Monitoring and Management Plan (CESMMP)***
The plan shall include the protection measures and mitigation and monitoring schedule during the term of the Contract and shall be developed in accordance with the Environmental and Social Impact Assessment (ESIA), Environmental Management Plan (EMP), and the Concession Agreement for the Project. Contractor's Environmental and Social Monitoring & Management Plan (CESMMP) which includes mitigation measures on erosion and sedimentation (appropriate drainage plan), water availability and pollution control, emission and dust control, waste management, hazard material management, vegetation clearing, landscaping and re-vegetation, biodiversity management, spoil disposal, quarry and construction layout and disposal, Construction of work camp, traffic and access, training and awareness, project

personnel health program, public safety, damage to properties and facilities, emergency preparedness camp management, and cultural resources.

(3) ***Site-Specific Contractor's Environmental and Social Monitoring and Management Plan (SSCESMMP)***

Site-Specific Contractor's Environmental and Social Monitoring and Management Plan (SSCESMMP) of each construction site for Employer's approval which includes detailed mitigation measures of each items of ESMMP.

4.3.2.1 Construction Flows

The construction will involve carrying out the Civil Works and EMHM Works in sequence and/or in parallel**.** The contractors are responsible for construction quality and schedule in accordance with the contracts. The contractors will plan their detailed construction methodology to fulfill the Employer's Requirements and to keep the contracted schedule. Therefore, the following construction methodology is assumed on the basis of the feasibility study level design.

(1) Pre-construction Activities

Pre-construction activities will include the following:

Preparation of Detailed Designs and Tender Documents

The Project Proponent will make detailed design and prepare tender documents for selection of three (3) contractors for the Civil Works, EMHM Works and T/L Works. The tender will be taken place through the international tender process.

Land Acquisition

All the land required for the construction will have to be acquired as soon as possible. The land acquisition process will involve compensation for acquired land and properties. The scope and extent of land acquisition and compensation are presented in ***Section 6*** and a support action plan is to be prepared and presented in this report. The action plan for land acquisition will be implemented and completed before commencing the construction. However, the proposed program for livelihood restoration program and community development support will be implemented during the construction period.

(2) Construction Phases

The construction will be carried out in four phases. Major activities in each phase are briefly described below:

Phase 0-Site Preparation and New Access Roads

This phase will involve site preparation and construction of access roads.

Site preparation works will be carried out as soon as the land is secured. Such works will include but not limited to clearing, grading, compacting, construction of worker camps, offices, warehouses, and fuel storage; erecting perimeter walls, and installation of utilities including water supply, electricity, telecommunication, drainage, and waste disposal facilities.

In parallel with the site preparation work, the two new access roads will be constructed, one on the right bank and another on the left bank.

Phase 0 will be quite short, about one month to complete.

Phase 1-Construction of the Separation Wall and River Diversion Channel

Phase 1 will construct a separation wall between the power house and the spillway structure. The reinforced concrete separation wall be about 110 m long and 5.75 m thick and will be constructed in the river about 25 m from the left bank. The construction will begin by construction of a ring coffer dam (see ***Figure 4.3-5***) to create a dry working space for constructing the separation wall. Excavation of the riverbed inside the ring coffer dam will be carried out as required for the foundation works of the separation wall and the power house, and also for coping with the diverted river flow. The channel between the left bank and the separation wall will serve as the diversion channel when the river channel between the separation wall and the right bank is closed for construction of the spillway structure.

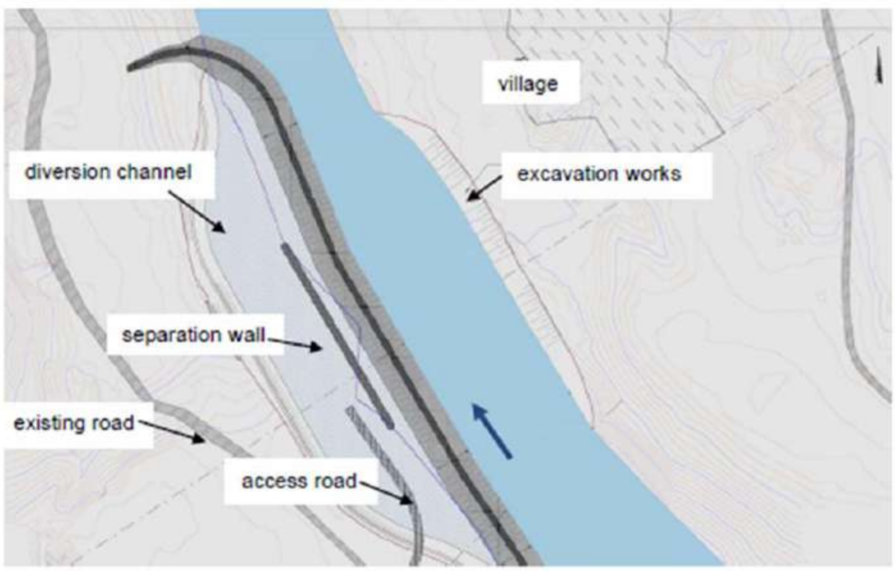


Figure 4.3-5 Construction Phase 1 - Excavation of Diversion Channel

The use of the separation wall as part of the diversion channel will avoid the need for an additional coffer dam during construction of the spillway structure. An ordinary coffer dam will be thicker than the separation wall and thus would block a larger section of the river, thereby reducing considerably the discharge capacity.

In this phase, the river will still flow in the main channel.

Phase 1 will take about 1 to 1.5 years to complete.

Phase 2-Construction of Spillway and Power House Structure

Phase 2 will first construct the spillway or weir structure.It will start with the removal of the ring cofferdam to open the diversion channel between the left bank and the separation wall.Subsequently, two coffer dams will be constructed, one upstream and one downstream of the dam axis. The two coffer dams will extend across the river from the separation wall and push through into the right bank (see ***Figure 4.3-6***).The river will therefore be closed for construction of the weir structure. The river flow will be through the diversion channel.

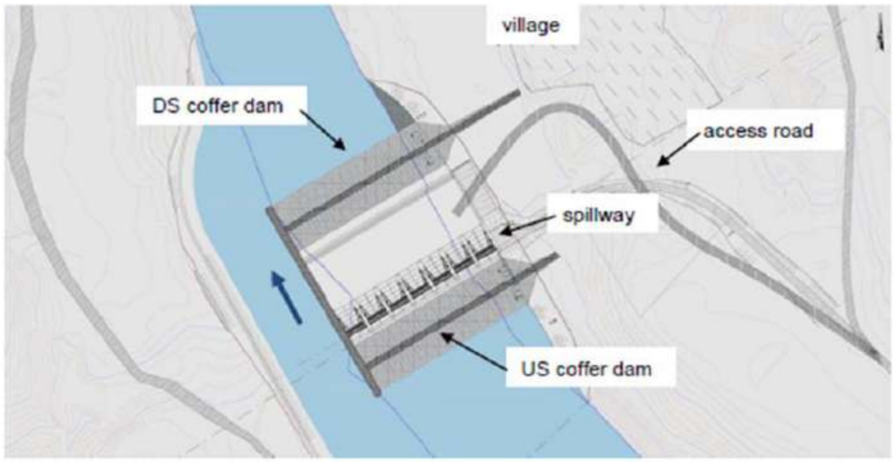


Figure 4.3-6 Construction Phase 2 - Construction of Spillway

The dry river bed enclosed within the separation wall and the two coffer dams will be excavated for foundation works of the weir.The excavation of the foundation will be followed by grouting works, piling (if necessary) and concreting of the base slab.

After the finalization of civil works of the spillway, including the installation of the embedded parts, the two cofferdams will be removed. The river will flow through the un-gated weir.

To construct the power house structure, two coffer dams, one downstream and one upstream of the power house site, will be constructed between the left bank and the separation wall.The river bed will be excavated for foundation works of the power house structure. The excavation of the foundation will be followed by grouting works, piling (if necessary) and concreting of the base slab.

Finally, the hydro-mechanical equipment will be installed sequentially using the upstream and downstream stop-logs in parallel to the civil works at the power house. The stop-logs are lowered during very low discharges released from the Yeywa dam.

Phase 2 will take about 2 to 2.5 years to complete.

Phase 3-Mechanical and Electrical Works at the Power House

The last phase will involve installation of all electro- and hydro-mechanical equipment and electrical works in the power house structure.

Phase 3 will take about 1.5 to 2 years to complete.

Figure 4.3-7 shows the construction phases 2 and 3.

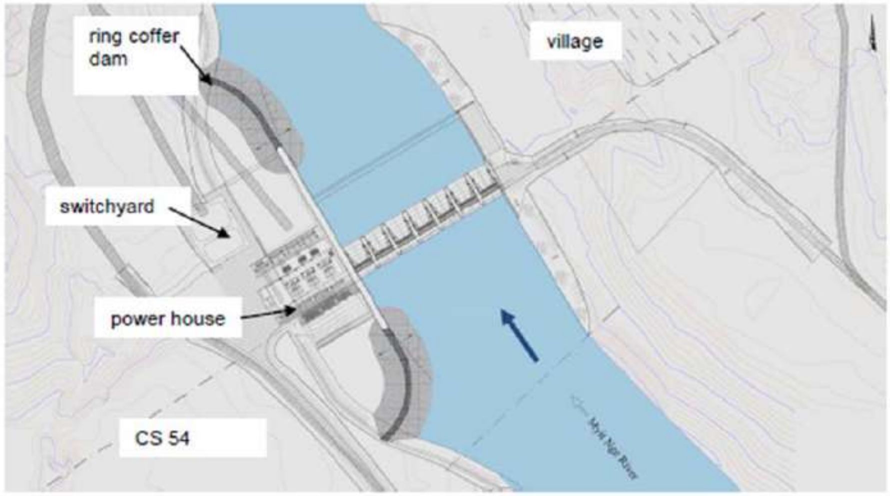


Figure 4.3-7 Construction Phase 3 -Construction of Power House

4.3.2.2 Method of Work

The general construction methodology of the main project component would be the following;

1) Spillway

a. Coffer dam

The ring coffer dam will be constructed for excavation of diversion channel and the construction of separation wall in Phase 1. The Myitnge river will be blocked by the upstream and downstream coffer dams, and the river flow will be diverted through the diversion channel in Phase 2. The coffer dams are built by pushing initially coarse materials such as boulders, cobble stones, gravels to lead the river flow to the diversion channel. And earth materials will be embanked to minimize seepage through the coffer dam body. During construction of the coffer dams, the downstream water quality is always monitored and construction speed of the embankment works will be adjusted to control turbidity of the downstream river water.

The main construction machines to be operated in the coffer dam work is assumed as below.

Table 4.3-2 Type of Machines for Coffer Dam Work

Work item	Machine	Specification	Number	Work capacity
Excavation and loading	Excavator	1.5 m^3	2	141 m^3/h
	Bulldozer	21 ton	2	180 m^3/h
Transporting	Dump truck	10 ton	18	16.5 m^3/h

b. Excavation work

The work will be implemented by two parties in 2 months. The excavation site mainly composes the fluvial materials. The seepage water from the cofferdam body and the riverbed will be discharged by pumping to a settling basin located downstream on the right bank. Light dump trucks are used for excavated sediment transportation. The main construction machines to be operated in the excavation work is assumed as below.

Table 4.3-2 Type of Machines for Excavation Work

Work item	Machine	Specification	Number	Work capacity
Excavation and dozing	Ripper bulldozer	32 ton	1	175 m^3/h
		44 ton	1	250 m^3/h
Excavation and loading	Excavator	1.5 m^3	1	115 - 141 m^3/h
	Wheel dozer	3.1 m^3	1	81-139 m^3/h
Transporting	Dump truck	10 ton	6	11.0 - 13.5 m^3/h (L=2km)

c. Concrete work

The concrete work of the spillway consists of mass concrete and structural concrete. The mass concrete includes ogees, an apron, an upstream concrete wall and downstream concrete walls of left and right sides. The total volume of the mass concrete is estimated to be approximately 58,000m^3. The structural concrete includes abutments, piers and trunnion corbels. The total volume of the structural concrete is estimated to be approximately 11,000 m^3.

It is assumed that the spillway is constructed dividing into multiple blocks so as to reduce a risk of causing cracks due to an increase in heat of hydration or autogenous shrinkage of the concrete.

Slumping concrete shall be used for the work since the spillway includes reinforced concrete structures. Therefore, concrete pumping trucks will be selected to place concrete. The main construction machines to be operated in the concrete work is assumed as below.

Table 4.3-3 Type of Machines for Concrete Work

Machine	Specification	Number	Remarks
Concrete pumping truck	100 m^3/h	2	60 m^3/h
Concrete mixer truck	5.0 m^3	4	L=1km
Crawler crane	80 ton	2	Miscellaneous work
Crane truck	8 ton	3	Miscellaneous work
High pressure washer		3	Green-cut work

The work for top slabs will comprise the production of precast, pre-stressed concrete girders and building them over the spillways although it is depending on the contractor. The work shall commence upon completion of the concrete work of the spillway. The girders are produced at casting yards near the project site.

d. Right bank embankment work

The right embankment work comprises a filling work and protection work for upstream and downstream embankment slopes. The right side of the spillway is filled with excavated materials and soil material of approximately 20,000 m^3 from a borrow pit on the right bank. The right embankment shall be completed prior to the commencement of the hydro-mechanical work of the spillway so that the crest of the embankment can be used as an access and unloading area for the hydro-mechanical work.

2) Power house

a. Coffer dam

After completion of the spillway structure and the ring coffer dams at the upstream and downstream ends of the separation wall, the upstream and downstream coffer dams surrounding the spillway will be removed in order to divert the river flow to the spillway.

b. Excavation work

The excavation work of the powerhouse site will be divided into two stages. In the first stage, the foundation area of a powerhouse building is excavated so as to place concrete in parallel with the second stage excavation. In the second stage, the areas of the intake channel portion and tailrace upstream and downstream of the powerhouse are excavated up to designed elevations.

In the first excavation stage, a two-shift system will be adopted for the blasting excavation work so as to avoid overlapping of blasting and muck conveying. As for the second excavation stage, the work is implemented by four parties. The main construction machines to be operated in the excavation works is assumed as below.

Table 4.3-3 Type of Machines for Excavation Work

Work item	Machine	Specification	Number	Work capacity
Excavation and dozing	Ripper bulldozer	32 ton	1	175 m^3/h
		44 ton	1	250 m^3/h
Loading	Excavator	1.5 m^3	1	115 - 141 m^3/h
	Wheel dozer	3.1 m^3	1	81-139 m^3/h
Transporting	Dump truck	32 ton	6	38.4-53.1m^3/h (L=1km)

c. Concrete work

A gantry crane which is provided for main erection of electro- and hydro-mechanical equipment such as turbine-generator units is required to build as earlier as possible since electro- and hydro-mechanical works of the powerhouse are a critical path of the project. For that reason, a minimum structure which supports the gantry crane is constructed prior to other portions.

After completion of the support structure, other concreting work including secondary concrete placing and installation of the since electro- and hydro-mechanical works will be carried out in parallel. The total period of the structural concrete will be 21 months. This period includes the period of construction of intake and tailrace structures. The main construction machines to be operated in the concrete work is assumed as below.

Table 4.3-4 Type of Machines for Concrete Work (for two parties)

Machine	Specification	Number	Remarks
Concrete pumping truck	100 m^3/h	2 to 3	60 - 90 m^3/h
Concrete mixer truck	5.0 m^3	4	L=1km
Crawler crane	80 ton	2	Miscellaneous work
Crane truck	8 ton	2	Miscellaneous work
High pressure washer		2	Green-cut work
Welding machine		4	Miscellaneous work

3) Switchyard

The period of the civil works for the switchyard is estimated to be 3 months. The switchyard is expected to be completed within 4 years and one month after the commencement of the Project so as to be ready for commissioning test of the first unit planned in the beginning of 5th year.

4) Temporary Facilities

Overall layout plan of the temporary facilities is shown ***Figure 4.3-8***.

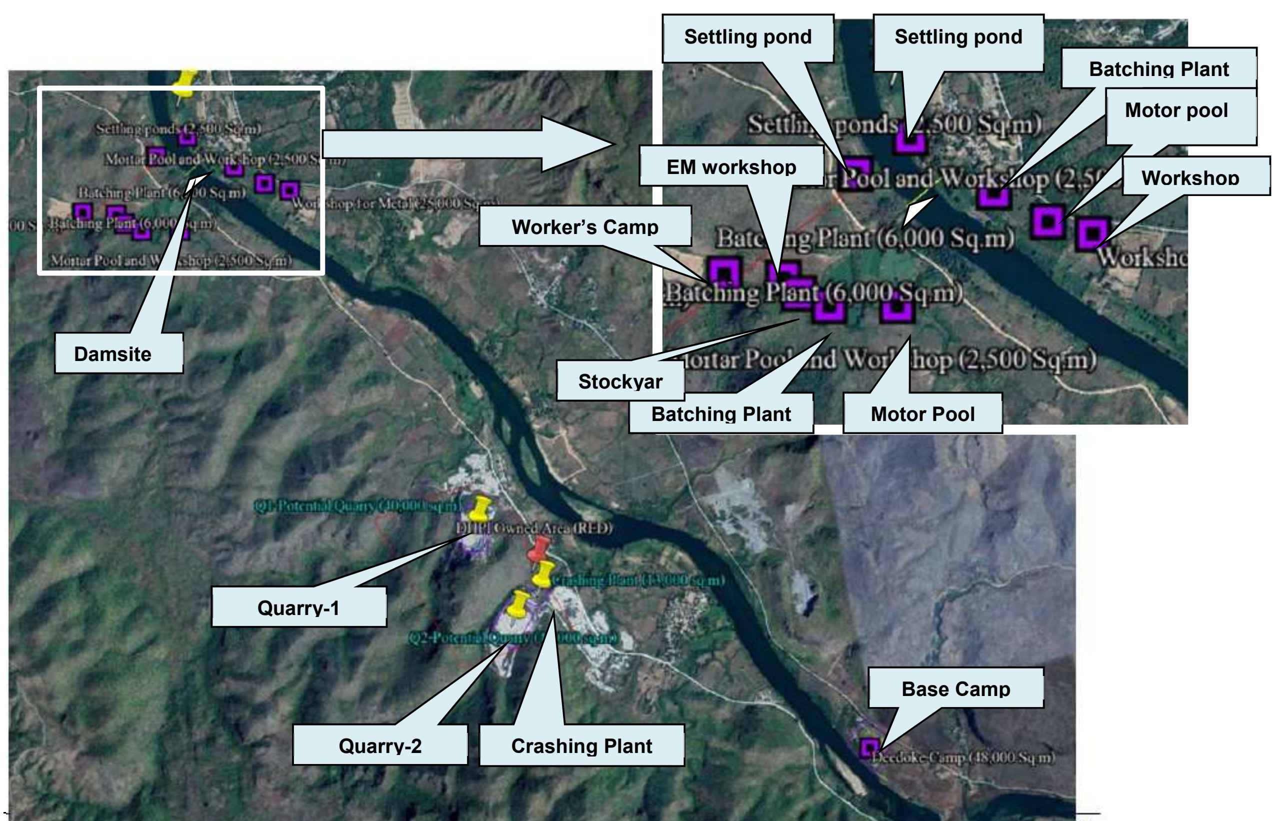


Figure 4.3-8 Overall Layout Plan of Temporary Works

a. Quarry

Two (2) existing quarries which produced aggregates for the construction of the Yeywa HPP are located around the 4 km upstream of the project site on the left bank. These quarries can be reused for the project. The total amount of aggregate is estimated to be 285,000 ton to produce concrete of 170,000 m^3. The amount to be used for permanent road improvement, access roads, construction roads, and the river protection works is assumed to be additional 10%. The project requires 207,000 m^3 quarried including loss ratios of quarrying and aggregate production, which are assumed to be 10% and 15% respectively. Quarrying shall start one month before crushing plants start to operate. The average quarrying volume is estimated at 230 m^3 per day and 47,000 ton/year per quarry assuming the operation period of 4 years. The existing quarry will be lowered by blasting, and rock materials are extracted from the area that has already been developed for the construction of the Yeywa HPP to minimize impacts to surrounding nature as shown in ***Figure 4.3-9***. The main construction machines to be operated in quarrying are assumed as below.

Table 4.3-5 Type of Machines for Quarry

Machine	Specification	Number
Hydraulic crawler drill	150 kg class	2
Ripper bulldozer	44 ton	1
Wheel dozer	3.1 m^3	1
Dump truck	20 ton	2

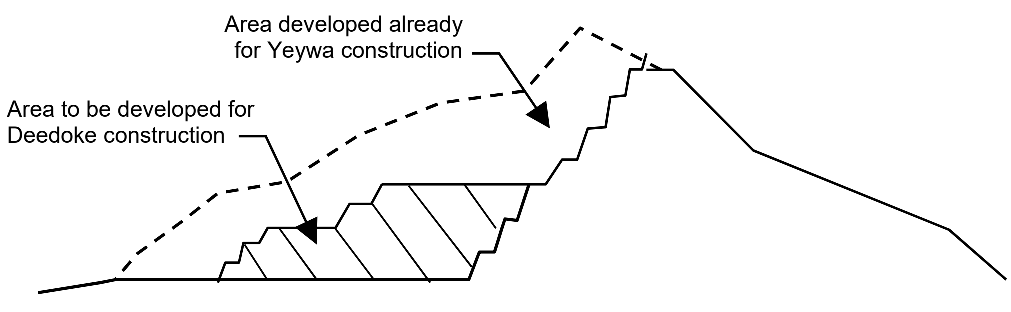


Figure 4.3-9 Image of Quarry Development

b. Borrow pit

Materials for embankments such as the cofferdams and the embankment connecting the dam to the right bank, will be obtained from the terrace deposits on the right bank. The location will be selected in the inundation area near the dam site. The geotechnical investigations to confirm suitability of the available materials should be carried out in the next detailed design stage.

c. Spoil bank

Materials of estimated volume of 600,000 m^3 that are excavated from the construction sites will be partly used for embankments, and the most will be transported to the spoil banks. There are two (2) spoil banks planned on the left bank and left bank.

Before embankment of the spoil bank, overburden in the area will be removed and stored in other places. The materials of the stockpile will be returned to the spoil bank after completion of the works for sodding of the embankment. A drainage system consisting of surface and underground drainage systems will be planned to immediately discharge rainwater from the embankment to protect embankment surface from erosion and to keep stability of the embankment.

d. Crushing Plant

Crushing plants are required to be arranged near quarries. It is necessary to consider additional crushing plants including mobile types in case that multiple quarries are required due to restriction for quarrying volume per site. Crushing plants shall start to produce aggregate one month before the first concrete work. An adequate amount of aggregate shall be stocked upon completion of operation of crushing plants. The capability of the crushing plant is assumed to be 120 ton/hour in consideration of the peak production. A type of the crushing plant is assumed as below.

Table 4.3-6 Type of Facilities for Aggregate Production

Facility	Specification	Number
Crushing plant	Including primary crusher, secondary crusher, tertiary crusher and sand crusher, 120 ton/hour	Single or plural

e. Batching Plant

Batcher plants are required to be arranged on both banks so as to shorten transportation time of concrete. If one batching plant is arranged on a bank of the river, concrete shall be transported around 20 km at longest by way of the upstream concrete bridge. It adversely affects concrete in quality due to high temperature. As a countermeasure against heat, chillers for mixing water will be required in each batching plant. A type of the batcher plant is assumed as below.

Table 4.3-7 Type of Facilities for Batcher Plant

Facility	Specification	Number
Batcher plant	Biaxial forced mixing type mixer, 100 m^3/h	2

f. Turbid Water Treatment Plant

Turbid water treatment plants are planned on the both banks. Turbid water (waste water) from construction areas such as powerhouse, main dam excavations will be transferred into these settling pond by pumping-up and water pipes to avoid the turbidity of river water by construction activities.

As shown in the example of ***Figure 4.3-10*** particles of sediment will settle in the settling basins, and clean water in the upper layer is discharged to the river. The treatment process is monitored by the contractor and reported to the Employer.

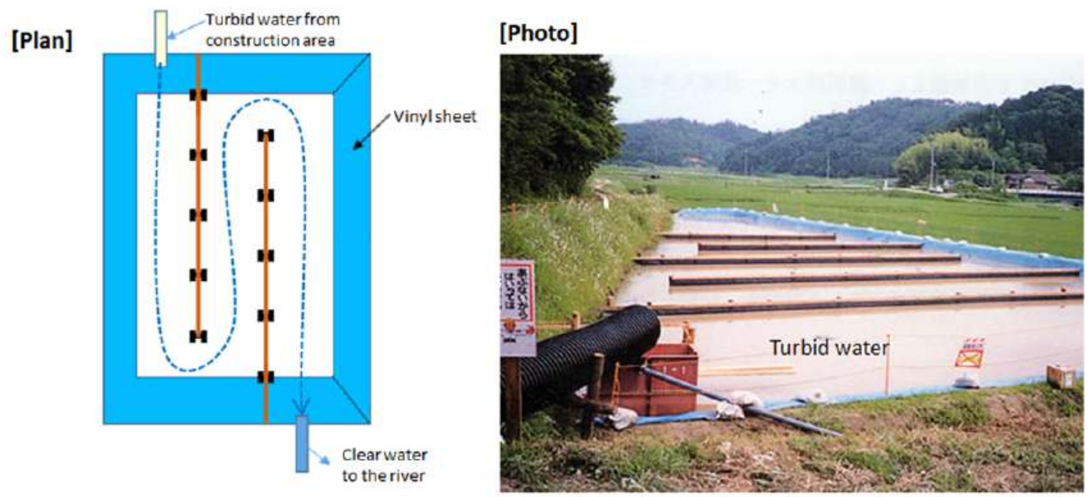


Figure 4.3-10 ***Example of Turbid Water Treatment Plant***

g. Temporary Water Supply

Water for construction plants will be taken from the Myitnge River, well and gullies, and be pumped up to water tanks located around the plants on both banks. Water usage for construction works is expected to be for curing concrete, concrete mixing, spraying to prevent dust due to construction traffic, etc.

h. Temporary Power Supply

The power supply for the construction is planned to be provided from the existing local power network of 33 kV in the vicinity of the project site. Power requirement for temporary facilities is assumed as assumed as below.

Table 4.3-9 Temporary Facilities to require the Power Supply

Facility	Power requirement (kVA)	Quantity
Right bank		
Batcher plant	300	1
Turbid water treatment plant	150	1
Site office and worker's camp	150	1
Left bank		
Site office and worker's camp	150	1
Batcher plant	300	1
Turbid water treatment plant	150	1
Standby power	200	1
Crushing plant	1,200	1

Total	**2,600**	

As shown in ***Table 4.3-9***, the power of 2.6 to 3 MVA including E/M & HSS works is estimated for the construction. The capacity of the existing 33 kV line is presently under investigation considering of future demand in the region.

i. Permanent Access Road

Existing roads on each bank are available for the construction. The existing road on the left bank which reaches the construction site is considerably rutted. Hence, the road shall be partly improved as a permanent road. The existing road on the right bank is paved with asphalt and available for construction vehicles. However, temporary access roads to the construction site shall be newly constructed since the existing road does not directly connect to the site, and these roads will be a permanent road after the construction. As for the connection between the right and left banks, a bridge located about 12 km upstream of the project site is available. ***Figure 4.3-11*** shows typical cross sections of the permanent and construction temporary roads assumed in the feasibility study.

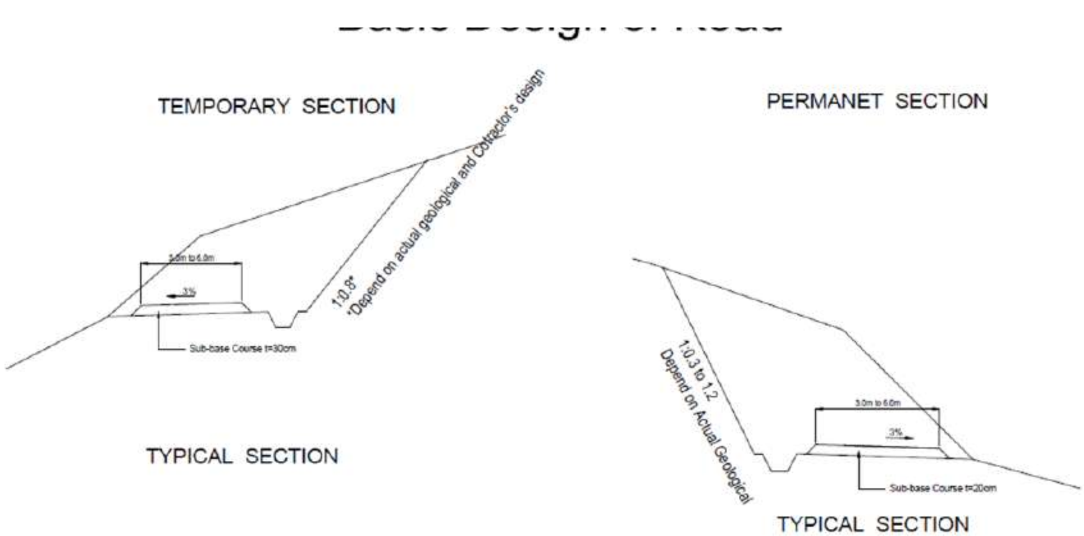


Figure 4.3-11 Typical Cross Section of Access Roads

j. Base Camp and Worker Camp

A base camp of 48,000 m^2 (12 acre) is planned on the right bank 5 km upstream of the damsite, and a worker camp of 4,900 m^2 (1.2 acre) in the left bank spoil bank area beside the damsite. The contractor is responsible for operation and maintenance of the base camp and worker camp during the construction period complying with his CESMMP and SSCESMMP to be approved by the Project Proponent. The following buildings and facilities are planned in the base camp and the worker camp.

Base Camp for the Project Proponent and contractor

a. Offices and meeting rooms
b. Accommodation with bath room for single

c. Accommodation with kitchen and bath room for family
d. Canteen
e. Clinic with one nurse
f. Parking area
g. Communication system including internet

The Project Proponent of approximately 40-50 engineers and office staffs and the contractor side of approximately 20-30 engineers and office staffs will use offices and 40 to 60 people stay in the base camp. After completion of the construction, the base camp will be used by operation and maintenance staffs of the Deedoke HPP.

Worker Camp

h. Accommodation
i. Canteen
j. Bathing place
k. Toilet and septic tank
l. Parking area
m. Communication system

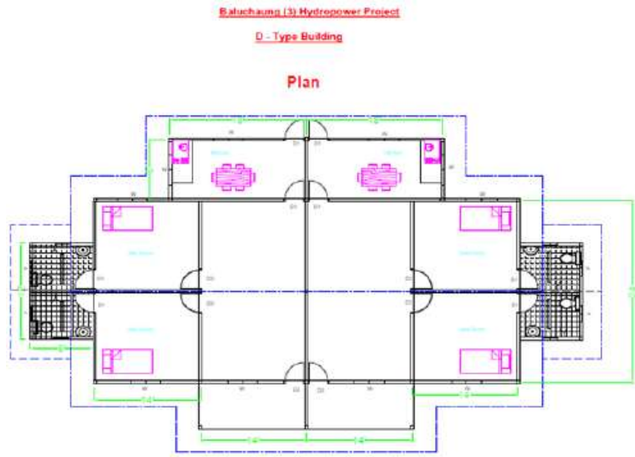
Approximately 200 to 300 workers will stay in the work camp although the number will vary depending on how many workers can be employed from the nearby villages.

Common Facilities

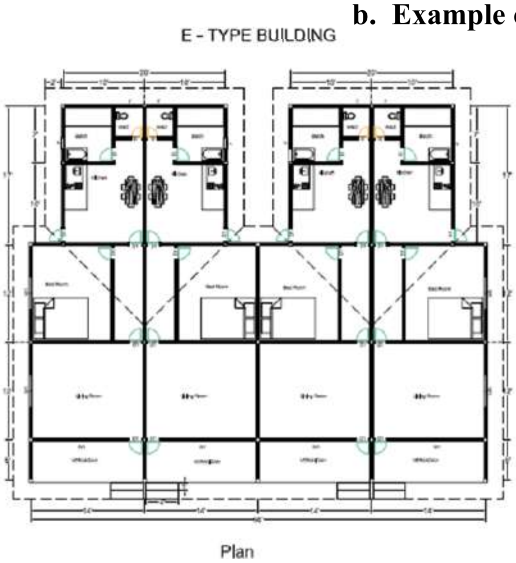
a. Power supply system from the existing 33kV transmission lines
b. Water supply system from river, well, creeks and rain water
c. Sewage system and treatment facility
d. Waste disposal facilities
e. Surface drainage system
f. Field lighting system
g. Fencing and security house
h. Landscaping

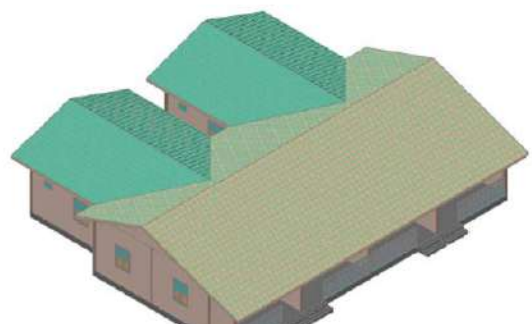
Figure 4.3-12 shows examples of the base camp and building design introduced in Baluchaung (3) Hydropower Project.

a. Image of Base Camp

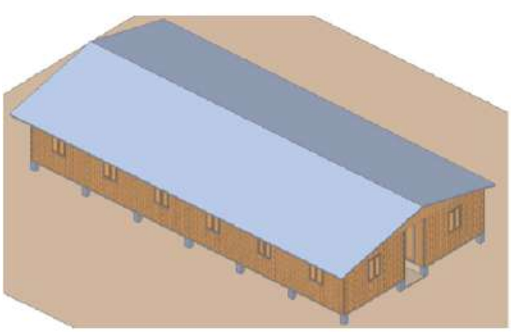


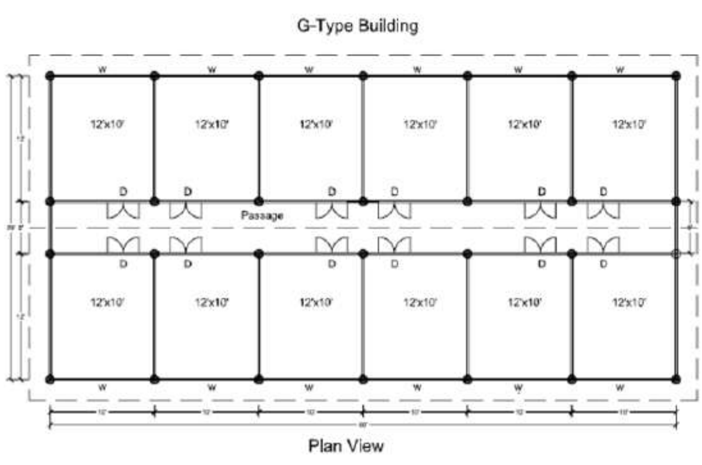
b. Example of building design in Base Camp





c. Example of building design in Base Camp





d. Example of building design in Worker Camp

Figure 4.3-12 Example of Base Cam & Worker Camp Buildings

k. Water treatment system in Base Camp and Worker Camp

A concrete septic tank commonly used in Myanmar will be utilized to collect the sewage waste from toilets in the Base and Worker Camps.

The domestic wastewater (grey water) such as bathing water and kitchen water will be distributed into small drainage channels will be absorbed by the surrounding vegetation or discharged into the river through a side ditch drainage system in the compound.

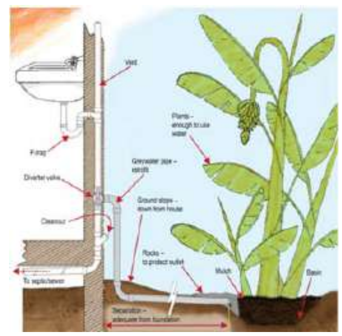


Figure 4.3-13 Septic Tank and Gray Water Disposal Plan

4.3.2.3 Construction Schedule

The total construction time will be 4 to 4.5 years. A tentative construction schedule is shown in ***Figure 4.3-14.***

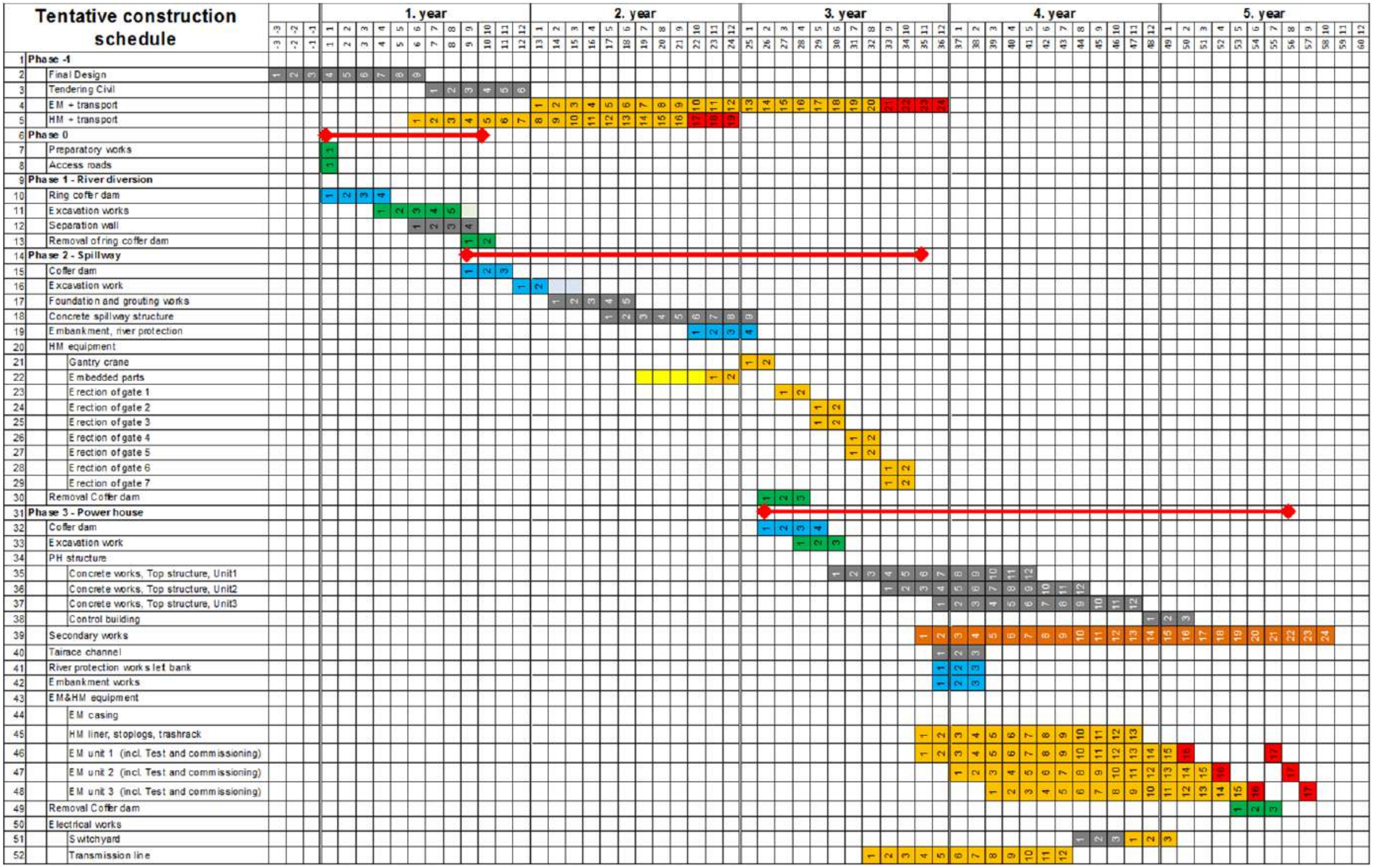


Figure 4.3-14 Tentative Construction Schedule

4.3.2.4 Construction Inputs

Materials

All materials are available in sufficient quantity and quality in close distances. Based on the selected site option of C 700/3, in the Feasibility Report, required quantities of the construction materials are tentatively estimated as indicate in ***Table 4.3-10***.

Table 4.3-10 Tentative Civil Work Construction Materials

Item	Description	Unit	Quantities
1	**Open Excavation**		
1.1	Clear ground - strip vegetation	m^2	50'000
1.2	Dam foundation	m^3	302'500
1.3	Dam foundation rock	m^3	247'500
2	**Fill works**		
2.1	Right embankment	m^3	12'100
2.2	Left embankment	m^3	34'500
2.3	Rip-rap protection	m^3	10'000
2.4	Preparation of foundation	m^2	37'500
3	**Concrete Works**		
3.0	Mass concrete for spillway base	m^2	58'000
3.1	Structural concrete high demands for spillway structure	m^3	11'125
3.2	Structural concrete high demands for powerhouse	m^3	88'700
3.3	Structural concrete for tailrace	m^3	12'000
3.4	Instrumentation		
4	**Drill and grout foundations**	**m**	
4.1	Grout curtain spillway	m	4'200
4.2	Consolidation grouting spillway	m	4'750
4.3	Grout curtain power house	m	1'500
4.4	Consolidation grouting power house	m	4'500
5	**Embankment cofferdams by**		
5.1	Excavation and fill	m^3	550'000
6	**Roads and bridges**		
6.1	Upgrade existing roads		
6.2	Construction road	m	600
6.3	Permanent access road incl.	m	700
6.4	Construction bridge	m	210
7	**site intsllation**		
7.1	Site offices and installations	ls	-
7.2	Sanitary installation		-
7.3	Communication		-
7.4	Power connection		-
7.5	Miscellaneous		
8	**Lateral dams at reservoir**		
8.1	Fill works	m^3	30'000
8.2	Construction road	m	500

Workers

The construction would require about 300 workers on average. The workers will be recruited locally as many as possible. Workers from other areas will stay on site in the provided camps.

4.3.2.5 Organization for Construction Management

Figure 4.3-15 presents a tentative organizational structure for construction management. The Project Proponent plans to establish Environmental and Social Management (ESM) team in Special Purpose Company (SPC) including experienced International Environment/ Social Specialists. The ESM team will monitor the contractor's compliance with environmental and social impact mitigation requirements specified in the contracts and the EMP for the construction as well as compensation & CSR works. This subject is discussed in detail in the EMP chapter.

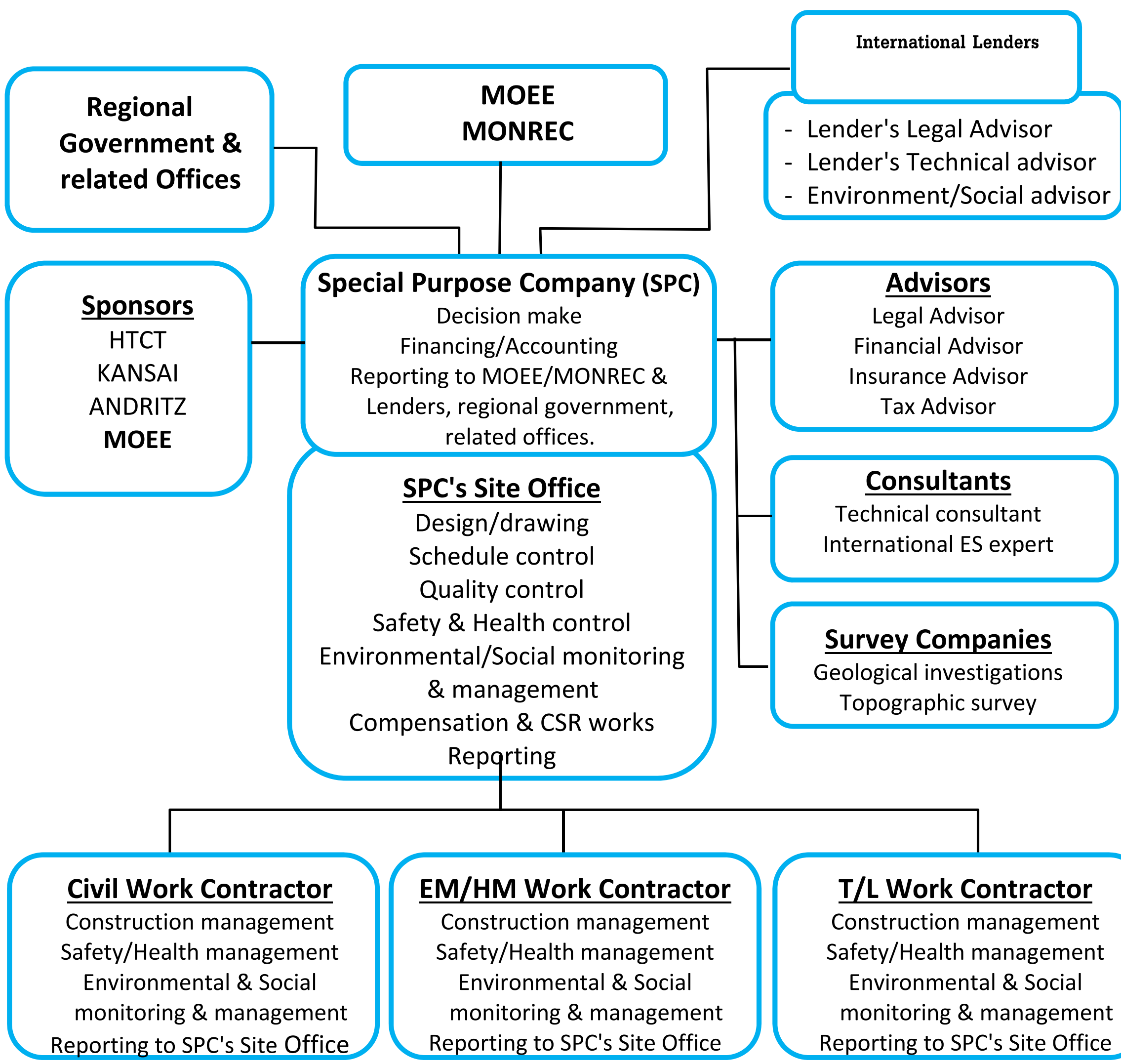


Figure 4.3-15 Organization for Construction Management

4.3.3 Operation Activities

Operation activities of the hydropower scheme will be simple and routine. The activities will include"

- Monitoring of water inflows from the Yeywa dam and inflow to the Deedoke HPP
- Monitoring of outflow from turbines and spillway
- Monitoring of water levels such as tailwater level, pond water level
- Operation of the spillway gates when the river water levels exceed the maximum limits set up for power operation.
- Operation of the turbines according to the production plan related to demand and the Yeywa HPP operation.
- Routine, scheduled and emergency maintenance of facilities and equipment.

The operation will require not more than 70 persons. ***Figure 4.3-16*** shows a tentative organization for operation of the Project.

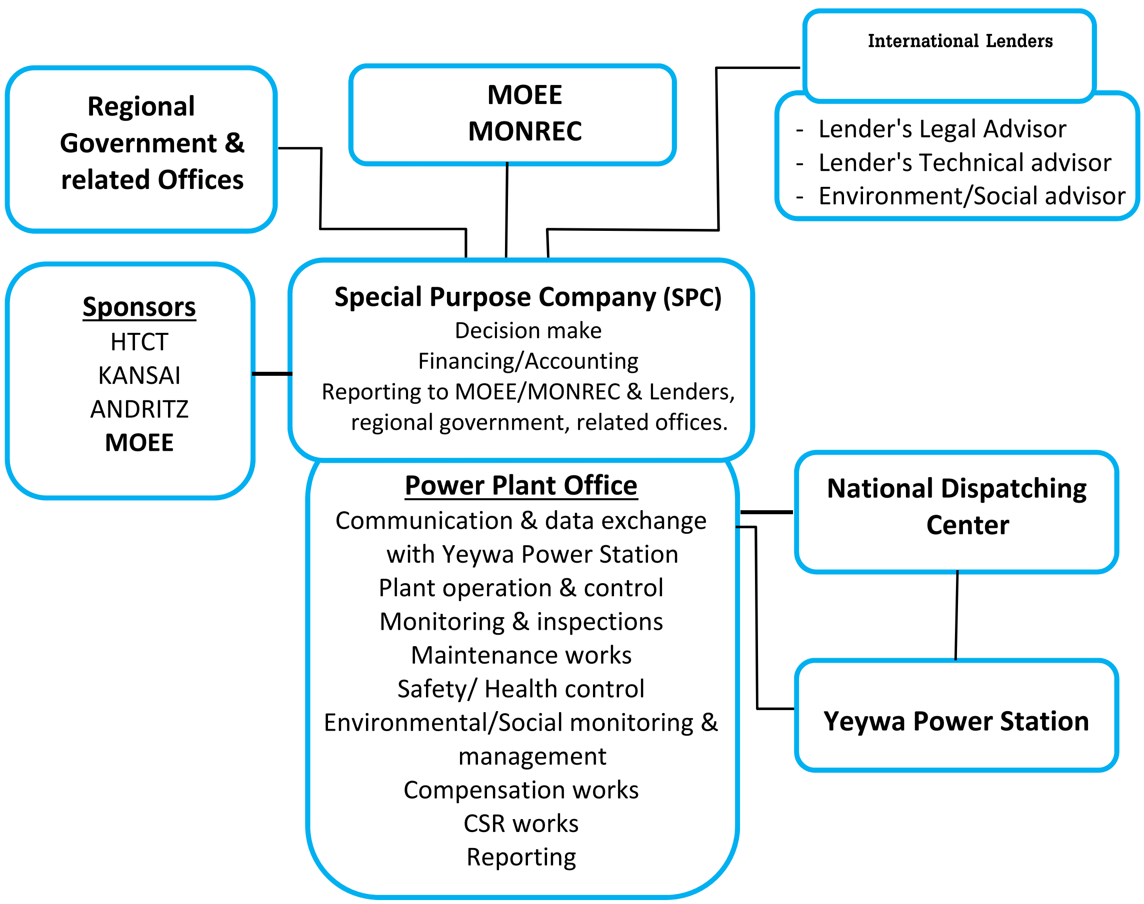


Figure 4.3-16 Organization for Operation of the Hydropower Plant

4.3.4 Decommissioning/Closure/Post Closure Activities

Decommissioning is not assumed in the Project because the plant will be transferred to MOEE on a BOT basis after the concession period. The below description is a part of the procedures related to environmental conservation to be included in the contract before hand-over to the Project Proponent from the contractor.

As the contractor is responsible for environmental conservation, in accordance with the contract, the contractor shall restore the construction site to original conditions before handing over the site to the Project Proponent as follows;

a. Site cleaning
   All temporary facilities, construction plants and equipment and construction materials shall be removed from the site by the contractor. After removal, the site shall be cleaned and covered by seeding, sodding, plantation or pavement with drainage systems. Solid and liquid waste materials shall be transferred in accordance with CESMMP.

b. Erosion and sediment control

   Excavated slopes and lands and embankments would be protected, if necessary, by suitable cover such as shotcrete, concrete panel, concrete retaining wall, seeding, sodding, plantation and so on, which depend on the geology of sites, to stabilize the slopes and to prevent erosion. For the same purpose, drainage systems constructed during the construction might be restored or reinstalled.

c. Removal of materials from site

   Construction materials are removed from the site unless otherwise the Project Proponent instructed. Hazardous materials at site shall be transferred in accordance with CESMMP.

CHAPTER 5

DESCRIPTION OF THE ENVIRONMENT

CHAPTER 5

DESCRIPTION OF THE ENVIRONMENT

5.1 SETTING THE STUDY LIMITS

As indicated in **Section 4.6.1 of the EIA Guidelines**, setting the study limits is to define the boundaries of the study areas and justify the chosen limit including the scope of ESIA study which is defined in the Scoping Report, and the Environmental and Social (ES) issues to be covered in the ESIA study.

Based on the proposed project design in the feasibility study report (FSR) and the identified potential ES issues, the study limits are defined as the study are as below.

Main Impact Study Area: This study area covers an area within 5 km radius from the river centerline at the proposed dam site. The area covers the entire construction areas on both banks of the river and outlying areas downstream and upstream of the dam. This area will cover most of the identified ES issues that will require mitigation during the construction and operation periods.

Fishery Impact Study Area: This study area covers Myitnge River from Yeywa Dam to the proposed Deedoke Dam site and the downstream reach from the Deedoke Dam to the point where Myitnge River joins Irrawaddy River.

Transmission Line Impact Study Area-Left Bank: This study area covers a corridor of about 50 m width along the alignment of the transmission line.

Quarry Site Impact Study Areas: Construction materials will be extracted from the existing quarry site near Thayet Pin village. The impact study area for each quarry site covers an area within 1 km from the quarry site.

The study areas are shown in a project area map in ***Figure 5.1-1*** and the covered ES issues are presented in ***Table 5.1-1***.

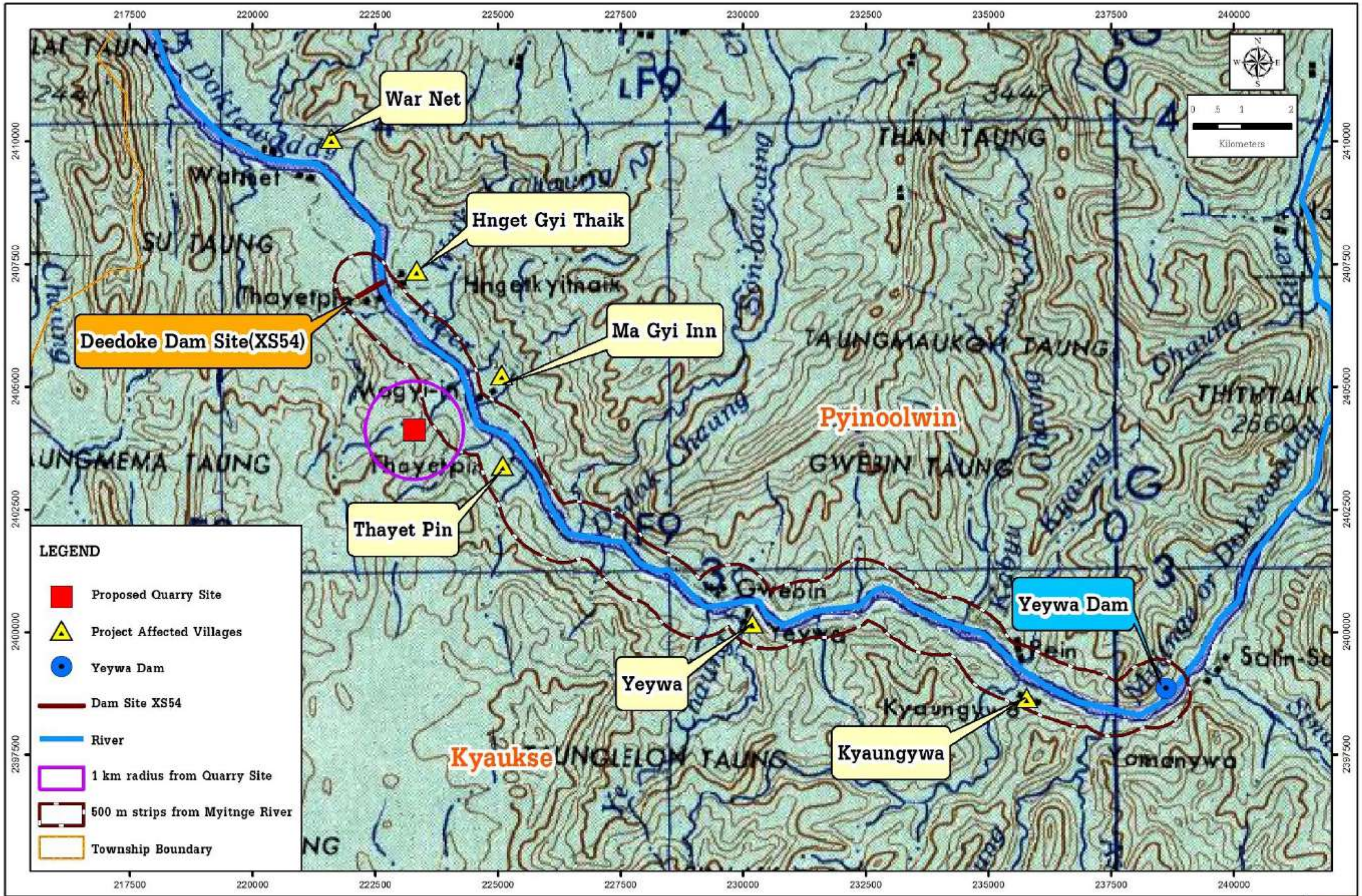


FIGURE 5.1-1 : PROJECT STUDY AREA

TABLE 5.1-1

EIA STUDY LIMITS BASED ON RESULTS OF THE FEASIBILITY STUDY REPORT

Study Areas	Boundarie	Major ES Issues Requiring Attention
Main Impact Study Area	Within 5 kms radius from the center line of the river at the selected dam site.	**During Construction** Land acquisition, noise and vibration, fugitive dust, river turbidity, access to river for water use, **During Operation** Storm drainage on the left bank, access to river for water use in the embankment areas upstream of the dam,
Fishery Impact Study Area	River course from Yeywa Dam to Irrawaddy River	**During Construction** No significant issues. **During Operation** Promotion of in-river aquaculture
Transmission Line Impact Study Area-Left Banks	25 m strips from the center line of the proposed alignment of the TL	**During Construction** Land acquisition, ecological disturbance, visual pollution **During Operation** No significant issues
Quarry Site Impact Study Areas	Area within 1 km radius from the quarry site.	**During Construction** Noise, vibration, fugitive dust **During Operation** Rehabilitation if proved to be necessary.

5.2 PHYSICAL COMPONENTS

5.2.1 Climate/Meteorology

5.2.1.1 Methodology

No meteorological data have been collected at the Deedoke dam site. As the project site is about 30 km from Mandalay City, climatic conditions of Mandalay would reflect conditions of the project area. Therefore, this section briefly describes climatic conditions of Mandalay based on secondary data searched from various sources including the FSR.

To supplement the secondary wind data, the Consultant collected data on wind speeds and directions in the project area over a 72 hour period during the dry season in April 2015, and over a 72 hour period during the wet season in July 2015. The wind data collected over these two short periods would only provide two snapshots of wind conditions in the project area. As the Project will not generate and discharge such air pollutants as nitrogen oxides and sulfur dioxides into the air at a high level above ground, long term wind data is not needed. The short term data on wind speed and directions coupled with secondary wind data in Mandalay will be adequate for use in the assessment of impacts of fugitive dusts being generated at ground level during the project construction.

Wind data was collected at two stations:

Station 1: Located at Hnget Gyi Thaik Primary School in Hnget Gyi Thaik village, Pyinoolwin Township (UTM (WGS84) 47Q 222626 E, 2406997 N)

Station 2: Located at Thayet Pin Primary School in Thayet Pin village, Kyaukse Township (UTM (WGS84) 47Q 224894 E, 2403704 N)

Figure 5.2.1-1 is a map showing the locations of the two wind data collection stations. Concurrently with the collection of wind data, noise, vibration and ambient air quality were also monitored at these two stations. ***Photo 5.2.1-1*** shows photographs of equipment set up at the two stations.

The two stations were selected as the two schools would be sensitive receptors of impacts from noise, vibration, and air pollution. Hnget Gyi Thaik Primary School is about 310 m from the selected dam site at Section 54 while Thayet Pin Primary School is near the proposed main quarry site, about 500 m away.

The measurement of wind speeds and directions was made at 10 meters above ground using anemometer.

	
Equipment for Wind and Air Quality Data Collection at Station 1: Hnget Gyi Thaik Primary School	**Equipment for Noise and Vibration Measurement at Station 1: Hnget Gyi Thaik Primary School**
	
Equipment for Wind and Air Quality Data Collection at Station 2: Thayet Pin Primary School	**Equipment for Noise and Vibration Measurement at Station 2: Thayet Pin Primary School**

PHOTO 5.2.1-1 : DATA COLLECTION EQUIPMENT AT THE TWO STATIONS

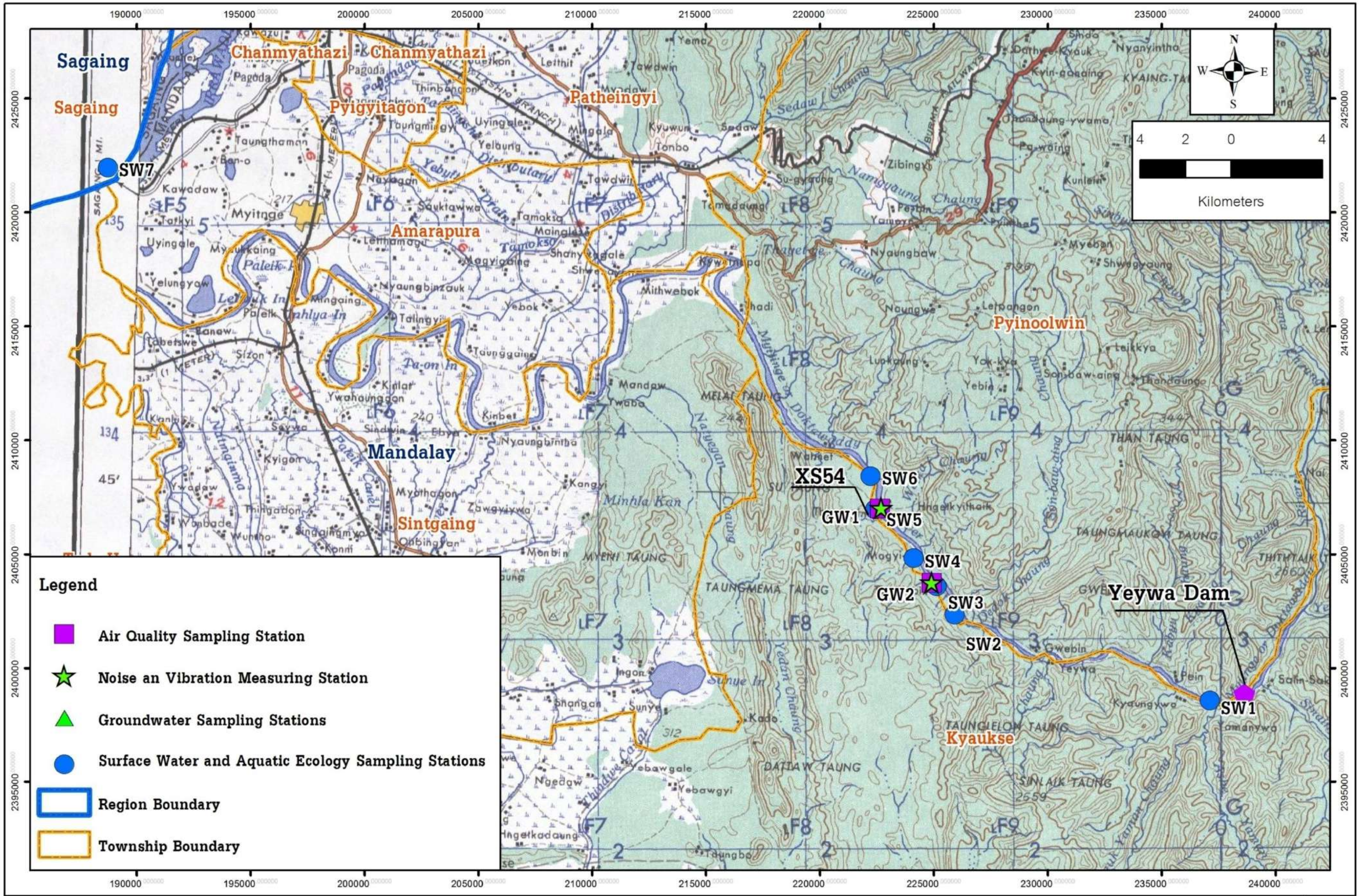


FIGURE 5.2.1-1 : MAP SHOWING ENVIRONMENTAL SAMPLING STATIONS

5.2.1.2 Description

Overview of the Climate of Mandalay Region

The climate of Myanmar is governed by westerlies flowing in June to November and easterlies (trade wind) in March to May. Because of these monsoons, in general there are three seasons in Myanmar such as the cool season with less rainfall from November to February, the hot season with less rainfall from March to the beginning of May, and the rainy season from May to October.

In terms of rainfall, the rainy season in the Myitnge River basin is from May to October and the dry season from November to April according to the rainfall record at the Shwesayan, Yeywa PS, Hsipaw and Mandalay.

The Myitnge River basin is located in the northeast Myanmar (***Figure 5.2.1-2***). Most of the Myitnge River basin is located in the Shan State, but the downstream reaches including the Yeywa PS and the Deedoke candidate dam sites are located in the Mandalay Division. The annual rainfall of the Deedoke HPP would be approximately 1'300 mm, which can be seen in the mean monthly rainfall record at the Shwesayan gaging stations and the Yeywa PS (***Figure 5.2.1-3***).

The climate in the basin may be influenced by the westerlies flowing in June to November and easterlies (trade wind) in March to May, since two peaks of the rainfall are observed in the rainfall record at the Yeywa PS and Mandalay.

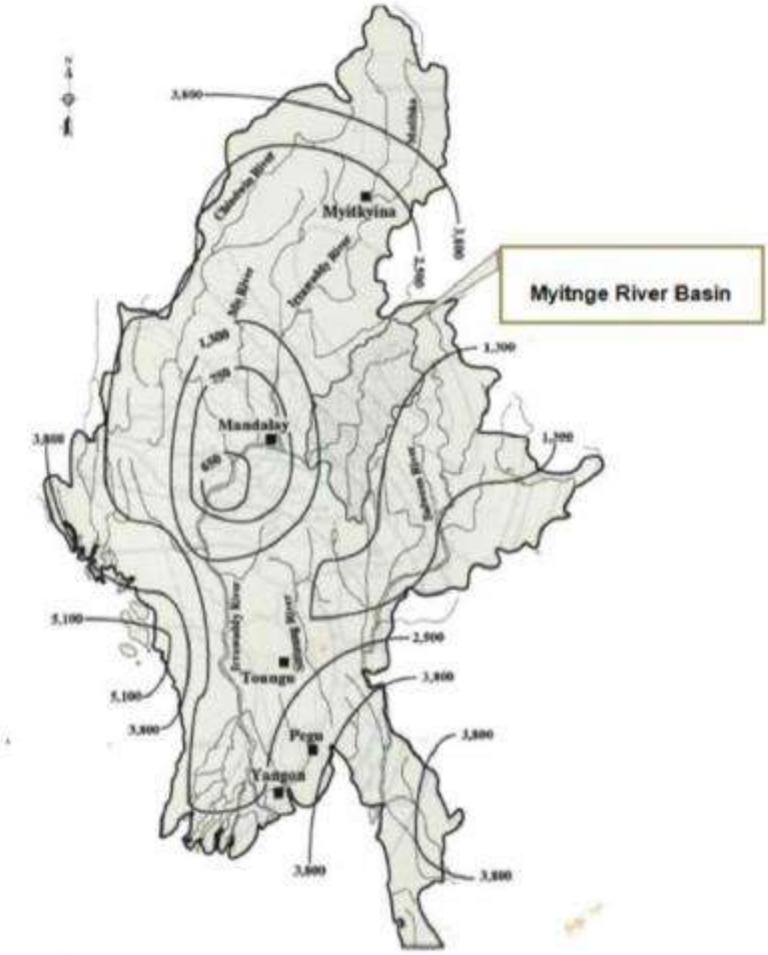


FIGURE 5.2.1-2 : ISOHYETE MAP OF MYANMAR

The temperature recorded at Mandalay and Hsipaw shows the same tendency (***Figure 5.2.1-3***). Namely, rather large gaps between the maximum and minimum are seen in the period from November or December to April or May, which agrees with the period of dry season. The maximum gap of temperature is observed in April. In April, a gap of the maximum and minimum relative humidity becomes largest in a year. Corresponding to this tendency, a peak of evaporation can be seen in April.

Following figure present the monthly values of the rainfall, the temperature, the relative humidity and the evaporation in the project area (***Figure 5.2.1-3 to 5.2.1-6***).

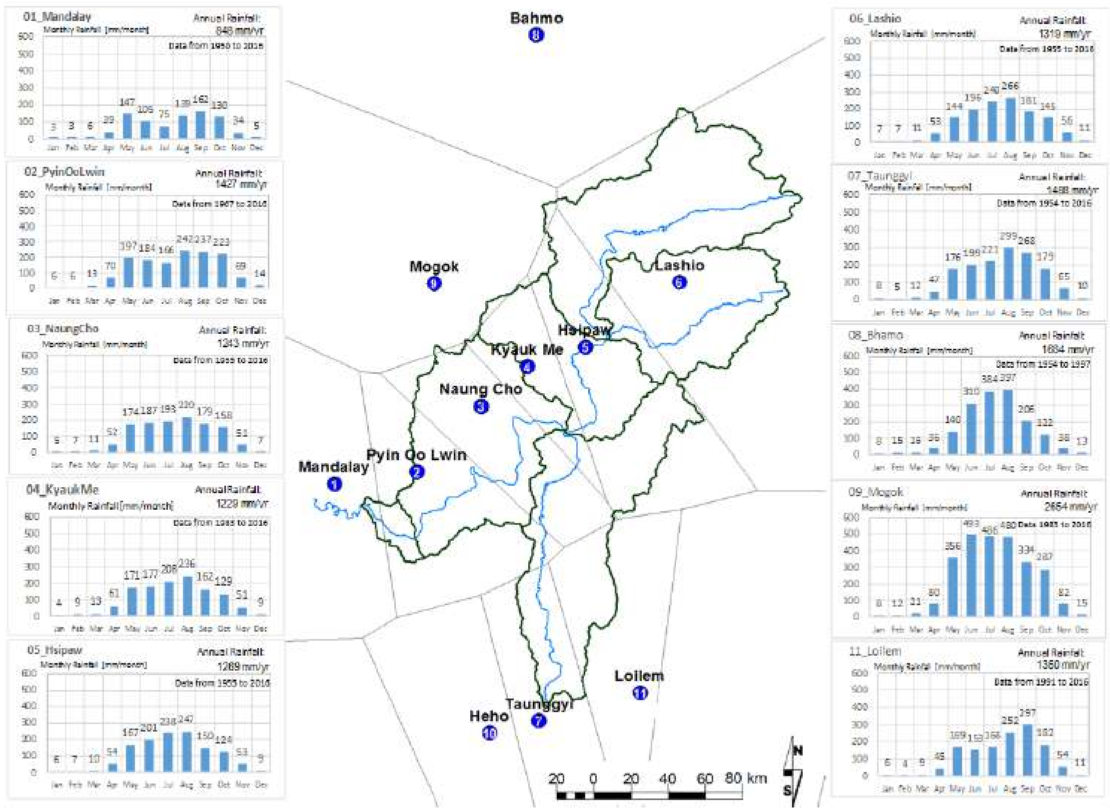


FIGURE 5.2.1-3 : MEAN MONTHLY RAINFALL IN PROJECT AREA

Temperatures

Figure 5.2.1-4 and ***Table 5.2.1-1*** presents average air temperatures in Mandalay. At an average temperature of 31.3 °C, April is the hottest month of the year. The lowest average temperatures in the year occur in January when it is around 20.4 °C.

FIGURE 5.2.1-4 : AVERAGE TEMPERATURE IN MANDALAY

Figure 5.2.1-5 presents minimum and maximum air temperatures in Mandalay and Hsipaw.

FIGURE 5.2.1-5 : MINIMUM AND MAXIMUM TEMPERATURE IN MANDALAY AND HSIPAW

TABLE 5.2.1-1

AVERAGE TEMPERATURE IN MANDALAY

Month	1	2	3	4	5	6	7	8	9	10	11	12
mm	1	1	5	29	139	121	85	116	147	120	40	8
ºC	20.4	23.0	27.7	31.3	31.1	29.9	29.6	29.2	28.9	27.6	24.4	20.8
ºC (min)	13.1	15.1	19.7	24.7	25.8	25.8	25.8	25.4	25.1	23.5	19.5	14.7
ºC (max)	27.7	30.9	35.7	37.9	36.4	34.0	33.5	3.0	32.8	31.7	29.3	26.9
ºF	68.7	73.4	81.9	88.3	88.0	85.8	85.3	84.6	84.0	81.7	75.9	69.4
ºF (min)	55.6	59.2	67.5	76.5	78.4	78.4	78.4	77.7	77.2	74.3	67.1	58.8
ºF (max)	81.9	87.6	96.3	100.2	97.5	93.2	92.3	91.4	91.0	89.1	84.7	80.4

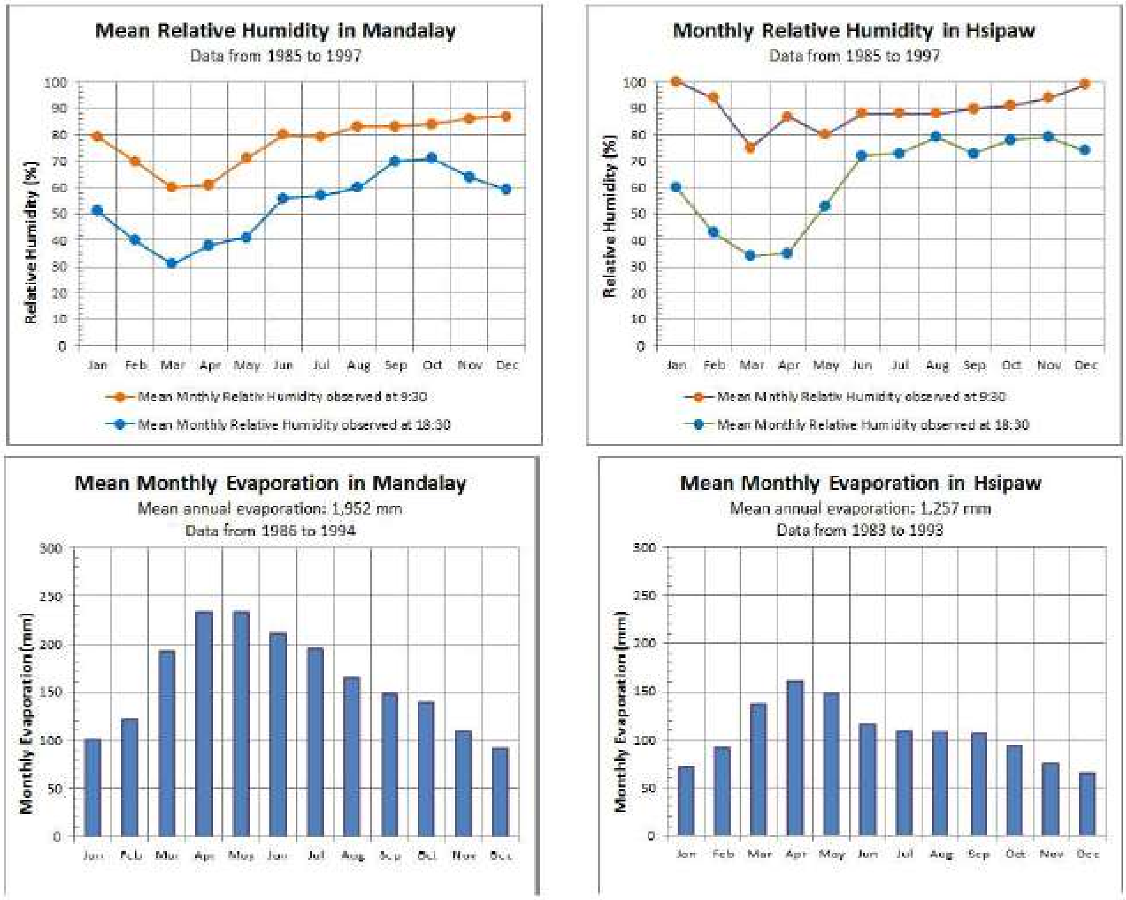


FIGURE 5.2.1-6 : RELATIVE HUMIDITY IN PROJECT AREA (TOP) EVAPORATION IN PROJECT AREA (BOTTOM)

Evaporation

Figure 5.2.1-6 shows mean monthly evaporation in Mandalay based on data from 1986 to 1994, taken from the FSR. Monthly evaporation rates were highest during the period from March to July. The highest rates above 200 mm were in April and May. The mean annual evaporation was 1,952 mm which is greater than the annual rain fall.

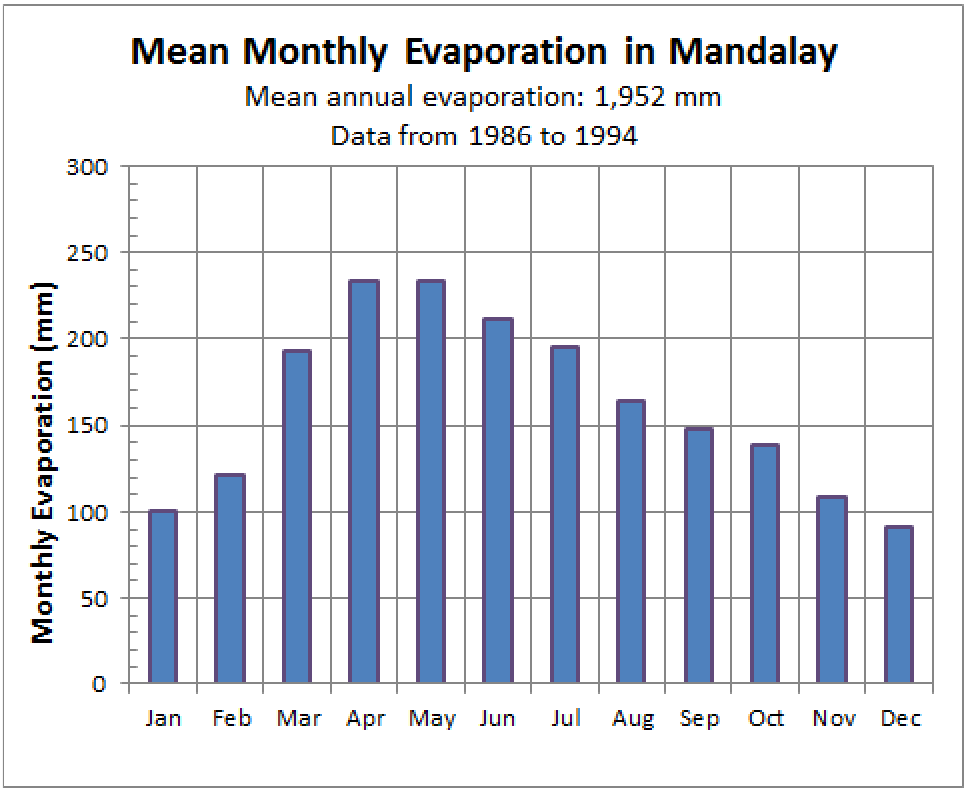


FIGURE 5.2.1-6 : MEAN MONTHLY EVAPORATION IN MANDALAY

Wind

Figure 5.2.1-7 shows records of wind data at Mandalay International Airport in 2013 (source: https://weatherspark.com/history/33995/2013/Mandalay-Myanmar-Burma). The highest *sustained wind speed* was 27 m/s, occurring on July 28; the highest *daily mean* wind *speed* was 5 m/s (June 28); and the highest wind *gust speed* was 15 m/s (May 2).The *windiest month* was August, with an average wind speed of 3 m/s. The *least windy month* was November, with an average wind speed of 1 m/s.

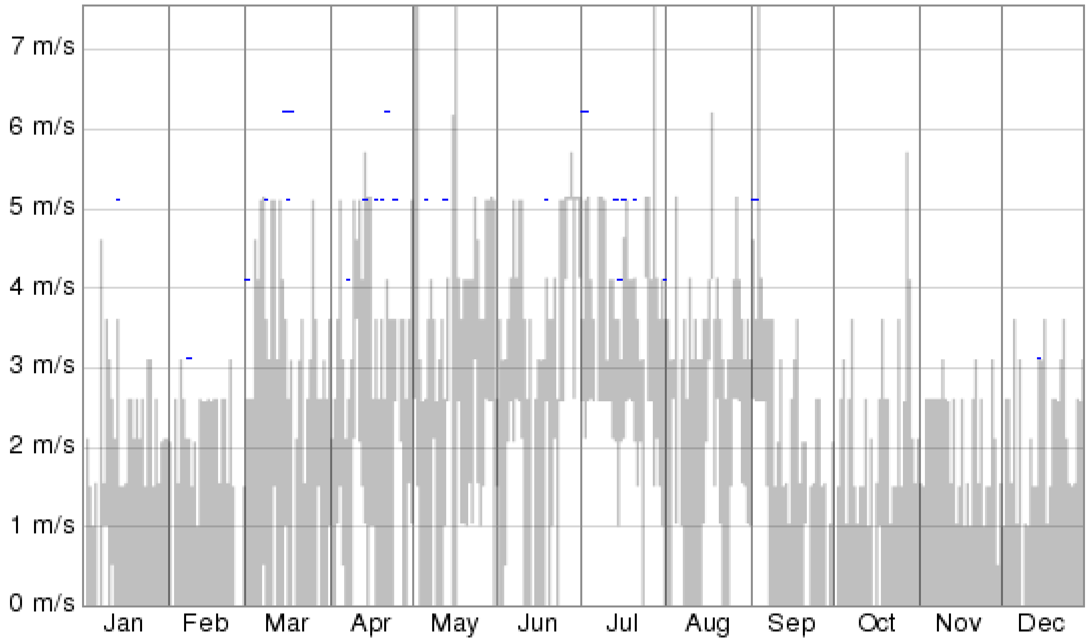


FIGURE 5.2.1-7 : WIND RECORDS AT MANDALAY AIRPORT IN 2013

The collected data on wind speeds and directions at two stations both wet (April 2015) and dry seasons (July 2015) at which air quality and noise data were also collected. ***Figure 5.2.1-1*** is a map showing the locations of the two air sampling stations. ***Figure 5.2.1-1*** shows photographs of the sampling stations. It should be noted that noise measurements were also carried out at the same locations.

Table 5.2.1-2 presents summarized results of wind measurements at the two stations. Details are given in ***Appendix 5A***. The wind rose profile at each station is shown in ***Figure 5.2.1-8***.

The results can be summarized as follows:

For dry season, the prevailing wind direction was southeast (SE) at Station 1 and north-northwest (NNW) at Station 2. These data sets indicate that the local wind directions at Station 1 are consistent with the south-east monsoon direction occurred during the measurement period in April. The wind speeds were between 0.4-4.8 m/s at Station 1 and 0.4-3.0 m/s at Station 2. These wind speed data indicated a low level of dispersion of air pollutants, mainly fugitive dust that would be emitted from the project construction sites, quarry sites, and material transport routes.

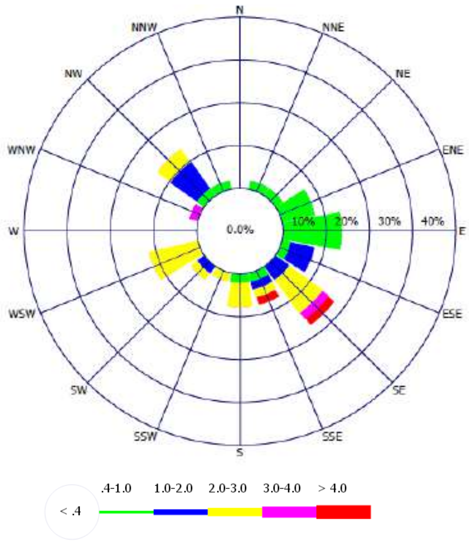
For wet season, the prevailing wind direction was north-northeast and southeast (NNE and SE) at Station 1 and south-southwest (SSW) at Station 2. The wind speeds were between 0.4-3.2 m/s at Station 1 and 0.4-2.1 m/s at Station 2. These wind speed data indicated a low level of dispersion of air pollutants, mainly fugitive dusts that would be emitted from the project construction sites, quarry sites, and material transport routes.

TABLE 5.2.1-2

RESULTS OF WIND SPEED AND DIRECTION MEASUREMENTS

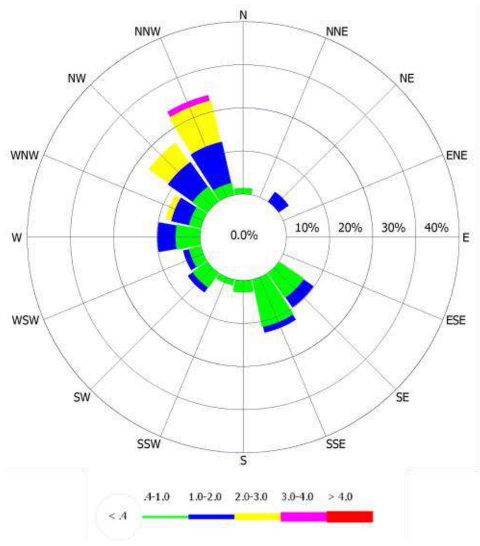
Station	Distance from project Site (m)	Wind Speed (m/s)		Prevailing Winds Direction	
		Dry Season	Wet Season	Dry Season	Wet Season
Station 1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	310 m to Site 54 4,304 m to Quarry Site	0.4-4.8	0.4-3.2	SE	NNE, SE
Station 2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	4,103 m to Site 54 387 m to Quarry Site	0.4-3.0	0.4-2.1	NNW	SSW

Source: Field Survey by TEAM Consulting Engineering and Management Co., Ltd.
Dry Season sampling during April 22-29, 2015.
Wet Season sampling during July 15-22, 2015.



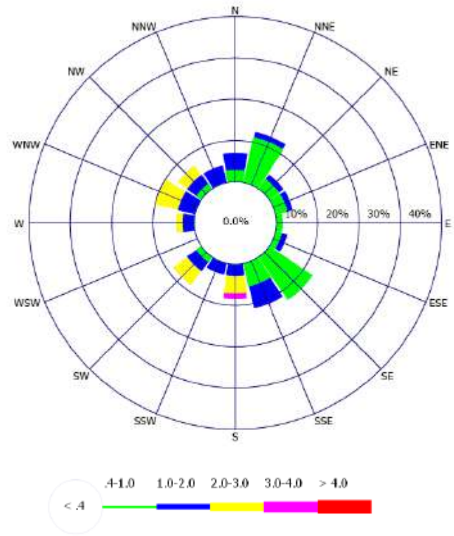
Station 1:

Wind Speed/Direction Measurement at
Hnget Gyi Thaik Primary School
during April 22-25, 2015



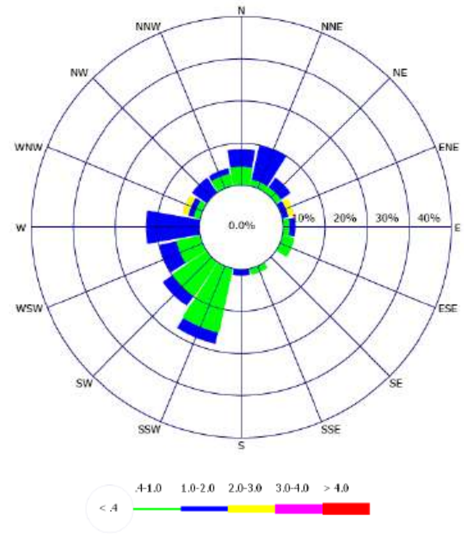
Station 2:

Wind Speed/Direction Measurement at
Thayet Pin Primary School
during April 26-29, 2015



Station 1:

Wind Speed/Direction Measurement at
Hnget Gyi Thaik Primary School
during July 19-22, 2015



Station 2:

Wind Speed/Direction Measurement at
Thayet Pin Primary School
during July 15-18, 2015

FIGURE 5.2.1-8 : WIND ROSE FROM WIND SPEED AND WIND DIRECTION MEASUREMENT OF THE PROJECT

5.2.2 Topography

From Yeywa Dam, Myitnge River meanders to drain into the Irrawaddy River at Amarapura, about 102 km from Yeywa dam. Mountains along the river define broad river terraces with varying widths along both banks. The river terraces have no forest cover and are mainly used for agriculture. Most common fruit trees include mango, banana, and lemon. Some cash crops are also seen such as cotton, pea, and corn. The river banks are covered with reeds, shrubs, bushes, and weeds. River bank erosions are visible indicating the effect of high river flows during the wet season.

Figure 5.2.2-1 shows the longitudinal profiles of Myitnge River between Yeywa Dam and the proposed Deedoke Dam site. The data was based on results of a geodetic survey conducted in May 2015 by the Department of Hydropower Implementation (DHPI) under the Ministry of Electricity and Energy. The survey covered ground contours at 1 m interval and river cross-sectional area as at each 500 m from Yeywa Dam to km 14.5 downstream, each 100 m from km 14.5 to km 17, and each 500 m from km 17 to km 23. ***Figure 5.2.2-2*** shows as an example, a cross section of the river at the selected dam site-Section 54.

5.2.3 Geology/Seismology

Text in this section is adapted from the text in the FSR to make it suit the context of the EIA study.

5.2.3.1 Geology

The local geology of the project site is dominated by surrounding dolomite limestone formations with elevations up to about 500 m.asl. Myitnge River is located in the valley bottom at approximately 90 m.asl. The river eroded a deep open valley into the dolomite limestone formations, probably due to an existing regional fault or fracture zone in the north west-south east direction.

The selected dam site at Sections 54 will encounter two main geological units for the overall foundation layout-dolomite limestone and alluvial–fluvial deposits of different compositions due to different alluvial deposition processes.

Based on results of three boreholes drilled at Section 54, geological conditions at this section can be briefly described as follows:

Left Bank

The left bank is composed of a major rocky dolomitic limestone ridge with good rock mechanical conditions for the foundation of the power house. The dolomite limestone is partially characterized by karstic formations (open joints, dissolution channels, small to big caves etc.) and needs to be carefully investigated in the foundation design of the dam.

The bedding dips with 30 degrees to the SE (130/30) against upstream direction. Additional discontinuities are mapped as (060/88) and (335/60). The rock surface extends presumably below the actual river deposits as shown in ***Figure 5.2.3-1*** as a schematic geological cross section.

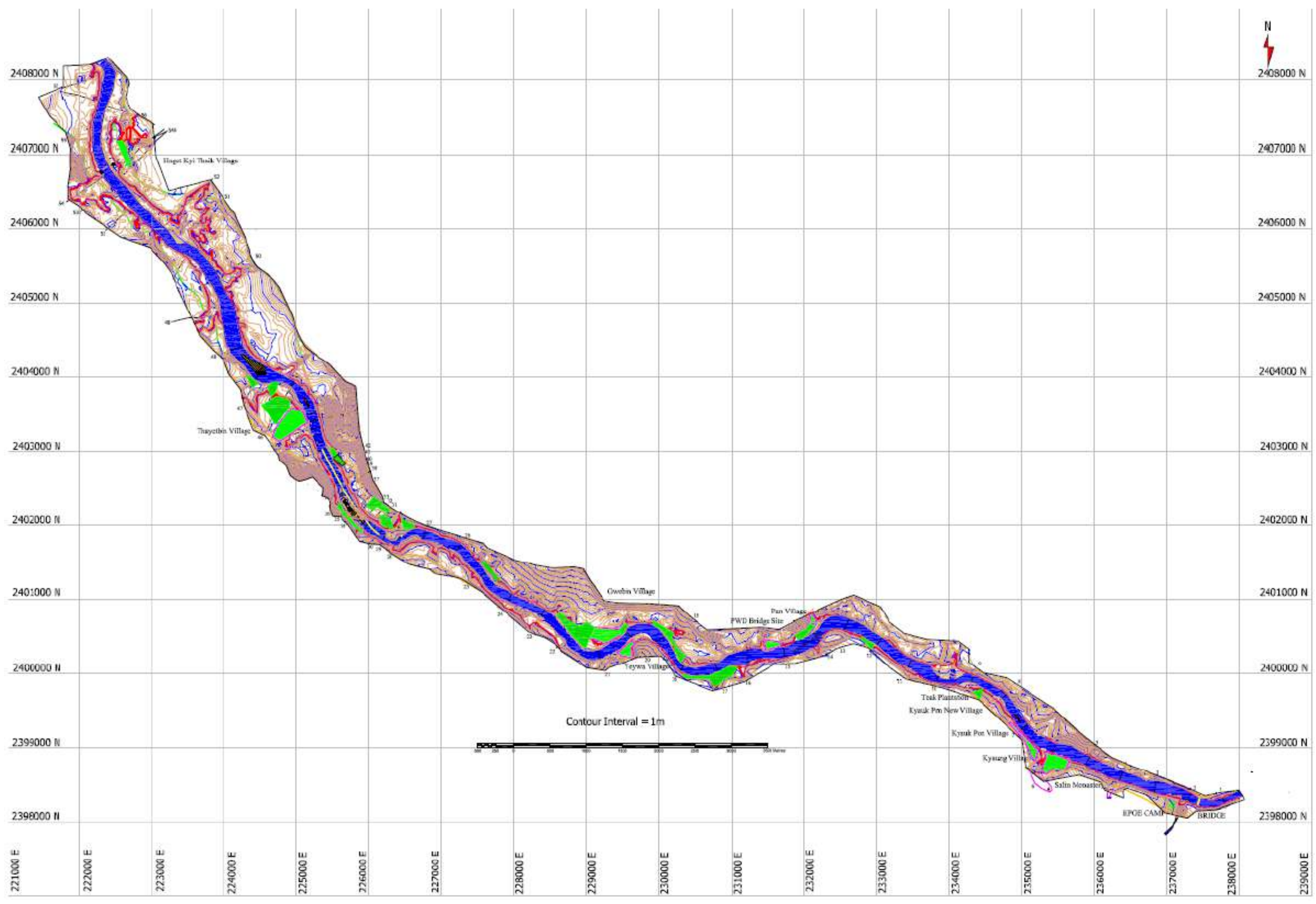


FIGURE 5.2.2-1 : TOPOGRAPHY AND BATHYMETRY OF THE PROJECT SITE AND RESERVOIR

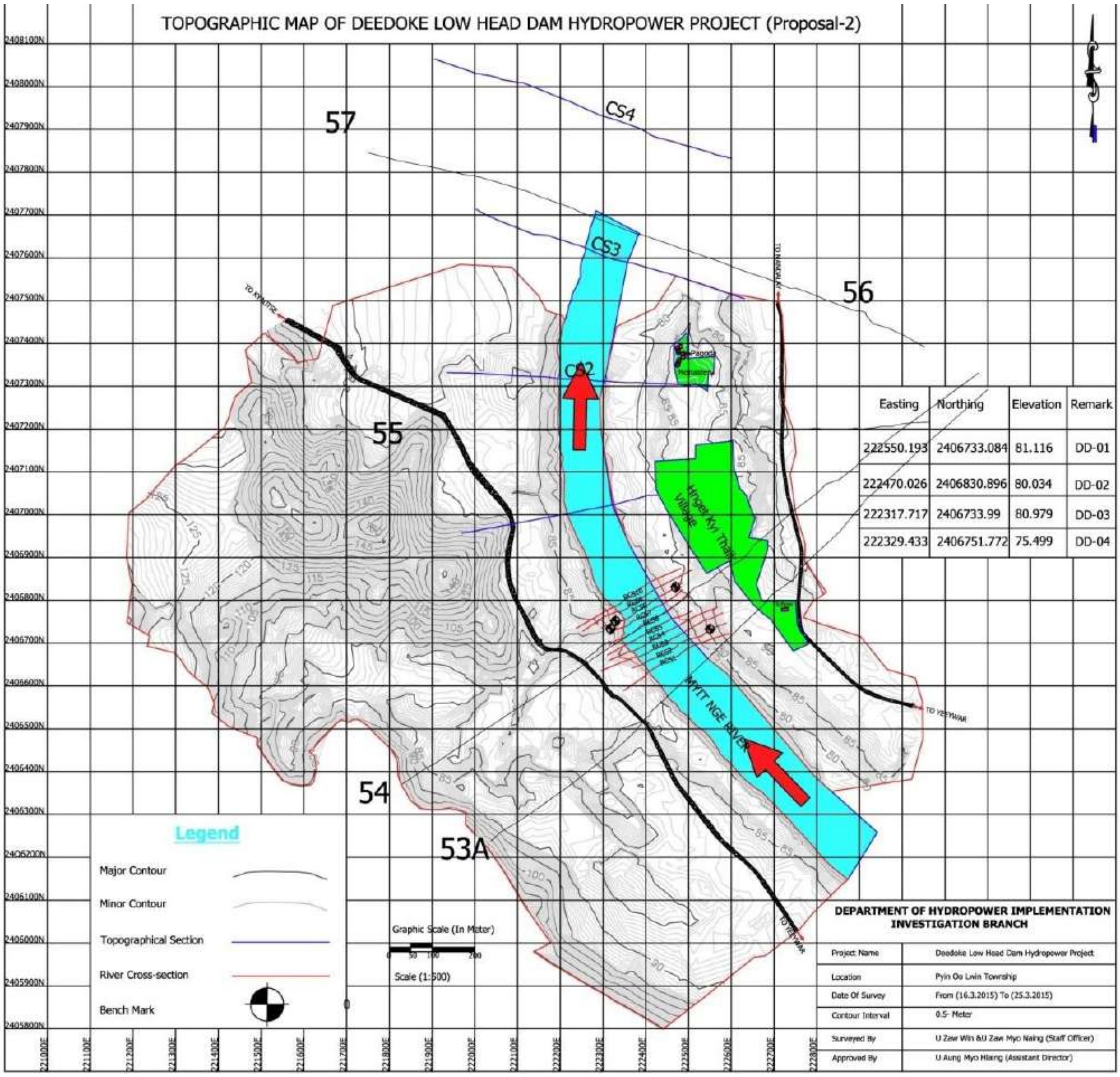


FIGURE 5.2.2-2 : A CROSS SECTION OF THE RIVER AT THE SELECTED DAM SITE-SECTION 54

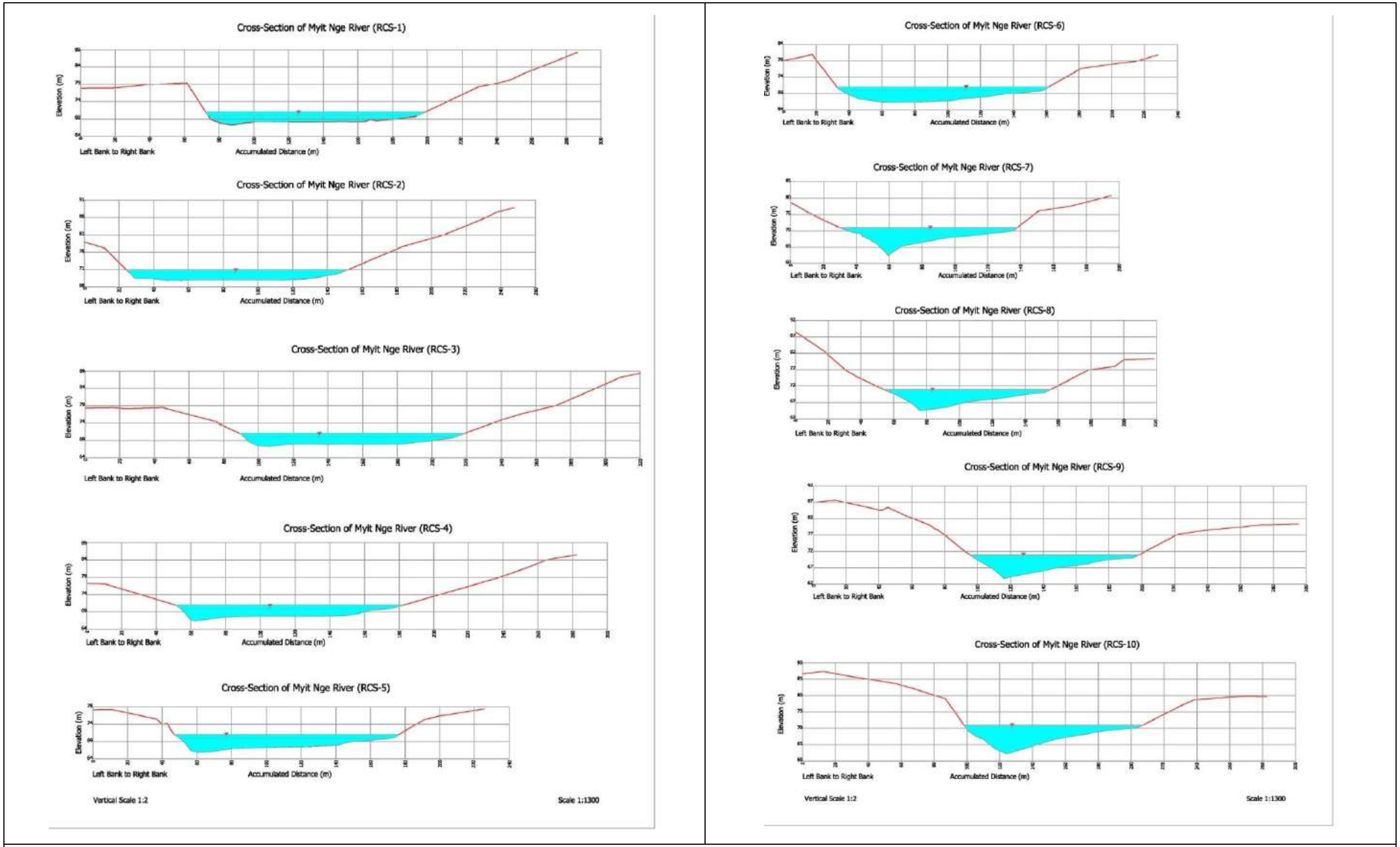


FIGURE 5.2.2-2 : A CROSS SECTION OF THE RIVER AT THE SELECTED DAM SITE-SECTION 54 (CONT'D)

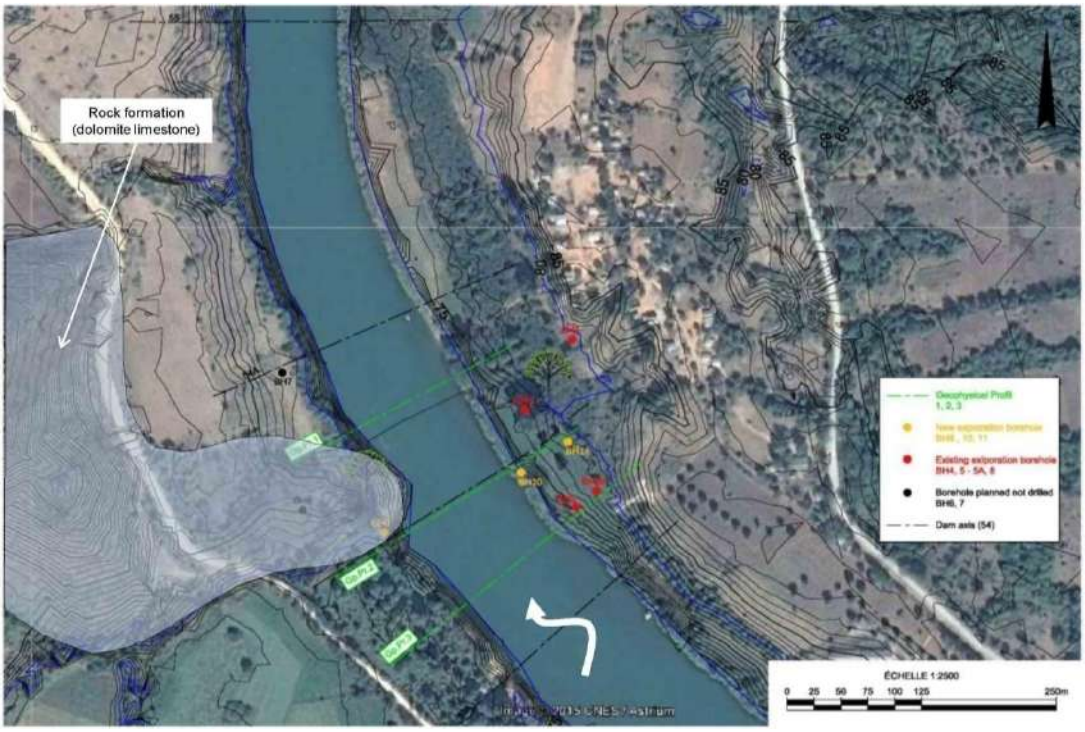


FIGURE 5.2.3-1 : SITE AT SECTION 54 SHOWING THE OUTCROPPING LIMESTONE (LEFT BANK SITE)

A simplified geological model consist of 5 major units, composed of 3 alluvial river deposits:

- unit 1: RR recent alluvial river deposits, clayey sands-silt, view gravel
- unit 2: FD 1 alluvial flood deposits; composed of clayey sand-silt
- unit 3: FD 2 alluvial flood deposits: composed of rounded gravels (limestones, $CaCo_3$ Tufa fragments), matrix may be composed of sands and a calcareous matrix.
- unit 4: TZ 3 alluvial deposits and transition zone to the rock mass; rounded and angular gravels (limestones, $CaCo_3$ Tufa fragments) , fractured and weathered rock fragments with a partially calcareous matrix.
- unit 5: BR bedrock, dolomitic limestone.

Right Bank

The right bank is composed of 2 to 3 thick alluvial terraces which continue to the left abutment in varying thickness, according to the fluvial deposition mechanics, a clear distinction is not possible. The alluvial-sedimentary terraces are composed of clayey sand- silt deposits, with minor gravels. Unit 4 may show the transition zone to the bedrock, since highly fractures and weathered dolomitic limestone cores are found, as well as rounded gravels but almost no soil. The dolomitic rock mass is characterized by an increased grade of fracturing and weathered overall rock mass.

In the deeper underground the sediments are cemented with a calcareous matrix (unit FD2, TZ3). At some locations the core recovery appears to be an intact conglomeratic composition, whereas in other locations a total loss of core have been observed. These calcareous matrix and alluvial sediments are referred to as TUFA, a formation which is well known for the Yeywa and Upper Yeywa dam also, only outcropping in a more massive deposit. The geomechanical parameters for this alluvial deposit need to be investigated in detail. Preliminary Geological Cross Section of Site at Cross Section 54 Based on Incomplete Borehole Logs (Looking Downstream) is shown in ***Figure 5.2.3-2***.

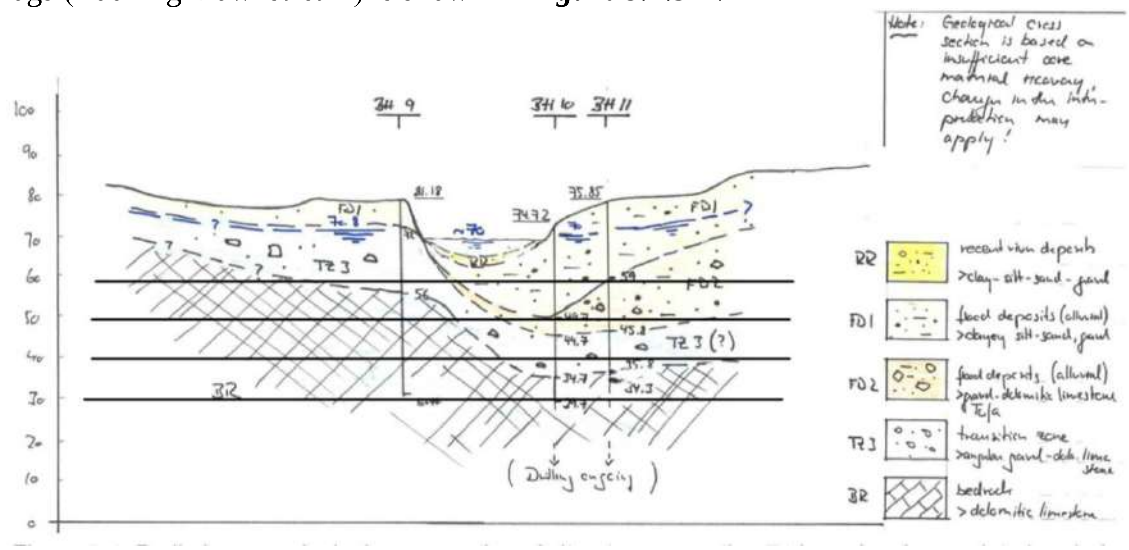


FIGURE 5.2.3-2 : PRELIMINARY GEOLOGICAL CROSS SECTION OF SITE AT CROSS SECTION 54 BASED ON INCOMPLETE BOREHOLE LOGS (Looking Downstream). (1:2500 x 625 (4:1))

5.2.3.2 Seismicity

Myanmar and also the project area is located within an active and high seismic zone, namely the Alpide Belt as well as the close by active Sagaing fault at approximately 40 km to the west. The project area is located in zone III to IV (high seismic risk), according to the seismic zonation map of Myanmar (***Figure 5.2.3-3***).

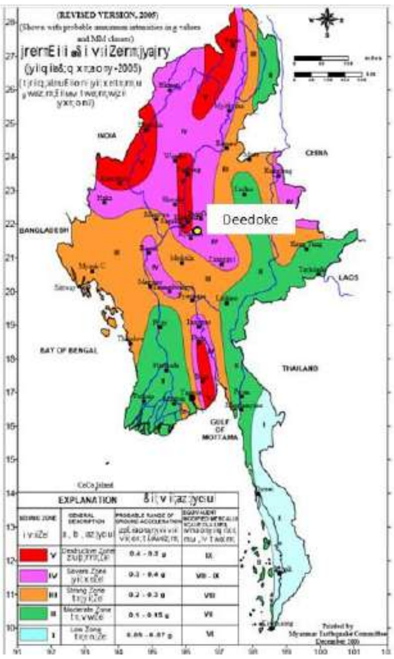


Table 1

Zone	MM Classes	Probable Damage	Examples of Damage
V	IX	Major damage	Considerable damage in specially designed structures Major damage in good RC buildings
IV	VIII – IX	Considerable damage	Considerable damage in good RC buildings Major damage in ordinary brick buildings
III	VIII	Moderate damage	Moderate damage in good RC buildings Considerable damage in ordinary brick buildings
II	VII	Minor damage	Minor damage in good RC buildings Moderate damage in ordinary brick buildings
I	VI	Slight damage	Minor damage in ordinary brick buildings

Source : SEISMIC ZONE MAP OF MYANMAR Revised by Dr. Maung Thein, U Tint Lwin Swe and Dr. Sone Han (December 2005)

FIGURE 5.2.3-3 : SEISMIC ZONATION MAP

A simplified extrapolation of the available hazard maps of the region of Mandalay has been carried out as shown in ***Figure 5.2.3-4 to 5.2.3-6***.

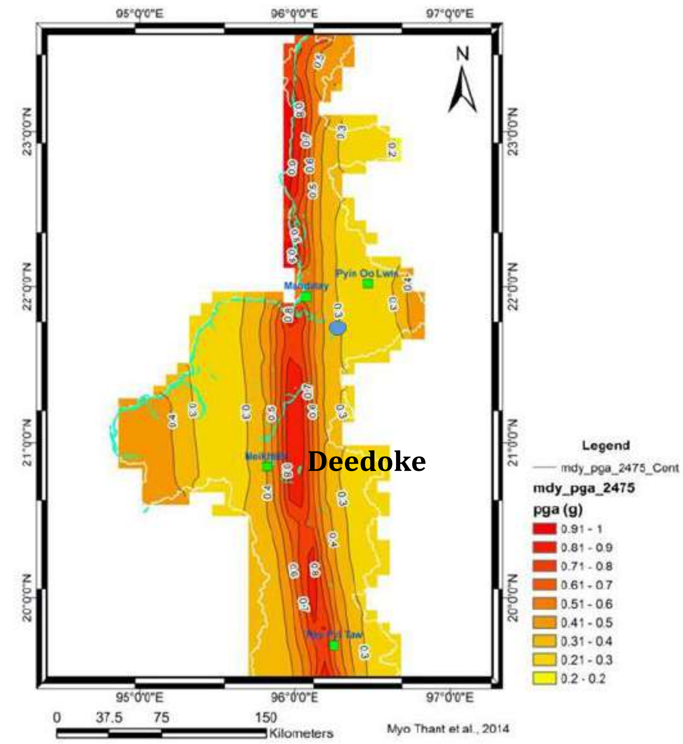


FIGURE 5.2.3-4 : PROBABILISTIC SEISMIC HAZARD MAP OF THE REGION OF MANDALAY -2% PROBABILITY IN 50 YEARS

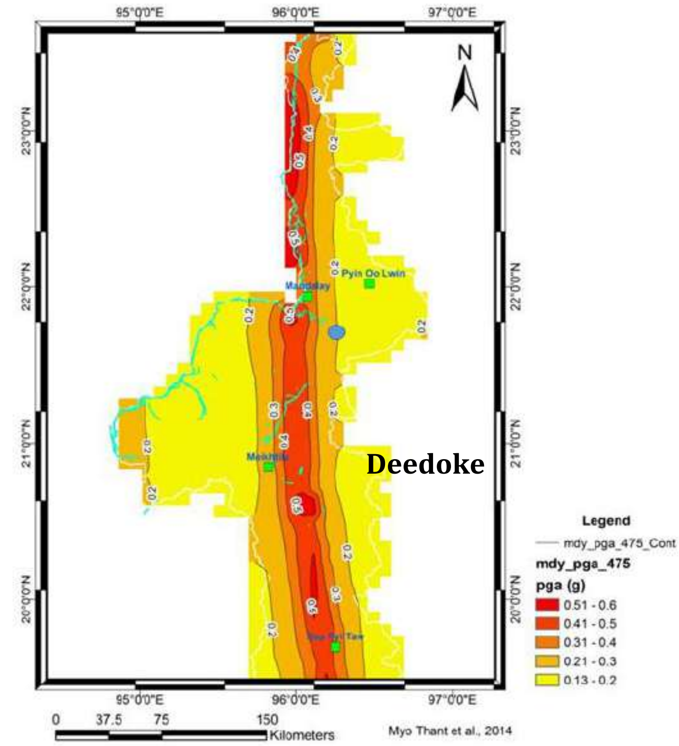


FIGURE 5.2.3-5 : PROBABILISTIC SEISMIC HAZARD MAP OF THE REGION OF MANDALAY - 10% PROBABILITY IN 50 YEARS

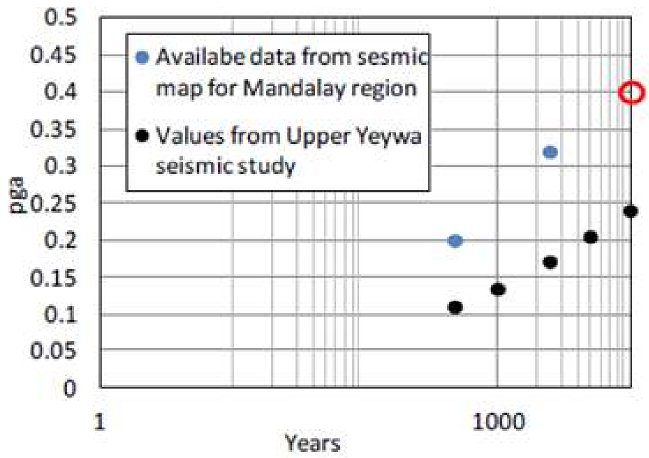


FIGURE 5.2.3-6 : ESTIMATION OF THE PGA WITH A RETURN PERIOD OF 10'000 YEARS BY EXTRAPOLATION OF THE AVAILABLE HAZARD MAPS OF THE REGION OF MANDALAY

Then Seismic hazard assessment shall be done by both Probabilistic Seismic Hazard Assessment (PSHA) and Deterministic Seismic Hazard Assessment (DSHA) methods are applied for the seismic hazard analysis of Deedoke Dam Project. PSHA is used for estimation of peak ground acceleration (PGA) and Spectral acceleration for MDE, DBE, OBE and CE together with the other suitable return periods, while DSHA for MCE. Both PSHA and DSHA methods are explained briefly in the following sections.

Basically, the seismic load for the structures is shown as below.

For dams with small or limited damage potential shorter return periods can be specified. Due to the limited damage potential of Deedoke dam the SEE is taken as a PGA with a mean annual exeedance probability of 1/2,475.

Seismic load for the Structures

Features	PGA	Seismic load*
OBE (Operational Basis Earthquake)	0.2g (475 years)	0.13g
SEE1 (Safety Evaluation Earthquake)	0.32g (2’475 years)	0.21g

*To compensate the quasi-static application of the dynamic loads in the stability analyses, a correction factor of 2/3 is applied to the peak ground accelerations according to the international standard (USACE).

The result of dam stability is shown as the table.

It was found that all safety requirements are met for three scenarios.

Stability of Dam

	Case	Result	Safety factor (Based to USACE)	Judgement
Sliding	OBE	1.8	≥ 1.7	OK
	SEE	1.3	≥ 1.3	OK
Overturning	OBE	69% of Base length	middle 1/2 (25%-75%)	OK
	SEE	73% of Base length	within base (0%-100%)	OK
	Ultimate (kPa)	Allowable (kPa)	Maximum pressure (kPa)	
Bearing capacity	13,891	4,782	>250	OK

5.2.4 Soils

According to soil map of Myanmar, soils in the study area and vicinity are classified into Acrisols and Ferralsols in FAO classification system. Acrisol is one of the 30 soil groups in the classification system of the Food and Agriculture Organization (FAO), as well as Ferralsol. Acrisols are clay-rich which can be found within the land where is humid and tropical. In term of its advantages, Acrisols have been used for silviculture. In addition to that, tea, para rubber tree, oil palm, coffee and sugar cane can be successfully cultivated provided that climatic conditions are appropriate. Ferralsols are red and yellow weathered soils, which compose of metal oxides, particularly iron and aluminum. Ferralsols contain low fertility. Additional lime and fertilizer are required if this type of soil is to be used for agricultural purposes such as perennial trees and crops plantation.

5.2.5 Natural Hazards

Myanmar ranks first as the ‘most at risk’ country in Asia the Pacific according to the UN Risk Model. The country is vulnerable to a wide range of hazards, including floods, cyclones, earthquakes, landslides and tsunamis. The likelihood for medium to large-scale natural disasters to occur every couple of years is high, according to historical data.

In Mandalay Region natural hazards are earthquake related to Sagaing Fault and flood hazards. Sagaing Fault is a major tectonic structure that cuts through the center of Myanmar, broadly dividing the country into a western half moving north with the Indian plate, and an eastern half attached to the Eurasian plate. In November 2012 the latest large earthquake caused by Sagaing Fault struck Thabeikky in area 100 km north of Mandalay.

Flash floods affected the Magway, Mandalay and Sagaing Regions on 19 October 2011. Authorities indicate that some 35,000 people were affected, and 78 either killed or missing. In Mandalay Region, some 8,835 people in three Townships (Sintgaing, Thazi and Yamethin) were affected, some 723 houses were destroyed and 1,763 damaged. In Yinmabin Township, Sagaing Region, some 530 people were affected and 95 houses were washed away in the flood. (add flooded statistic 2015)

5.2.6 Hydrology

The catchment area of Myitnge River is about 28,695 km^2 at the selected Deedoke Dam site and about 28,206 km^2 at Yeywa Dam. The difference is only 489 km^2 accounting for only about 1.7% of the catchment area at Yeywa Dam. Therefore, flood characteristics of Myitnge River established at flood statistics of Yeywa Dam should also be applicable to those at Deedoke Dam. As Deedoke Dam is only about 21.1 km downstream of Yeywa Dam, outflows from Yeywa Dam are inflows to Deedoke Dam.

The information presented in this section is based on the results of hydrological analysis presented in FSR.

Design Flood

Since the distance between the Deedoke site and the Yeywa site is very small (see in ***Figure 5.2.6-1***), the difference of catchment areas between the Deedoke HPP site and the Yeywa dam is only about 1% of the catchment area of the Yeywa dam and is therefore negligible. Hence, the flood statistics of the Yeywa dam are deemed to be applicable for the Deedoke HPP.

However, a new frequency analysis was carried because in the feasibility study in 1999 of Yeywa dam mean daily discharges are used as annual maximum discharges and not the maximum daily discharges.

Finally, the probable maximum flood (PMF) studied in the Yeywa FS report (1999) was reviewed and compared with other design floods in Myanmar.

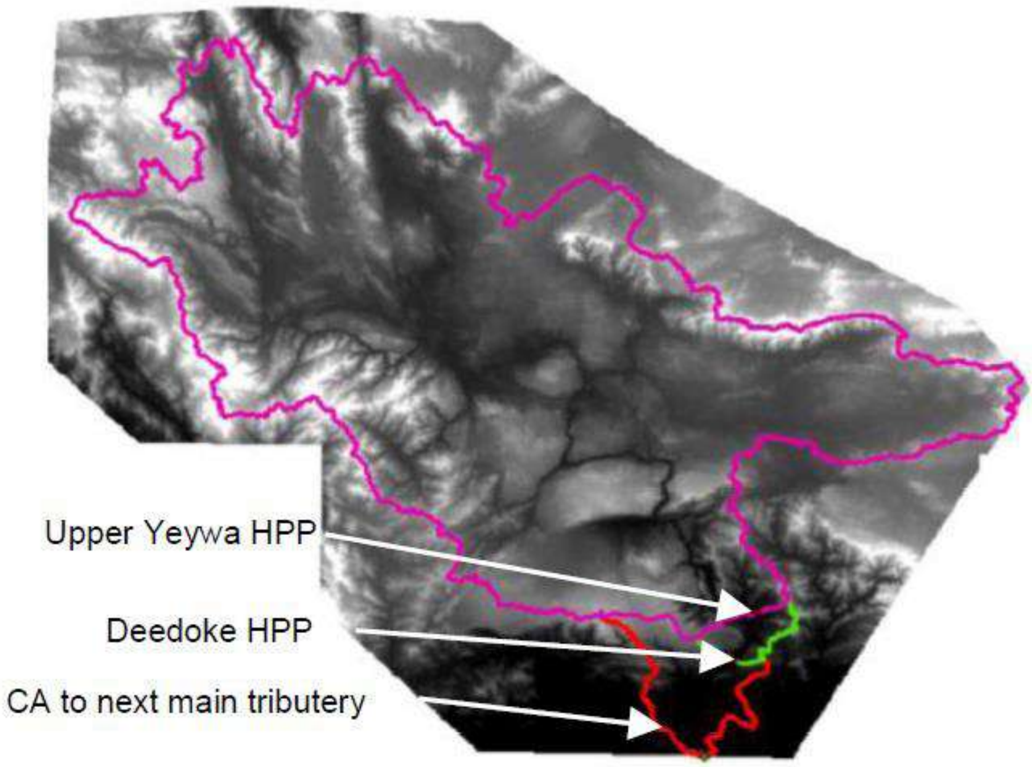


FIGURE 5.2.6-1 : CALCULATED CATCHMENT AREA FROM THE SRTM USING ArcGIS

Frequency Analysis

The table below shows the annual maximum flood data recorded at the Shwesayan GS, which is presented in the Yeywa FS report (1999) for frequency analysis. However, the data seems to be the mean daily discharge data, which can be confirmed by the attached data to the same FS report (1999). Although this data shows the discharge data after simulation, the data from 1972 to 1994 is the data recorded at the Shwesayan GS, by which the simulation model had been calibrated according to the Yeywa FS report (1999).

Therefore, the frequency analysis considers:

- the data from 1972 to 1994 is used, and
- the data is be converted to instantaneous peak discharges by formula.

There are basically two different approaches to estimate the instantaneous peak flow from mean daily flow data. The first approach is to estimate a peak flow coefficient; a ratio of instantaneous peak flow and the corresponding mean daily flow with physiographic characteristics of the basin (Fuller 1914, Silva 1997, Silva and Tucci 1998). The second approach is that a sequence of mean daily flow data is used to estimate peak flow (Jarvis 1936, Langbein 1944, Linsley et al 1949, Sangal 1983, Fill 2003).

In this study, the method proposed by Sangal (1983) was applied.

In the Table below (***Table 5.2.6-1 to 5.2.6-3***) the mean daily flow data and the instantaneous peak flow data converted by Sangal's method is presented. Fill's method is presented for reference only.

Sangal's equation is given as follows;

$$Qpp = \frac{4Q2 - Q1 - Q3}{2}$$

with,

Q_{pp}: instantaneous peak flow

Q_1: mean daily flow on the preceding day of the maximum

Q_2: the maximum mean daily flow

Q_3: mean daily flow on the succeeding day of the maximum

The frequency analysis of the converted peak flows from 1972 to 1994 was carried out by Gumbel and Log Pearson III. As a result, following design floods were obtained. Those are estimated by the Gumbel's probability density function because, as seen in ***Figure 5.2.6-2***, Gumbel shows higher floods than those of Log Pearson III.

TABLE 5.2.6-1

MEAN DAILY FLOW AND CONVERTED PEAK FLOW AT SHWEZAYAN

	Year	Date	Q2 Mean Daily Discharge at Shwesayan (m3/s)	Q1 -1 day	Q3 +1 day	Sangal (1983) Qmax=(4Q2-Q1-Q3)/2	Fill and Steiner (2003) x	k	Qmax= (0.8Q2+0.25(Q1+Q3))/k	Remarks
1	1972	1-Sep	1,342	1,134	1,097	1,569	0.83	1.12	1,456	
2	1973	22-Aug	2,600	2,005	2,462	2,967	0.86	1.15	2,790	
3	1974	13-Aug	2,178	2,138	1,744	2,415	0.89	1.18	2,309	
4	1975	4-Sep	1,712	1,291	1,700	1,929	0.87	1.16	1,827	
5	1976	27-Sep	1,990	1,400	1,772	2,394	0.80	1.09	2,190	
6	1977	2-Sep	2,650	2,420	2,650	2,765	0.96	1.23	2,744	
7	1978	24-Jul	2,046	1,959	1,763	2,231	0.91	1.19	2,154	
8	1979	6-Aug	1,985	1,942	1,568	2,215	0.88	1.17	2,110	
9	1980	5-Oct	1,488	1,230	1,327	1,698	0.86	1.15	1,597	
10	1981	12-Sep	2,296	2,074	2,054	2,528	0.90	1.18	2,427	
11	1982	23-Aug	2,010	1,532	2,005	2,252	0.88	1.16	2,140	
12	1983	5-Aug	1,996	1,700	1,840	2,222	0.89	1.17	2,119	
13	1984	22-Oct	3,266	2,245	3,230	3,795	0.84	1.13	3,534	
14	1985	11-Sep	2,329	1,219	2,165	2,966	0.73	1.02	2,644	
15	1986	15-Oct	3,926	3,854	3,872	3,989	0.98	1.26	4,027	
16	1987	26-Aug	1,491	1,006	1,376	1,791	0.80	1.09	1,640	
17	1988	8-Aug	1,410	1,160	1,320	1,580	0.88	1.16	1,501	
18	1989	17-Aug	1,357	1,163	1,158	1,554	0.86	1.14	1,458	
19	1990	17-Aug	1,285	1,103	1,155	1,441	0.88	1.16	1,369	
20	1991	6-Nov	2,162	1,787	2,034	2,414	0.88	1.17	2,298	
21	1992	17-Oct	3,048	2,630	2,608	3,477	0.86	1.15	3,271	
22	1993	5-Sep	2,296	2,046	2,138	2,500	0.91	1.19	2,416	
23	1994	25-Aug	2,294	2,035	1,897	2,622	0.86	1.14	2,464	

TABLE 5.2.6-2

FLOOD DISCHARGES AT SHWESAYAN GAUGING STATION AND AT THE PROJECT ARE FOR VARIOUS RETURN PERIODS

Return Period (year)	Shwesayan GS (28,717 km^2)	Deedoke HPP (28,695 km^2)
10,000	7,304	7,300
5,000	6,910	7,000
1,000	5,997	6,000
500	5,603	5,600
100	4,688	4,700
50	4,291	4,300
20	3,763	3,800
10	3,354	3,400
5	2,928	3,000
2	2,285	2,300
1	1,209	1,300

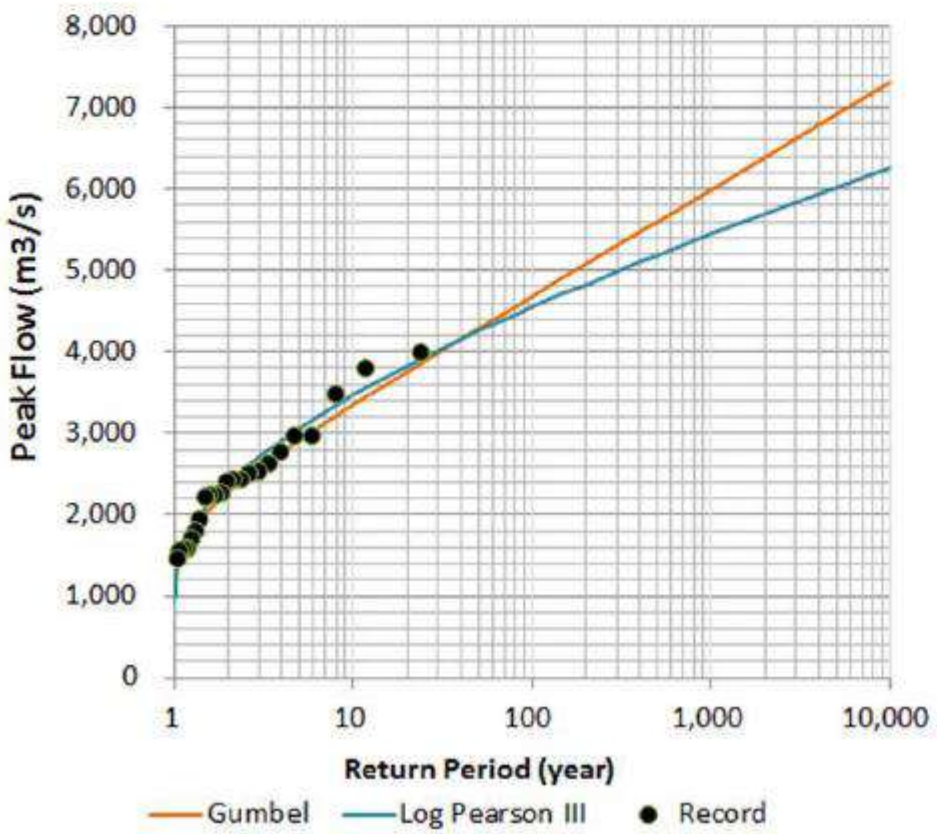


FIGURE 5.2.6-2 : FREQUENCY ANALYSIS AT SHWESAYAN

An issue of importance for the designer is the dry season, this period allowing to complete works related to the river (diversion, cofferdams, excavations, etc.). A flood frequency analysis has been carried out for the period from December to June by using the approach by Gumbel.

TABLE 5.2.6-3

MEAN DAILY FLOW AND CONVERTED PEAK FLOW AT SHWEZAYAN IN DRY SEASON

	Year	Date	Q2 Max. Q in dry season (Dec to May)	Q1 -1 day	Q3 +1 day	Sangal (1983) Qmax= (4Q2-Q1-Q3)/2	Fill and Steiner (2003) x	k	Qmax= (0.8Q2+0.25(Q1+Q3))/k
1	1972	2-Dec-72	674	506	634	778	0.85	1.13	727
2	1973	1-Dec-73	845	776	820	892	0.94	1.22	879
3	1974	1-Dec-74	386	405	374	1) 396	1.01	1.28	393
4	1975	2-Dec-75	522	492	495	551	0.95	1.22	543
5	1976	1-Dec-76	794	624	763	895	0.87	1.16	847
6	1977	21-May-78	515	426	482	576	0.88	1.17	548
7	1978	1-Dec-78	358	364	356	1) 361	1.01	1.28	365
8	1979	3-Dec-79	678	592	640	740	0.91	1.19	714
9	1980	27-May-81	906	293	867	1,232	0.64	0.95	1,073
10	1981	1-Dec-81	616	616	608	620	0.99	1.27	630
11	1982	1-Dec-82	344	346	335	1) 345	0.99	1.27	352
12	1983	1-Dec-83	520	526	514	1) 523	1.00	1.27	530
13	1984	26-May-85	433	362	387	492	0.86	1.15	464
14	1985	1-Dec-85	512	512	511	513	1.00	1.27	522
15	1986	1-Dec-86	412	422	402	1) 417	1.00	1.27	420
16	1987	5-Dec-87	930	634	628	1,229	0.68	0.98	1,080
17	1988	17-May-89	319	310	182	392	0.77	1.07	355
18	1989	27-May-90	849	703	717	988	0.84	1.12	919
19	1990	2-Dec-90	310	310	308	311	1.00	1.27	317
20	1991	1-Dec-91	745	763	721	1) 754	1.00	1.27	761
21	1992	1-Dec-92	502	508	490	1) 505	0.99	1.27	513
22	1993	1-Dec-93	790	807	784	1) 799	1.01	1.28	804
23	1994	1-Dec-94	412	427	392	1) 420	0.99	1.27	421

1) Qmax=(Q1+Q2)/2

In the ***Table 5.2.6-4*** and ***Figure 5.2.6-3*** below, several instantaneous peak flows on 1st December have been calculated as an average of Q1 and Q2. In such cases, Q1 on 30th November (the last day of rainy season) is larger than Q2 on 1st December (the first day of dry season) and this would not be the case Sangal expected. Therefore, the possible highest discharge on 1st December is regarded as an average of Q1 and Q2. As a result, the following design floods in dry season were obtained.

TABLE 5.2.6-4

DESIGN FLOODS IN DRY SEASON (DECEMBER TO MAY)

Return Period (year)	Shwesayan GS ($28,717\ km^2$)	Deedoke HPP ($28,695\ km^2$)
50	1,429	1,500
25	1,271	1,300
10	1,058	1,100

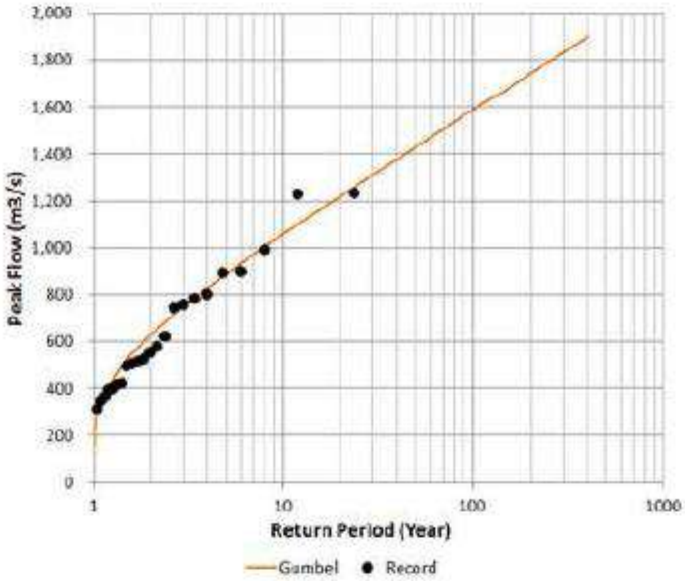


FIGURE 5.2.6-3 : **FREQUENCY ANALYSIS AT SHWESAYAN FOR DRY SEASON**

Probable Maximum Flood (PMF)

The PMF (Probable Maximum Flood) of the Yeywa PS was estimated to 12'500 m3/s in the FS report (1999) by the runoff simulation model i.e. a unit hydrograph introducing the PMP (Probable Maximum Precipitation) and observed floods at the Shwesayan GS. PMP was estimated by two approaches such as a statistical approach and a meteorological approach, and both led to the almost same PMP of 208.8 mm and 201.1 mm, respectively. The ***Figure 5.2.6-4*** shows maximum flood record in Myanmar.

In principle, the flood statistics of Yeywa dam is valid for the Deedoke project since the additional catchment area between the two sites is negligible. Therefore no specific PMF study has been carried out for the Feasibility Study.

Nevertheless, the PMF discharge calculated for Yeywa dam seems very high. However, since the Deedoke weir has practically no important influence on the water level during such high, extreme discharges the effective value is less important for the design of Deedoke power plant.

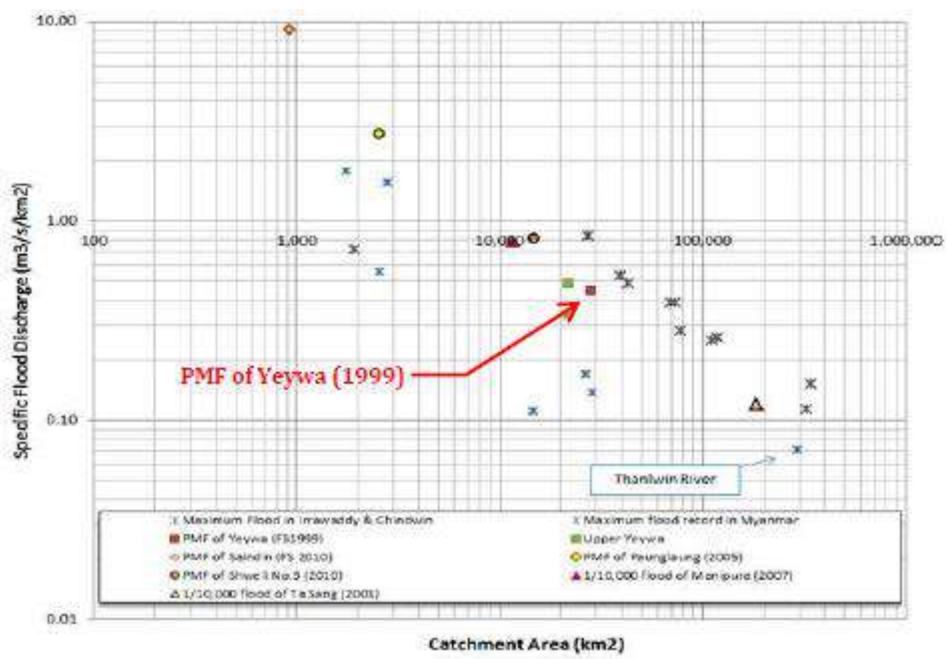


FIGURE 5.2.6-4 : MAXIMUM FLOOD RECORDS IN MYANMAR

5.2.7 Erosion and Sedimentation

As Yeywa reservoir is storage reservoir with a large volume (2,630 m^3), almost all or all silt loads generated by soil erosion in the basin would settle in the reservoir. Sedimentation in the downstream Deedoke Dam should therefore be minimum. As Deedoke Dam is designed as a run-of- the river type with submerged weir, sedimentation in the river pondage between Deedoke Dam and Yeywa Dam will not be an issue in the operation of Deedoke hydropower scheme. However, the Deedoke dam design will incorporate measures to avoid coarse sediment materials from entering into the turbine.

Sediment Data in Myitnge River Basin

No soil erosion and sedimentation data in Myitnge River Basin is available although some suspended load samples have been taken according to the FS report (1999). The dead storage volume of the Yeywa reservoir is planned based on the annual sediment yield of 200 m^3/km^2/year. This sediment yield was estimated on the basis of the sediment yield of 160 m^3/km^2/year in the Paunglaung river basin. In the feasibility study report of Yeywa hydropower project (1999), the horizontal sediment level of 131.5 m after 100 years was estimated assuming a trap efficiency of 90 % at the reservoir.

Generally, periodical monitoring of the reservoir by sounding gives useful sediment data for planning of hydropower projects on the same basin or nearby. Such monitoring activities, however, have not been carried out in Yeywa reservoir. Routine water quality sampling and testing have not been carried out. Therefore, no information exists for estimating the extent of siltation in Yeywa reservoir. Although, Yeywa dam has a bottom outlet. Its function is only to release water during impounding and in emergency, not to release sediment. No sediment flushing has been planned so far.

At the regional level, 5,653,182. 72 acres of land in Mandalay Region are susceptible to various degrees of erosion-slight susceptibility 4,968,876.66 acres, moderate susceptibility 555,614.1 acres and critical susceptibility 128,692 acres. (Source: Case Study on Land Degradation of Dry Zone of Myanmar, http: / / www. apipnm. org/ swlwpnr/ reports/y_ta/z_mm/mmtx611.htm, downloaded on 22 July 2015).

According to the "Yeywa HPP-Inception Report,2001", the MEPE performed 3 sediment sampling at the Yeywa dam site in 1998, and the AF-Consultant added 12 test results on suspended sediment concentration in 2001.

Despite a relatively wide variation of discharges at the measurements, the sediment concentrations of the Myitnge River basically ranged from 0.005g/l to 0.05g/l, and the maximum value was 0.2g/l.

The consultant evaluated 200 m^3/year/km^2 would be reasonable as the specific sediment transportation of the river.

It is expected that 90% of the sediment yielded from the basin have been trapped in the Yeywa HPP and the rest of the sediment is wash load and/or suspended load which have passed through the Yeywa HPP or overflowed on the spillway. Those sediments would be transported by outflows of the Yeywa HPP including the spillway.

According to the information, the total sediment into the Deedoke project was calculated as follows.

Schematic diagram of sediment discharge in the Myitnge River Basin is shown in

FIGURE 1. Left figure shows the natural condition for the Deedoke Reservoir without the Yeywa Reservoir. Middle figure shows the natural condition to the Yeywa reservoir. Right figure shows the future condition for the Deedoke Project.

Sediment inflow to Deedoke Reservoir can be calculated as follows:

Qsinact(DDK) = Qsoutact(YYW) + Qsinact(RB)

Qsinact(RB) = Qsinnat(DDK) – Qsinnat(YYW)

Qsoutact(YYW) = Qsinact(YYW) - Qsinact(YYW) x TE(YYW)

Qsinact(YYW) = Qsinnat(YYW)

Where;

Qsinact(DKK)	:	Sediment Inflow to Deedoke in actual condition with Yeywa (m^3/year)
Qsoutact(YYW)	:	Sediment outflow from Yeywa in actual condition with Yeywa (m^3/year)
Qsinact(RB)	:	Sediment inflow from the residual basin between Yeywa and Deedoke (m^3/year)
Qsinnat(DDK)	:	Sediment inflow to Deedoke in natural condition (m^3/year)
Qsinnat(YYW)	:	Sediment inflow to Yeywa in natural condition (m^3/year)
Qsinact(YYW)	:	Sediment inflow to Yeywa in actual condition with Yeywa (m^3/year)

As shown in ***Table 5.2.7-1 and Figure 5.2.7-1***, the total sediment into the Deedoke reservoir per year is around 640,000 m^3/s.

As mentioned above, the sediment can be transported by river water from the dam site to the conference of the Irrawaddy River, distributed in the bottom of the river. The length of the river is around 80km and the width is assumed to be 100m. It is noted that the thickness of the sediment accumulated annually would be at large 8 centimeter (640,000m^3 / (80,000m x 100m), while most of the wash load will flow into the Irrawaddy River considering the nature of the wash load. It is concluded that the sedimentation downstream of the Deedoke spillway would be negligible for the safety.

TABLE 5.2.7-1

ESTIMATION OF THE SEDIMENT

	A	B	C =A x B	D	E	F	G=C(DDK)−C(YYW)	H=F+G	
			Qsinnat	TE(YYW)		Qsoutact	Qsinact(RB)	Qsinact(DDK)	TE(DDK)
Reservoir	Catchment Area (km2)	Specific Sediment Yield (m3/km2/year)	Sediment Inflow (m3/year)	Trap Efficiency of Yeywa (%)	Trapped Sediment Inflow (m3/year)	Sediment outflow of Yeywa (m3/year)	Sediment inflow from residual basin (m3/year)	Sediment inflow of Deedoke =sediment outflow of Yeywa + sedimetnt inflow from residual basin (m3/year)	Trap Efficiency of Deedoke (%)
Yeywa	28,206	200	5,641,200	90	5,077,080	564,120			
Deedoke	28,578	200	5,715,600				74,400	638,520	0

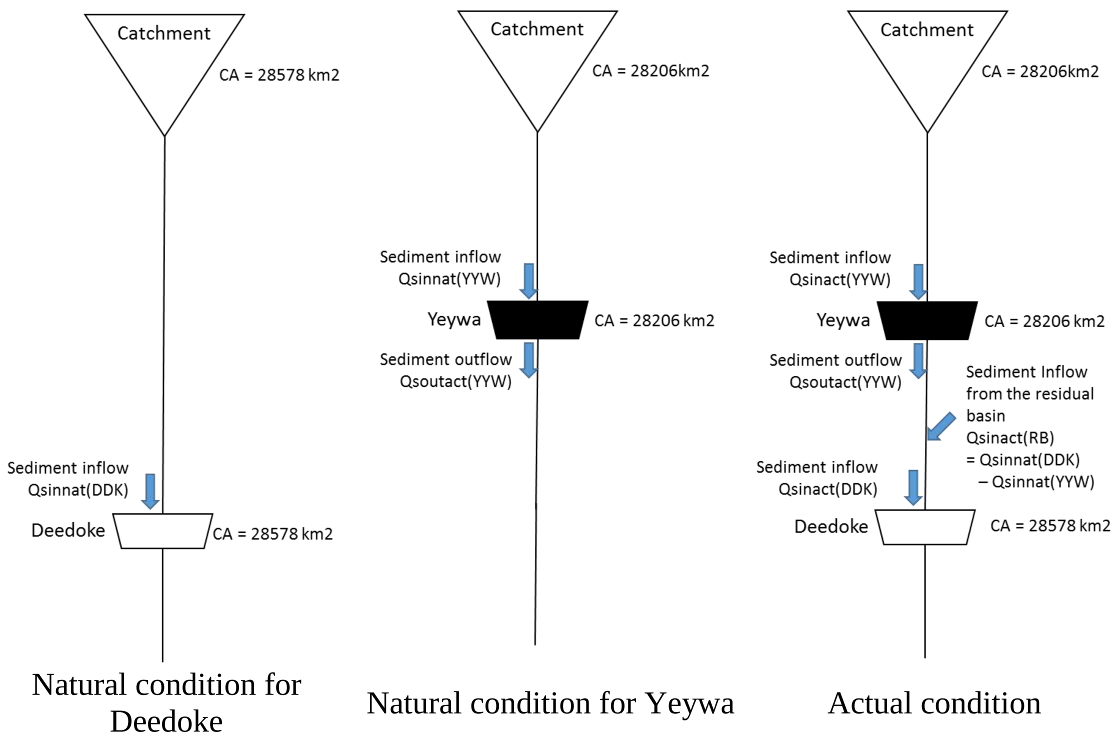


FIGURE 5.2.7-1 : SCHEMATIC DIAGRAM OF SEDIMENT DISCHARGE IN THE MYITNGE RIVER BASIN

5.2.8 Surface and Groundwater Quality

5.2.8.1 Surface Water Quality

Water quality surveys were carried out in two occasions. The first survey was conducted in the dry season from 25 to 26 April 2015, and the second survey in the rainy season from 21 to 22 July 2015. Each survey involved taking grab water samples from 6 stations in Myitnge River and 1 station in Irrawaddy River near the confluence of the two rivers. Map showing the water sampling stations is presented in ***Figure 5.2.1-1***. The seven stations covered about 19.5 km of the river section starting from about 1.6 km downstream of Yeywa Dam to the confluence.

Only one boat was used in the survey for sampling from Station 1 to Station 7 in sequential order. At each station, only one river water sample was collected from mid-depth and at mid-section using water sampler. Collecting of samples at each station was performed by composite sample as shown in ***Photo 5.2.8-1***. The sample from each station is obtained by combining of multiple grab from different depth at sampling station. This technique can improve temporal coverage of an area without increasing sampling number. The water samples at each station were poured into appropriate container prior completed and preserved immediately to prevent the change in constituent (*See **Table 5.2.8-1** below for preservation method*). The samples were store at low temperature (≤ 6˚C but above freezing). Some parameters includes Conductivity, Dissolved oxygen, pH, Temperature and Salinity were measure *in situ.* The water samples were preserved and analyzed in the Consultant's laboratory in Bangkok for other quality parameters. The sampling, preservation of water samples, and sample analyses followed *Standard Method for the Examination of Water and Wastewater. APHA, AWWA and WEF 21st Edition, 2012.*

Most parameter of surface water were analysed within appropriate interval time between collection and analysis but there are two parameters of BOD and turbidity which were not analysed within such time. The water sample for these two parameters are kept in opaque container and stored in cool condition in order to minimize microbiological activities which would probably degrade the sample. It is noted that only of those water samples which collected in April are sent to Thailand while water samples of July 2015 are sent to laboratory in Myanmar (ISO Tech, see ***Photo 5.2.8-2***), these samples are analysed within three days after collection. Result of BOD analysis of this study in dry season (April) are relatively low (1.0 – 2.0 mg./L) compared with 6.0 – 22.0 mg./L during wet season, measured concentration of turbidity is coincident. This is proably caused by runoff during wet season.

	
Sampling of water from different depth at sampling station	Gathering of sampled water from each grab into plastic jar
	
Pouring of sampled water to containers and fixation prior store in cool container	In situ measurement of water quality at sampling station

PHOTO 5.2.8-1 : **SURFACE WATER SAMPLING AT EACH STATION**

TABLE 5.2.8-1

SUMMARY OF PRESERVATION, ANALYSIS METHODS, DETECTION LIMIT AND CONTAINER OF WATER SAMPLE FOR SURFACE WATER QUALITY STUDY

Category	Parameter	Unit	Preservation Method [1/]	Analysis Method [1/]	Max. Period of Allowable Storage	Container
1.Physical	Depth	m.	Measure at Site		-	-
	Conductivity	µmho/cm.	Measure at Site	*In situ*/ Conductivity Meter	-	-
	Temperature	°c	Measure at Site	*In situ*/ Thermometer	-	-
	Transparency	m.	Measure at Site	Secchi disc		-
2.Chemical	pH	- -	Measure at Site	*In situ*/pH meter	-	-
	Salinity	ppt	Measure at Site	*In situ*/ Salino meter	-	-
	Dissolved oxygen	mg/L.	Measure at Site	*In situ*/ DO Meter	-	-
	BOD_5	mg/L.	Refrigerate in Cooling Container ≤ 6˚C	5120-B	**48 hr.**	PPE Bottle
	Turbidity	NTU	Refrigerate in Cooling Container ≤ 6˚C	2130-B	**48 hr.**	PPE Bottle
	Suspended Solids	mg/L.	Refrigerate in Cooling Container ≤ 6˚C	2540-D	7 days	PPE Bottle
	Total Dissolved Solids	mg/L.	Refrigerate in Cooling Container ≤ 6˚C	2540-C	7 days	PPE Bottle
	Total Solids	mg/L.	Refrigerate in Cooling Container ≤ 6˚C		7 days	PPE Bottle
	Oil and grease	mg/L.	Add H_2SO_4 to pH<2 and refrigerate to ≤ 6˚C	5520-D	28 days	Glass Bottle
	Total Hardness	mg $CaCO_3$/L.	Add H_2SO_4 to pH<2 and refrigerate	2340-C	6 months	PPE Bottle
	Carbonate Alkalinity	mg $CaCO_3$/L.	Refrigerate in Cooling Container ≤ 6˚C	2320-B	14 days	PPE Bottle
	Bicarbonate alkalinity	mg $CaCO_3$/L.	Refrigerate in Cooling Container ≤ 6˚C	2320-B	14 days	PPE Bottle
	Ammonia-Nitrogen	mg/L.	Add H_2SO_4 to pH<2 and refrigerate ≤ 6˚C	4500-NH_3-C	28 days	HDPE Bottle
	Nitrate-Nitrogen	mg/L.	Refrigerate in Cooling Container ≤ 6˚C	4500-NO_3^--B	14 days	HDPE Bottle
	Total Nitrogen	mg/L.		4500-Norg-B, 4500-NO_2-B 4500-NO_3^--B and calculate	28 days	HDPE Bottle
	Total Phosphorus	mg/L.	Add H_2SO_4 to pH<2 and refrigerate	4500-P-E	28 days	HDPE Bottle

TABLE 5.2.8-1

SUMMARY OF PRESERVATION, ANALYSIS METHODS, DETECTION LIMIT AND CONTAINER OF WATER SAMPLE FOR SURFACE WATER QUALITY STUDY (CONT'D)

Category	Parameter	Unit	Preservation Method [1/]	Analysis Method [1/]	Max. Period of Allowable Storage	Container
2.Chemical (Cont'd)	Potassium	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Aluminium	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Magnesium	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Sodium	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Total Chromium	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Zinc	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Cadmium	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Copper	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Manganese	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Nickel	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Total Iron	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Arsenic	mg/L.	Add HNO_3 to pH<2 and refrigerate	3114-C	28 days	HDPE Bottle
	Lead	mg/L.	Add HNO_3 to pH<2 and refrigerate	3120-B	28 days	HDPE Bottle
	Mercury	mg/L.	Add HNO_3 to pH<2 and refrigerate	3112-B	28 days	HDPE Bottle
3.Biological	Total Coliform Bacteria	MPN/100 ml.	Refrigerate in Cooling Container ≤ 6˚C	9221-B		Glass Bottle, then completely wrap by Aluminium Foil

Remark : 1/ American Public Health Association (APHA), American Water Works Association (AWWA) and Water Pollution Control Federation (WEF). 2012. Standard Methods for the Examination of Water and Wastewater. 22nd Edition. Washington, DC: American Public Health Association.

PHOTO 5.2.8-2 : RESULT OF WATER QUALITY ANALYSIS BY ISOTECH (St.SW1-SW7 and GW1 & GW2)

Results of the April Survey

Results of the April survey are presented in ***Table 5.2.8-2*** and ***Appendix 5B*** and compared with the surface water quality standard for the Project recommended in ***Table 3.4-1*** and ***3.4-2 in Chapter 3***.

Myitnge River-Stations 1 to 6

Water in Myitnge River at Stations 1 to 6 was very clean as inferred from its high levels of DO, low levels of BOD_5, high transparency, low SS, low turbidity and low coliform counts. The water was however relatively high in TDS, total hardness, carbonate alkalinity, and Magnesium. These would be the products of leaching from the limestone geological structure of the river.

Irrawaddy River-Station 7

Water in Irrawaddy River was also clean although its Coliform was higher than the Myitnge River water. The water was slightly more turbid than that of Myitnge River. The river could be considered slightly polluted and the sources of pollution may be Sagaing City on the right banks of this river, about 1 km from the sampling station.

All the water samples had low concentrations of heavy metals compared to the standards.

Results of the July Survey

Results of the July survey are presented in ***Table 5.2.8-3*** and ***Appendix 5B*** and compared with the surface water quality standard for the Project recommended in ***Table 3.4-1*** and ***3.4-2 in Chapter 3***.

- The pH level of water sample from Myitnge River is slightly alkaline (7.9) while Irrawaddy River is near neutral (7.1). The pH value of dry season and rainy season show no significantly different. The pH value at all sampling station were within the standard (5.0-9.0)
- Water samples from Myitnge River had relatively high electrical conductivity (EC) compared with sampled water from Irrawaddy River in both dry and rainy season.
- The dissolved oxygen from all station in Myitnge River and Irrawaddy River generally above level required for protection of aquatic fauna and fisheries (6.0 mg/L; Thailand surface water quality standard, 1994) except SW1 which located near residential area of Yeywa Dam's staff.
- Turbidity of water sample from Myitnge River (5.0 - 16.0 NTU) is relatively lower than from Irrawaddy River (372 NTU) as same as suspended solid which its level of 5.0 - 36.0 mg/l from water of Myitnge River and 413.0 from water of Irrawaddy River.
- Total coliform count mainly ranged from 240 - 490 MPN/100 ml. but SW1 and SW7 which is located near communities showed high concentration of 24,000 and 13,000 MPN/100 ml. respectively. It is noted that total coliform in SW1 is exceed the standard.
- Oil and grease from all station are analyzed as low level (0.40 - 1.40 mg./l). Oil and grease are not observed during water sampling.
- Concentration of all analyzed heavy metal from all station are lower than designated in the standard.

TABLE 5.2.8-2

RESULTS OF SURFACE WATER QUALITY SURVEY ON 25-26 APRIL 2015

Characteristic	Parameter	Unit	W1	W2	W3	W4	W5	W6	W7	Standard*	
										A	C
Sampling Date			26/4/2015	25/4/2015	25/4/2015	25/4/2015	25/4/2015	25/4/2015	26/4/2015	-	-
1. Physical	Temperature	C	24.4	23.0	23.8	23.7	24.1	24.9	28.6	-	-
	Transparency	m.	3.9	4.9	4.0	4.8	1.9	4.5	0.8	-	-
	Conductivity	µs/cm	314.4	324.3	335.4	337.6	340.2	337.0	109.3	-	-
	Depth	m.	3.9	4.9	4.0	4.8	1.9	6.9	2.3	-	-
2. Chemical	pH	-	7.7	7.8	7.9	8.0	7.9	7.9	7.3	-	6.5-9
	DO	mg/l	6.1	7.7	7.8	8.0	7.9	7.8	8.0	7/3	-
	Salinity	ppt	0.2	0.2	0.2	0.2	0.2	0.2	0.1	-	-
	Turbidity	NTU	1.0	1.2	1.1	1.0	1.2	1.3	39.0	-	-
	BOD_5	mg/l	1.3	1.3	1.4	1.4	1.4	2.0	1.0	-	-
	TDS	mg/l	213.0	220.0	207.2	221.3	207.4	195.0	46.0	-	-
	SS	mg/l	<5.0	<5.0	5.0	<5.0	<5.0	5.3	37.0	-	-
	Oil & Grease	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-	-
	Total Hardness	mg $CaCO_3$/l	188.6	188.6	194.3	194.3	188.6	186.7	34.3	-	-
	Carbonate Alkalinity	mg $CaCO_3$/l	16.0	24.0	28.0	20.0	28.0	20.0	<0.1	-	-
	Bicarbonate Alkalinity	mg $CaCO_3$/l	180.0	176.0	172.0	178.0	174.0	176.0	228.0	-	-
	Ammonia-Nitrogen	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
	Total Nitrogen	mg/l	6.0	2.0	2.0	7.0	9.0	4.0	3.0	-	-
	Nitrate-Nitrogen	mg/l	0.07	0.09	0.13	0.14	0.14	0.43	0.58	-	-
	Total Phosphorus	mg/l	0.03	0.02	0.02	0.02	0.02	0.02	0.05	-	-
	Potassium	mg/l	0.78	1.04	0.88	0.96	0.10	1.03	1.13	-	-
	Aluminium	mg/l	0.134	0.817	0.124	0.210	0.099	0.179	1.250	-	-
	Magnesium	mg/l	14.4	19.1	18.6	19.9	19.0	19.6	3.3	-	-
	Sodium	mg/l	0.85	1.32	1.09	1.15	1.10	1.22	3.57	-	-
	Total Chromium	mg/l	<0.001	0.008	<0.001	<0.001	<0.001	<0.001	0.002	-	-
	Zinc	mg/l	0.008	0.007	0.016	0.031	0.010	0.041	0.022	0.12	0.12
	Cadmium	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.002	0.00025
	Copper	mg/l	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	0.004	-	-
	Manganese	mg/l	0.008	0.015	0.018	0.037	0.010	0.023	0.070	-	-
	Nickel	mg/l	<0.004	0.005	<0.004	<0.004	<0.004	<0.004	<0.004	0.47	0.052
	Total Iron	mg/l	<0.03	0.07	0.08	0.22	0.03	0.09	1.60	-	1
	Arsenic	mg/l	0.0014	0.0027	0.0021	0.0025	0.0020	0.0023	0.0012	0.34	0.15
	Lead	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.065	0.0025
	Mercury	mg/l	0.0012	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0014	0.00077
3.Biological	Total Coliform Bacteria	MPN/100	23	43	23	<1.8	<1.8	15	240	-	-

Remark : Station W1 : Myitnge River (UTM 273093E 2398575N) W2 : Myitnge River (UTM 225895E 2402343N) W3 : Myitnge River (UTM 225110E 2403599N)
W4 : Myitnge River (UTM 224095E 2404823N) W5 : Myitnge River (UTM 222408E 1865065N) W6 : Myitnge River (UTM 222216E 1866491N)
W7 : Irrawaddy River (UTM 808809E 242191N)
* National Recommended Water Quality Criteria (Freshwater), U.S. EPA 2009
1 : Due to the DO measurement was 1 day, the minimum DO concentration $\geq$3 ms/L
A : Acute Effect C : Chronic Effect

TABLE 5.2.8-3

RESULTS OF SURFACE WATER QUALITY SURVEY DURING 21-22 JULY 2015

Characteristic	Parameter	Unit	W1	W2	W3	W4	W5	W6	W7	Standard*	
										A	C
Sampling Date			22/7/2015	21/7/2015	21/7/2015	21/7/2015	21/7/2015	21/7/2015	22/7/2015	-	-
1. Physical	Temperature	C	29.6	29.7	29.8	25.1	26.1	26.2	25.9		
	Transparency	m.	0.8	1.1	0.9	1.3	1.1	0.8	0.1		
	Conductivity	µs/cm	391.1	389.8	389.7	387.9	368.9	398.7	61.2		
	Depth	m.	1.9	4.9	4.0	4.8	1.9	6.9	2.9		
2. Chemical	pH	-	29.6	29.7	29.8	25.1	26.1	26.2	25.9	-	6.5-9
	DO	mg/l	0.8	1.1	0.9	1.3	1.1	0.8	0.1	7/3	-
	Salinity	ppt	391.1	389.8	389.7	387.9	368.9	398.7	61.2	-	-
	Turbidity	NTU	1.9	4.9	4.0	4.8	1.9	6.9	2.9	-	-
	BOD_5	mg/l	7.9	7.9	7.9	7.9	7.9	7.9	7.1	-	-
	TDS	mg/l	5.8	7.5	7.4	7.3	7.6	7.8	7.7	-	-
	SS	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	Oil & Grease	mg/l	16.0	5.0	10.0	5.0	13.0	12.0	372.0	-	-
	Total Hardness	mg $CaCO_3$/l	192.0	196.0	198.0	192.0	196	204	32	-	-
	Carbonate Alkalinity	mg $CaCO_3$/l	0	0	0	0	28.0	20.0	0	-	-
	Bicarbonate Alkalinity	mg $CaCO_3$/l	194.0	198.0	198.0	196.0	174.0	176.0	30.0	-	-
	Ammonia-Nitrogen	mg/l	0	0	0	0	0	0	0	-	-
	Total Nitrogen	mg/l	5.0	4.0	7.0	3.0	5.0	11.0	5.0	-	-
	Nitrate-Nitrogen	mg/l	0	0	0	0	0	0	0	-	-
	Total Phosphorus	mg/l	0	0	0	0	0	0	0	-	-
	Potassium	mg/l	1.58	1.64	1.71	1.52	1.58	1.62	2.18	-	-
	Aluminium	mg/l	0.122	0.095	0.115	0.086	0.224	0.244	9.20	-	-
	Magnesium	mg/l	18.00	20.80	20.10	19.90	20.70	20.30	4.26	-	-
	Sodium	mg/l	2.93	2.33	2.39	2.36	2.42	2.63	2.30	-	-
	Total Chromium	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.007	-	-
	Zinc	mg/l	0.059	0.037	0.036	0.030	0.029	0.030	0.064	0.12	0.12
	Cadmium	mg/l	0.002	0.001	0.003	0.002	0.003	0.003	0.008	0.002	0.00025
	Copper	mg/l	0.022	0.026	0.031	0.033	0.036	0.038	0.058	-	-
	Manganese	mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.019	-	-
	Nickel	mg/l	0.012	0.013	0.014	0.038	0.03	0.032	0.048	0.47	0.052
	Total Iron	mg/l	0.016	0.073	0.011	0.013	0.017	0.019	1.145	-	1
	Arsenic	mg/l	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.34	0.15
	Lead	mg/l	0.018	<0.015	0.023	<0.015	0.024	0.016	0.022	0.065	0.0025
	Mercury	mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0014	0.00077
3.Biological	Total Coliform Bacteria	MPN/100	24,000	330	240	330	490	240	13,000	-	-

Remark : Station W1 : Myitnge River (UTM 273093E 2398575N) W2 : Myitnge River (UTM 225895E 2402343N) W3 : Myitnge River (UTM 225110E 2403599N)
W4 : Myitnge River (UTM 224095E 2404823N) W5 : Myitnge River (UTM 222408E 1865065N) W6 : Myitnge River (UTM 222216E 1866491N)
W7 : Irrawaddy River (UTM 808809E 242191N)
* National Recommended Water Quality Criteria (Freshwater), U.S. EPA 2009
1 : Due to the DO measurement was 1 day, the minimum DO concentration ≥3 ms/L
A : Acute Effect C : Chronic Effect

5.2.8.2 Groundwater Quality

Collection of ground water samples was also carried out in two occasions, the first collection on 29 April 2015 and the second collection on 22 July 2015. Several bored wells exist in communities near the project site. Two wells were selected for the sample collection, one in Hnget Gyi Thaik village and another in Thayet Pin village. At each well, a single water sample was collected. The collected samples were tested for pH and conductivity on site and their odors were also observed. The samples were preserved and sent to the Consultant's laboratory in Bangkok for analyses of other quality parameters. The analyses followed *Standard Method for the Examination of Water and Wastewater. APHA, AWWA and WEF 21st Edition, 2012.*

Results of groundwater quality sampling are presented in ***Table 5.2.8-4*** to ***Table 5.2.8-5*** by compared with the ground water standards of WHO and Thailand and detailed in ***Appendix 5C***.

For dry season, overall water qualities of the groundwater samples meet the WHO's groundwater standards except conductivity which is higher than the WHO standard. It is noted that the concentrations of TDS and total hardness are quite high but still within suitable allowance value. The high concentrations of TDS and total hardness would be due to the limestone geological structure in the project area.

For wet season, overall quality of the groundwater complies with the WHO and Thailand groundwater standard but conductivity is higher than that designated in WHO standard. It is noted that concentration of dissolved solid and total hardness is quite high but still under suitable allowance value.

TABLE 5.2.8-4

RESULTS OF GROUND WATER QUALITY ANALYSIS, 29 APRIL 2015

Characteristic	Parameter	Unit	GW1	GW2	WHO Drinking Water Standard	Standard[1]	
						Suitable allowable	Maximum allowable
1. Physical	Odour	-	None	None	-	-	-
	Depth	m	6.5	5.9	-	-	-
	Conductivity	µs/cm	615.0*	764.0*	250	-	-
2. Chemical	pH at 25°C	-	7.90	7.50	-	7.0 – 8.5	6.5 – 9.2
	Salinity	ppt	0.3	0.3	-	-	-
	Turbidity	NTU	0.8	1.2	-	≤ 5	-
	TDS	mg/l	331.2	437.4	-	≤ 600	1,200
	Total Hardness	mg/l	232.4	281.9	-	≤ 300	500
	Sulfate	mg/l	<5.0	12.2	-	≤ 200	250
	Total Iron	mg/l	<0.03	0.04	-	<0.5	1.0
	Lead	mg/l	<0.005	<0.005	0.01	None	0.05
	Manganese	mg/l	0.007	0.011	0.4	0.3	0.5
	Cadmium	mg/l	<0.003	<0.003	0.003	None	0.01
3. Biological	*E. coli*	MPN/100 ml	NONE	NONE	-	None	-
	Total Coliform Bacteria	MPN/100 ml	<1.1	<1.1	-	<2.2	-

Remark : Station GW1 : Hnget Gyi Thaik School, Mandalay, Myanmar (UTM 222668E 2406992N)
GW2 :Thayet Pin village, Mandalay, Myanmar (UTM 224861E 2403670N)
[1] Thailand Groundwater Quality Standard for Drinking Proposes, Suitable Allowance and Maximum Allowance Concentrations, Notification of the Ministry of Industry No. 12 B.E. 2542 (1999) Issued under in the Groundwater Act B.E. 2520 (1977)
* = Not complied with the WHO Drinking Water Standard

TABLE 5.2.8-5

RESULTS OF GROUND WATER QUALITY ANALYSIS, 21 JULY 2015

Characteristic	Parameter	Unit	GW1	GW2	WHO Drinking Water Standard	Standard[1]	
						Suitable allowable	Maximum allowable
1. Physical	Odour	-	None	None	-	-	-
	Depth	m	6.5	5.9	-	-	-
	Conductivity	µs/cm	866.8*	874.3*	250	-	-
2. Chemical	pH at 25°C	-	7.80	7.80	-	7.0 – 8.5	6.5 – 9.2
	Salinity	ppt	0.3	0.3	-	-	-
	Turbidity	NTU	3	3	-	≤ 5	-
	TDS	mg/l	316	342	1,500	-	-
	Total Hardness	mg/l	220	252	-	-	-
	Sulfate	mg/l	29	32	-	≤ 300	500
	Total Iron	mg/l	0.024	0.029	0.01	<0.5	1.0
	Lead	mg/l	0.02	0.025	0.4	None	0.05
	Manganese	mg/l	<0.0015	<0.0015	0.003	0.3	0.5
	Cadmium	mg/l	0.003	0.003	-	None	0.01
3. Biological	*E. coli*	MPN/100 ml	NONE	NONE	-	None	-
	Total Coliform Bacteria	MPN/100 ml	<1.1	<1.1	-	<2.2	-

Remark : Station GW1 : Hnget Gyi Thaik School, Mandalay, Myanmar (UTM 222668E 2406992N)
GW2 :Thayet Pin village, Mandalay, Myanmar (UTM 224861E 2403670N)

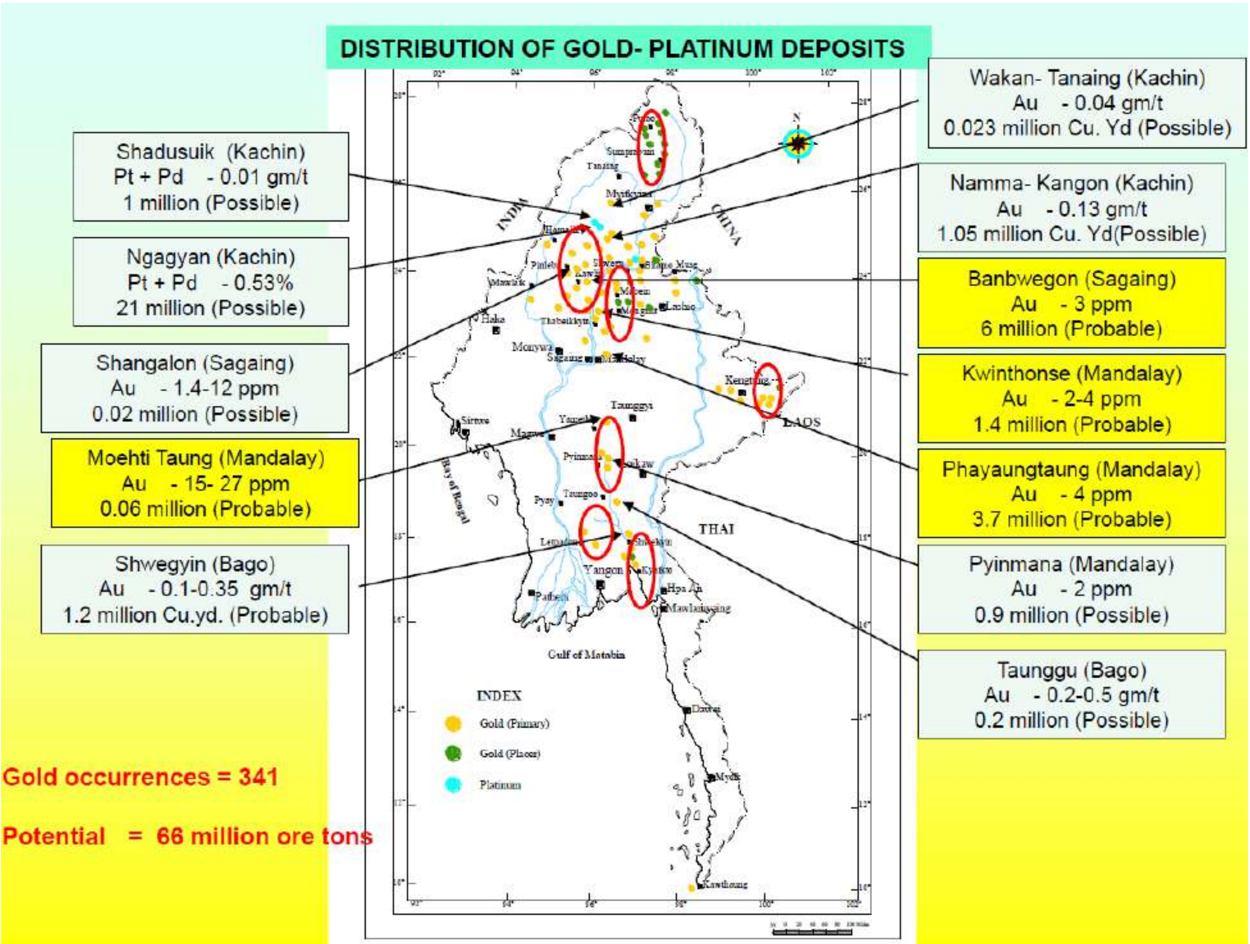
[1] Thailand Groundwater Quality Standard for Drinking Proposes, Suitable Allowance and Maximum Allowance Concentrations, Notification of the Ministry of Industry No. 12 B.E. 2542 (1999) Issued under in the Groundwater Act B.E. 2520 (1977)

* = Not complied with the WHO Drinking Water Standard

5.2.9 Mineral Resources

Myanmar is endowed with several types of mineral resources discovered and commercially mined in various locations. In Mandalay Region, gold and platinum are known to exist. At present, large scale gold mines in Mandalay Region are Modi-Momei work sites (A), (B), (C), (D), (E) in Yamethin Township (five mines) and Phayoungtaung gold mine in Patheingyi Township. (Source: Current Mining Activitiesin Myanmar, Presented by U Kyaw Thet, Director, Department of Mines, downloaded on 22 July 2015 from http://www.charltonsnaturalresources.com/images/stories/Documents/China_Myanmar/ current_mining_activities_myanmar.pdf). ***Figure 5.2.9-1*** is a map showing gold and platinum deposits in the country. These known gold and platinum deposits are quite far from the project site, the nearest deposit in Mandalay district is about 30 km from the project site.

The project area, particularly the main construction site, has no known valuable mineral resources apart from limestone and rock for construction materials. As the Project will not create a large water reservoir, loss of mineral resources due to inundation of a large land area is not an issue in this EIA study.



Source: Data Base Building in Ministry of Mines, Myanmar, by Saw Lwin, Department of Geological Survey and Mineral Exploration, Myanmar. Downloaded on 22 July 2015 from http://www.ccop.or.th/eppm/projects/36/docs/Myanmar CCOPmetadata_presentation%20(13-03-2012).pdf

FIGURE 5.2.9-1 : DISTRIBUTION OF GOLD-PLATINUM DEPOSITS

5.2.10 Noise and Vibration

The project construction will invariably create noise and vibration which could disturb nearby sensitive receptors. As the project area is sparsely populated and still largely undeveloped, existing levels of background noise and vibration are expected to be below the maximum permissible limits prescribed in the national noise standard and applicable vibration standard recommended in ***Table 3.4-1***. Nevertheless, it would be useful to establish the baseline data on background noise and vibration levels in the Project site.

(1) Noise

The Consultant conducted noise measurements in April and July 2015 at Stations 1 and 2 already described in **Section 5.2.1** (see ***Figure 5.2.1-1***). Information on the two stations and noise sources is summarized in ***Table 5.2.10-1***.

According to Environmental, Health and Safety (EHS) Guidelines GENERAL EHS GUIDELINES: ENVIRONMENTAL NOISE MANAGEMENT, Typical noise monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more requently, as appropriate. Therefore, 72 hours or 3 days consecutive monitoring is appropriate for noise monitoring as mentioned in IFC EHS Guideline, 2007.

For the measurements in April, the background noise levels at each station were measured and recorded using a sound level meter on a continuous basis over a 72 hour period from 22 to 25 April 2015 at Station 1: Hnget Gyi Thaik Primary School, and 26 to 29 April 2015 at Station N2: Thayet Pin Primary School. For the noise measurements in July, the measurements at Station 1 were conducted during 19-22 July 2015, and Station 2 during 15-18 July 2015.

TABLE 5.2.10-1

INFORMATION OF NOISE LEVEL MEASURING STATION (DRY SEASON, APRIL 2015)

Particulars	Station 1: Hnget Gyi Thaik Primary School	Station 2: Thayet Pin Primary School
Reference Coordinates	UTM (WGS84) 47Q 0181149 E, 1867290 N	UTM (WGS84) 46Q 0818370 E, 1865925 N
District	Pyin Oo Lwin Township, Mandalay Region	Kyaukse Township, Mandalay Region
Nearest village	Hnget Gyi Thaik	Thayet Pin
Nearest noise sources	Village activities and road transportation	Village activities

Results of Noise Measurements in April 2015

Results of the noise measurements in April at the two stations are summarized in ***Table 5.2.10-2*** and detailed results are provided in ***Appendix 5D***. The IFC noise standards are also compared with the measured background noise levels. Major finding are as follows:

- The maximum background noise level expressed in LAeq-1 hr. exceeded the limit set by Myanmar National Environmental Quality (Emission) Guidelines and the IFC Standard during both daytime and nighttime.

- The average background noise levels expressed in L_{90} were significantly below the maximum limit set by IFC Standard.

TABLE 5.2.10-2

NOISE LEVEL MEASUREMENT AT 2 SAMPLING STATIONS DURING APRIL 22-25 AND 26-26, 2015 (DRY SEASON)

Sampling Location	Sampling Date	Noise Level (dB(A))			
		LAeq 1 hr (Daytime)	LAeq 1 hr (Nighttime)	LA_{max}	L_{90}
N1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	22-23 April 2015	53.3-68.7	54.6-59.4	91.4	56.6
	23-24 April 2015	58.0-62.5	55.8-62.2	84.9	60.1
	24-25 April 2015	54.1-62.5	56.0-62.3	91.4	59.2
Min-Max		**53.3-68.7**	**54.6-62.3**	**53.3-68.7**	**84.9-91.4**
N2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	26-27 April 2015	41.3-56.3	34.5-51.2	88.4	39.4
	27-28 April 2015	48.1-56.9	37.4-66.5	84.1	40.9
	28-29 April 2015	36.0-50.2	40.6-55.4	84.6	40.3
Min-Max		**36.0-56.9**	**34.5-66.5**	**34.8-66.5**	88.4
National Environmental Quality (Emission) Guidelines, Final Draft (2015) 1/		**55.0***	**45.0****	**-**	**-**
IFC Standard, 2007* **		**55.0***	**45.0****	-	-

Remark : * For residential, institutional and educational area during daytime (7am-10 pm)
**For residential, institutional and educational area during nighttime (10 pm-7 am)
1/Myanmar National Environmental Quality (Emission) Guidelines, 2015
2/Guidelines for Community Noise, World Health Organization (WHO), 1999
Source : Field survey by TEAM Consulting Engineering and Management Co., Ltd., April 22-29, 2015.

Results of Noise Measurements in July 2015

Results of the noise measurements in July 2015 at the two stations are summarized in ***Table 5.2.10-3*** and detailed results are provided in ***Appendix 5D***. The IFC noise standards are also compared with the measured background noise levels. Major finding are as follows:

- The maximum background noise level expressed in LAeq- 1 hr. exceeded the limit set by Myanmar National Environmental Quality (Emission) Guidelines and the IFC Standard during both daytime and nighttime.

- The average background noise levels expressed in L_{90} were significantly below the maximum limit set by IFC Standard.

TABLE 5.2.10-3

NOISE LEVEL MEASUREMENT AT 2 SAMPLING STATIONS DURING 15-22 JULY 2015 (WET SEASON)

Sampling Location	Sampling Date	Noise Level (dB(A))			
		LAeq 1 hr (Daytime)	LAeq 1 hr (Nighttime)	LA_{max}	L_{90}
N1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	19-20 July 2015	42.2-54.0	39.4-54.4	86.9	41.7
	20-21 July 2015	42.6-59.7	39.9-51.8	87.8	42.8
	21-22 July 2015	46.0-58.6	40.9-51.4	89.0	42.2
Min-Max		42.2-59.7	39.4-54.4	**86.9-89.0**	**41.7-42.8**
N2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	15-16 July 2015	40.1-67.0	37.4-50.5	89.6	44.5
	16-17 July 2015	40.3-65.7	36.3-49.1	96.7	43.8
	17-18 July 2015	39.7-67.2	36.2-51.2	96.4	41.2
Min-Max		39.7-67.2	36.2-51.2	**89.6-96.7**	**41.2-44.5**
National Environmental Quality (Emission) Guidelines, Final Draft (2015) 1/		**55.0***	**45.0****	**-**	**-**
IFC Standard, 2007 2/		**55.0***	**45.0****	**-**	**-**

Remark : * For residential, institutional and educational area during daytime (7am-10 pm)
**For residential, institutional and educational area during nighttime (10 pm-7 am)
1/Myanmar National Environmental Quality (Emission) Guidelines, 2015
2/Guidelines for Community Noise, World Health Organization (WHO), 1999
Source : Field survey by TEAM Consulting Engineering and Management Co., Ltd., July 22-29, 2015

(1) Vibration

The project construction facilities would involve drilling, excavating, piling and rock blasting. These construction activities could generate vibration with negative consequences on sensitive receptors. As the project area is still rural, it is expected that the background level of vibration will be very low. However, it will be useful to establish for the record the baseline data on vibration in the project area.

Background vibration measurements were carried out at the two noise measurement stations concurrently with the noise measurements in April and July 2015. At each station, the ground vibration was recorded over a 72 hour period using a vibration meter in terms of peak particle velocity (PPV) in mm/s in 3 mutually perpendicular directions (transverse, vertical and longitudinal) and frequency (Hz).

Results of Vibration Measurements in April 2015

Results of the vibration measurement in April 2015 are given in ***Table 5.2.10-4*** and details are provided in ***Appendix 5E***. Major findings are:

- **Station 1-** the magnitudes of vibration or PPV measured over a 72-hour period varied over a narrow range between 0.50-0.75 mm/s (at 32-73 Hz frequency). The vibration was caused by moving vehicles on the nearby road.
- **Station 2-** the magnitudes of vibration or PPV measured over a 72-hour period varied over a narrow range between 0.25-0.48 mm/s (at 37-64 Hz frequency). The vibration was caused by moving vehicles on the nearby road as same as Station N1.
- The magnitudes of background vibration levels at both stations were still much below the perceptible level of 2.0 mm/s prescribed in German Vibration Guideline Values (Din4150-3, 1999) given in ***Table 5.2.10-5***.

TABLE 5.2.10-4

RESULTS OF THE VIBRATION MEASUREMENTS DURING 22-29 APRIL 2015

Station	Sampling date	Results			
		Time of Vibration	Peak particle velocity* (mm/s)	Frequency (Hz)	Sources of Vibration
N1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	22-23 April 2015	8:28:57 AM	0.64 (Tran)	32.0	vehicles
	23-24 April 2015	7:23:57 AM	0.75 (Tran)	58.0	vehicles
	24-25 April 2015	4:05:12 PM	0.50 (Tran)	73.0	vehicles
N2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	26-27 April 2015	6:07:25 AM	0.25 (Long)	57.0	vehicles
	27-28 April 2015	4:58:29 AM	0.48 (Tran)	37.0	vehicles
	28-29 April 2015	11:09:30 AM	0.43 (Tran)	64.0	vehicles

Remark: * Peak Particle Velocity; Vert = Vertical, Long = Longitudinal, Trans=Transverse.

Results of Vibration Measurements in July 2015

Results of the vibration measurement in July 2015 are given in ***Table 5.2.10-6*** and details are provided in ***Appendix 5E***. Major findings are:

- **Station 1-** the magnitudes of vibration or PPV measured over a 72-hour period varied over a narrow range between 0.48-0.68 mm/s (at 64-73 Hz frequency). The vibration was caused by moving vehicles on the nearby road.

- **Station 2-** the magnitudes of vibration or PPV measured over a 72-hour period varied over a narrow range between 0.43-0.71 mm/s (at 32-64 Hz frequency). The vibration was caused by moving vehicles on the nearby road as same as Station N1.
- The magnitudes of background vibration levels at both stations were still much below the perceptible level of 2.0 mm/s prescribed in German Vibration Guideline Values (Din4150-3, 1999) given in ***Table 5.2.10-5***.

TABLE 5.2.10-5

EFFECT OF VIBRATION ON PEOPLE AND BUILDINGS

PPV[a] (mm/s)	Human Reaction	Effect on Buildings[c]
0-0.15	Imperceptible	Unlikely to cause damage of any type
0.15-0.3[b]	Threshold of perception	Unlikely to cause damage of any type
2.0	Vibrations perceptible	Recommended upper level to which ruins and ancient monument should be subjected
2.5	Continuous exposure to vibrations begins to feel annoy[d]	Virtually no risk of "architectural" damage to normal buildings
5	Vibrations annoying people in buildings	Threshold for risk of "architectural" damage in houses with plastered walls and ceilings
10-15	Continuous vibrations, unpleasant and unacceptable	Would cause "architectural" and possibility minor structural damage

Remark: a Peak Particle Velocity in the vertical direction. For human reaction, the value applies at the point at which the person is situated. For buildings, the value refers to the ground motion (but without an allowance for the amplifying effect of structural components). It is assumed that the frequency of vibration is in the range of 5 to 20 Hz.

b This level appliers to a continuous sinusoidal vibration. However, truck induced vibration is of sorter duration (about 2 to 3 seconds) and thus higher levels appear to be applicable.

c This criteria for buildings recognize that the building damage will result from a fatigue failure over a long period of time (not from a one-time event).

d Vibration levels causing annoyance may be lower for occurrences during right time and for occurrences that are very frequent (1).

Source: Deutsches Institut für Normung, Berlin, Germany, DIN 4150-3, Structural Vibration Part 3: Effects of Vibration on Structures, 1999.

TABLE 5.2.10-6

RESULTS OF THE VIBRATION MEASUREMENTS DURING 15-22 JULY 2015 (WET SEASON)

Station	Sampling date	Results			
		Time of Vibration	Peak particle velocity* (mm/s)	Frequency (Hz)	Sources of Vibration
N1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	19-20 July 2015	9:17:45 AM	0.62 (Tran)	73.0	vehicles
	20-21 July 2015	12:34:40 AM	0.68 (Tran)	64.0	vehicles
	21-22 July 2015	3:10:59 PM	0.48 (Tran)	73.0	vehicles
N2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	15-16 July 2015	1:03:29 PM	0.48 (Vert)	64.0	vehicles
	16-17 July 2015	9:45:41 AM	0.71 (Tran)	32.0	vehicles
	17-18 July 2015	12:41:02 PM	0.43 (Tran)	57.0	vehicles

Remark: *Peak Particle Velocity; Vert = Vertical, Long = Longitudinal, Trans=Transverse.

5.2.11 Air Quality

Air quality surveys were conducted at the two stations in April and July 2015. The surveys in April were conducted from 22 to 25 April 2015 at Station 1 and from 26 to 29 April 2015 at Station 2. The surveys in July were conducted from 15 to 18 July 2015 at Station 1 and from 19 to 22 July 2015 at Station 2. The survey at each station was carried out on a continuous basis over a 72 hour period for 3 consecutive days.

For air quality, according to Environmental, Health and Safety Guidelines, GENERAL EHS GUIDELINES: ENVIRONMENTAL AIR EMISSIONS AND AMBIENT AIR QUALITY, the length or duration of ambient air quality monitoring has not fixed, it depend on emission discharged by the project over time. Overall project construction activiaties in each day not much vary. The activity might be a little bit different during weekend (SAT-SUN) and weekdays (MON-FRI). Therefore, the Consultant conducted monitoring with 3 consecutive days covering 1 weekend and 2 weekdays is and represented the emission discharged.

The survey measured the concentrations of Total Suspended Particles (TSP) and particles with sizes less than 10 microns (PM10) using one set of high volume air sampler[1] for each parameter. The sampling and analytical methods used were those recommended by US.EPA and are as follows:

Pollutant	Sampling/ Analytical Method	Sampling Period
TSP (Average 24 Hour)	High-Volume Air Sampler/Pre-Post weight different method	72-hours
PM-10 (Average 24 Hour)	High-Volume Air Sampler (PM-10) / Pre-Post weight different method	72-hours

Results of Air Quality Surveys in April 2015

Results of the air quality surveys in April 2015 are presented in ***Appendix 5F*** and are summarized and compared with the Myanmar National Environmental Quality (Emission) Guidelines and Ambient Air Quality Standards of IFC (World Bank Group) in ***Table 5.2.11-1***.

Major findings are as follows:

Station 1 (Hnget Gyi Thaik Primary School): The concentration of TSP (avg. 24 hr.) ranged from 20.53-43.72 µg/m^3 and PM-10 (avg. 24 hr.) from 19.24-42.39 µg/m^3. The values of TSP and PM-10 were much below the permissible maximum values prescribed in Myanmar National Environmental Quality (Emission) Guidelines and the Ambient Air Quality Standards of IFC (World Bank Group (2007)).

Station 2 (Thayet Pin Primary School): The concentration of TSP (avg. 24 hr.) ranged from 37.26-60.37 µg/m^3 and PM-10 (avg. 24 hr.) from 31.09-49.97 µg/m^3. The values of TSP and PM-10 were much below the permissible maximum values prescribed in Myanmar National Environmental Quality (Emission) Guidelines and the Ambient Air Quality Standards of IFC (World Bank Group (2007)).

[1] High-Volume Air Sampler (HV).A device for sampling large volumes of an atmosphere for collecting the contained particulate matter by filtration. Consists of a high-capacity blower, a filter to collect suspended particles, and a means for measuring the flow rate.

TABLE 5.2.11-1

RESULTS OF THE AIR QUALITY MEASUREMENTS (DRY SEASON, APRIL 2015)

Station	Sampling Date	Results of Measurement ($\mu g/m^3$)	
		TSP Average 24 Hour	PM-10 Average 24 Hour
Station A1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	22-23 April 2015	36.50	25.84
	23-24 April 2015	20.53	19.24
	24-25 April 2015	43.72	42.39
	Min-Max	**20.53-43.72**	**19.24-42.39**
Station A2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	26-27 April 2015	60.37	49.97
	27-28 April 2015	37.26	31.09
	28-29 April 2015	57.19	39.72
	Min-Max	**37.26-60.37**	**31.09-49.97**
National Environmental Quality (Emission) Guidelines, Final Draft (2015) 1/		**-**	**50**
Ambient Air Quality Standards of IFC, World Bank Group (2007)2/		**230**	**150**

Remark: 1/Myanmar National Environmental Quality (Emission) Guidelines, 2015
2/ WHO Ambient Air Quality Guidelines stated on Environmental, Health, and Safety Guidelines: Environmental Air Emissions and Ambient Air Quality of International Finance Corporation-IFC (April 30, 2007).

Source: Field survey by TEAM Consulting Engineering and Management Co., Ltd., April 22-29, 2015

Results of Air Quality Surveys in July 2015

Results of the air quality surveys in July 2015 are presented in ***Appendix 5F*** and are summarized and compared with the Myanmar National Environmental Quality (Emission) Guidelines and Ambient Air Quality Standards of IFC (World Bank Group) in ***Table 5.2.11-2***.

Major findings are as follows:

Station 1 (Hnget Gyi Thaik Primary School): The concentration of TSP (avg. 24 hr.) ranged from 38.66-57.05 $\mu g/m^3$ and PM-10 (avg. 24 hr.) from 9.30-15.58 $\mu g/m^3$. The values of TSP and PM-10 were much below the permissible maximum values prescribed in Myanmar National Environmental Quality (Emission) Guidelines and the Ambient Air Quality Standards of IFC (World Bank Group (2007)).

Station 2 (Thayet Pin Primary School): The concentration of TSP (avg. 24 hr.) ranged from 54.88-61.40 $\mu g/m^3$ and PM-10 (avg. 24 hr.) from 25.12-36.20 $\mu g/m^3$. The values of TSP and PM-10 were much below the permissible maximum values prescribed in Myanmar National Environmental Quality (Emission) Guidelines and the Ambient Air Quality Standards of IFC (World Bank Group (2007)).

Therefore, the ambient air in the project area both dry season and wet season were clean as would be expected due to lack of industrial activities and low traffic loads on the nearby roads

TABLE 5.2.11-2

RESULTS OF THE AIR QUALITY MEASUREMENTS (WET SEASON, JULY 2015)

Station	Sampling Date	Results of Measurement (μg/m³)	
		TSP Average 24 Hour	PM-10 Average 24 Hour
Station A1: Hnget Gyi Thaik Primary School, Hnget Gyi Thaik village, Pyinoolwin Township, Mandalay Region	19-20 July 2015	57.05	15.32
	20-21 July 2015	54.65	15.58
	21-22 July 2015	38.66	9.30
	Min-Max	**38.66-57.05**	**9.30-15.58**
Station A2: Thayet Pin Primary School, Thayet Pin village, Kyaukse Township, Mandalay Region	15-16 July 2015	61.40	36.20
	16-17 July 2015	54.88	28.26
	17-18 July 2015	55.04	25.12
	Min-Max	**54.88-61.40**	**25.12-36.20**
National Environmental Quality (Emission) Guidelines, Final Draft (2015) 1/		**-**	**50**
Ambient Air Quality Standards of IFC, World Bank Group (2007)2/		**230**	**150**

Remark: 1/ Myanmar National Environmental Quality (Emission) Guidelines, 2015
2/ WHO Ambient Air Quality Guidelines stated on Environmental, Health, and Safety Guidelines: Environmental Air Emissions and Ambient Air Quality of International Finance Corporation-IFC (April 30, 2007).
Source: Field survey by TEAM Consulting Engineering and Management Co., Ltd., July 15-22, 2015

5.3 BIOLOGICAL COMPONENTS

5.3.1 Terrestrial Ecology/Wildlife

The project area is largely a vacant land covered with shrubs and few trees of no commercial values. To establish baseline information on the terrestrial ecosystem in the project area, the Consultant conducted a terrestrial ecological survey during 22 and 25 April 2015. The survey covered three land areas: (i) the main impact study area confined to only the areas to be used in the construction area of various project facilities, (ii) potential inundated area, and (iii) potential quarry site.

Considering low vegetation densities and small survey areas, the Consultant did not use a sampling- based methods, normally used for a large survey area. The walk over survey with GPS mapping method was used in which the Consultant walked around the survey areas taking notes of flora and fauna species found and recording their number. ***Figure 5.3.1-1*** presented location of terrestrial ecology sampling plot within project study area. Information was also sought from villagers regarding wildlife present in the area.

Results of the Survey

Results of the surveys on wildlife and their ICUN status are summarized and also indicated in the ***Tables 5.3.1-1*** and ***5.3.1-2***. All the wildlife species found are common in other areas of Mandalay Region. No species were found to be in the IUCN list of endangered species. Wildlife in the project area and vicinity are shown in ***Photo 5.3.1-1***.

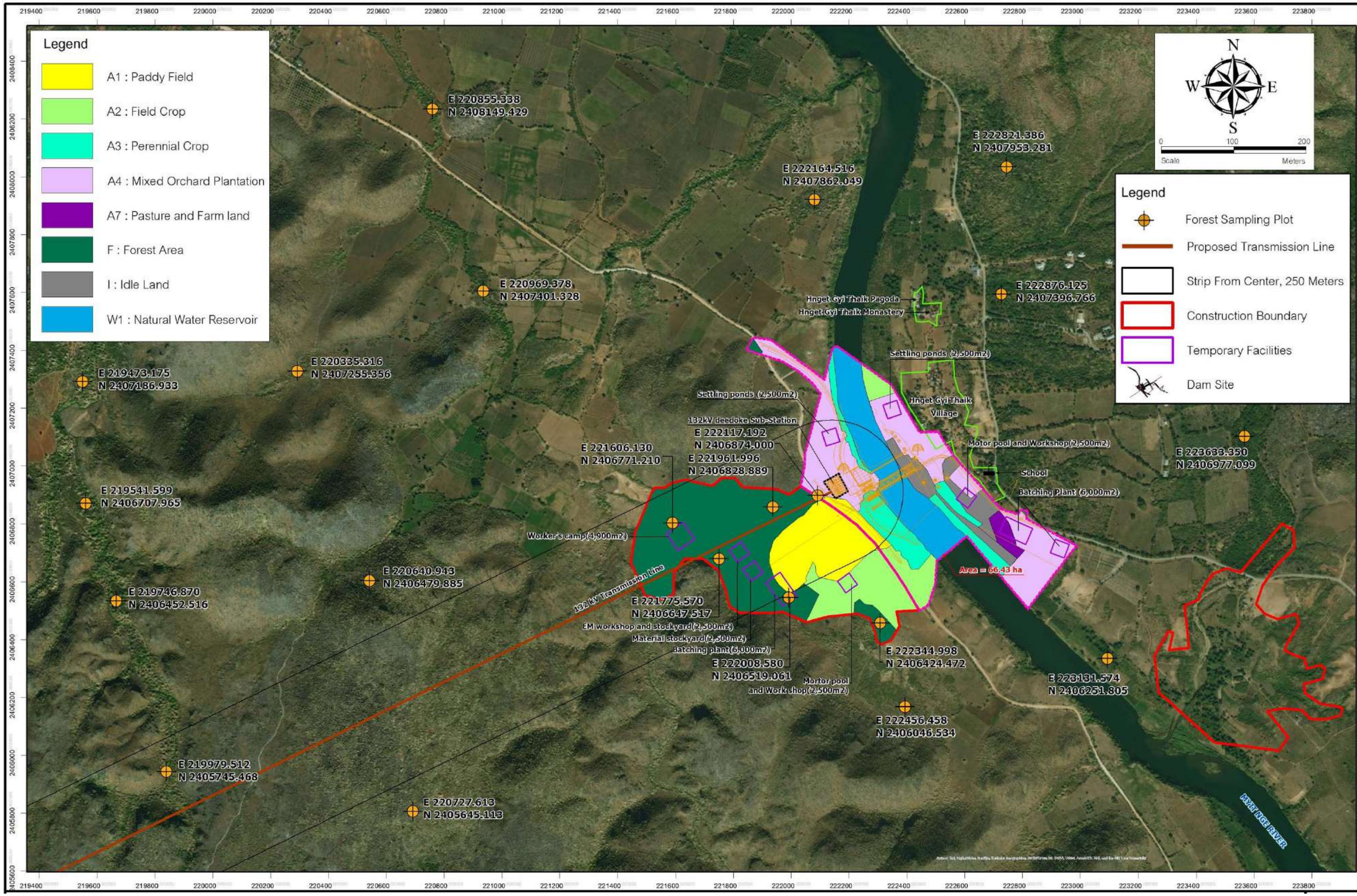


FIGURE 5.3.1-1 : FOREST SAMPLING PLOT WITHIN PROJECT STUDY AREA

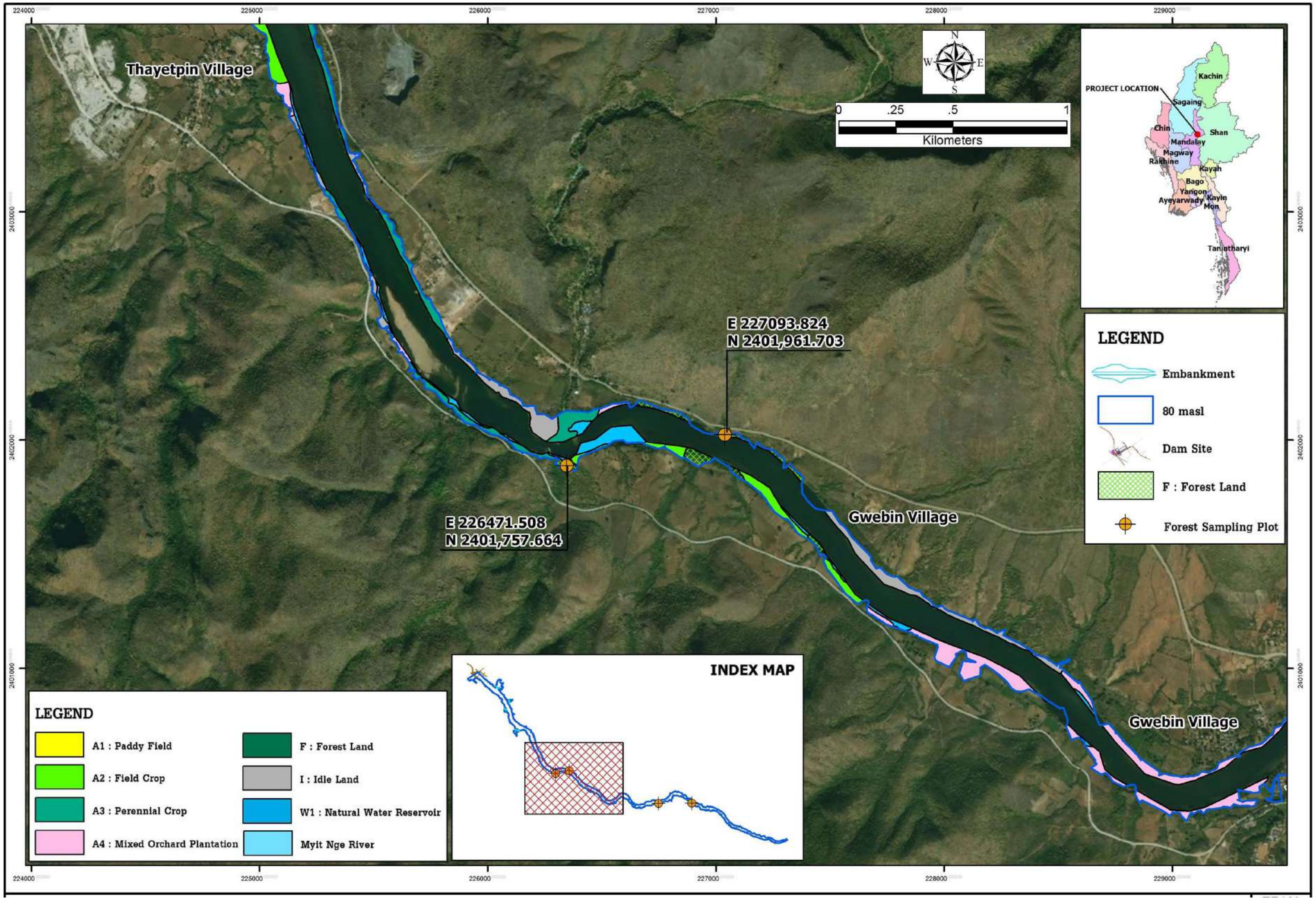


FIGURE 5.3.1-1 : FOREST SAMPLING PLOT WITHIN PROJECT STUDY AREA (CONT'D)

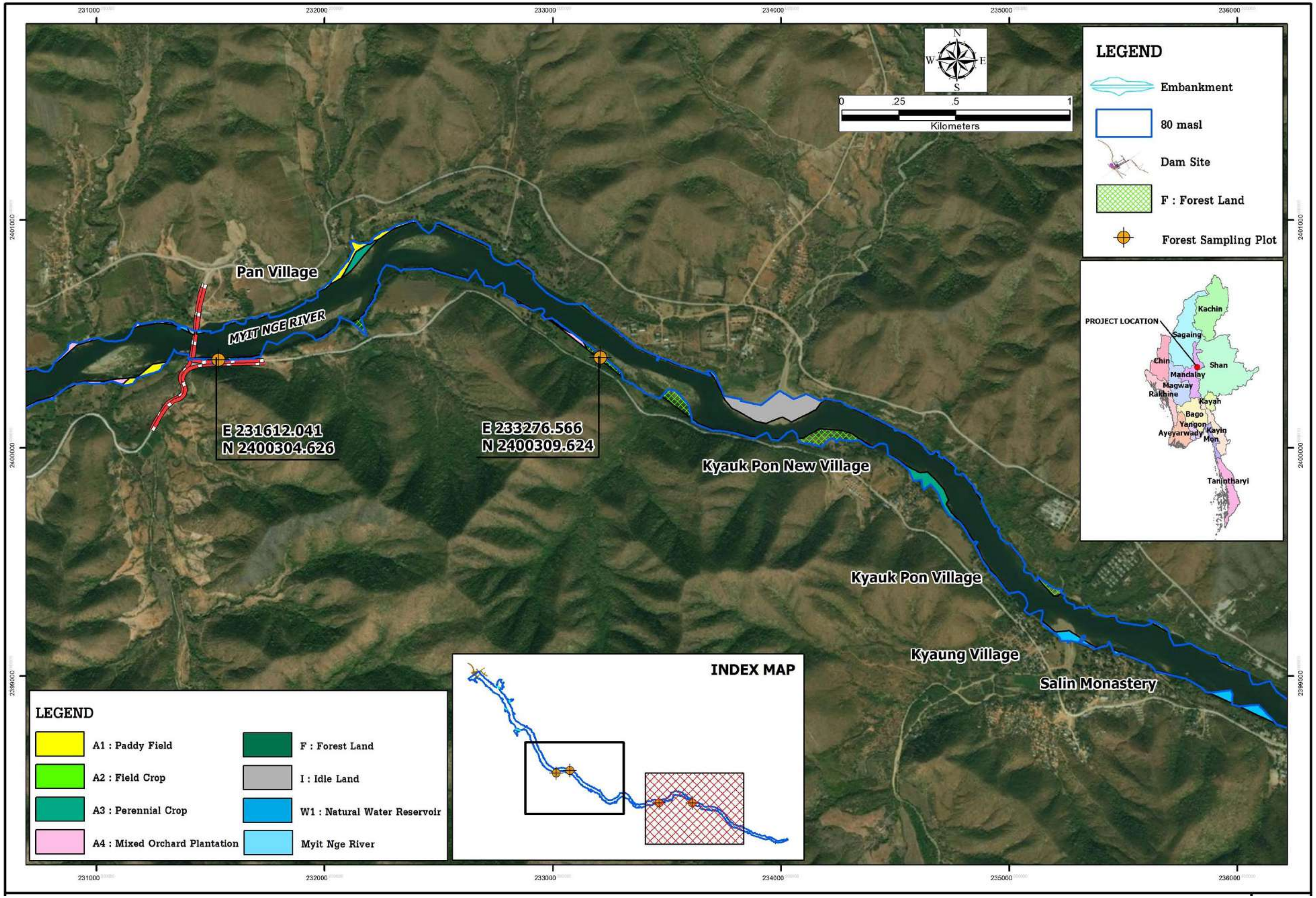


FIGURE 5.3.1-1 : FOREST SAMPLING PLOT WITHIN PROJECT STUDY AREA (CONT'D)

PHOTO 5.3.1-1 : WILDLIFE IN THE PROJECT AREA AND VICINITY

TABLE 5.3.1-1

LIST OF WILDLIFE SPECIES FOUND IN PROJECT AREA AT SECTION 54

No	Class, Order, Family, Scientific Name	Status				Proposed Project areas														
		IUCN				AcR			CnA			DmA			EmA			Sin		
		Cr	En	Vu	Nt	Vc	Cc	Un	Vc	Cc	Un	Vc	Cc	Un	Vc	Cc	Un	Vc	Cc	Un
	Aves-Birds																			
	Charadriiformes																			
	Charadriidae (Plovers)																			
1	Red-wattled Lapwing *(Vanellus indicus)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-
	Columbiformes																			
	Columbidae (Doves, Pigeons)																			
2	Spotted Dove *(Streptopelia chinensis)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-
	Coraciiformes																			
	Meropidae (Bee-eaters)																			
3	Green Bee-eater *(Merops orientalis)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-
	Meropidae (Bee-eaters)																			
4	Blue-tailed Bee-eater *(Merops philippinus)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
	Cuculidae (Cuckoos)																			
5	Greater Coucal *(Centropus sinensis)*	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-
	Falconiformes																			
	Accipitridae (Hawks, Kites, Eagles, Vultures)																			
6	Shikra *(Accipiter badius)*	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
	Passeriformes-Passeri																			
	Chloropseidae (Ioras, Leafbirds)																			
7	Iora Common *(Aegithina tiphia)*	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
	Dicruridae (Drongos)																			
8	Balck Drongo *(Dicrurus macrocercus)*	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
	Fulvettas																			
9	Puff-throated Babbler (Pellorneum ruficeps)	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
	Hirundinidae																			
10	Swallow *(Hirundo rustica)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-
	Laniidae (Shrikes)																			
11	Grey-backed Shrike *(Lanius tephronotus)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-
	Muscicapidae (Flycatchers)																			
12	Grey-chested Flycatcher*(Rhinomyias umbratillis)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
	Nectariniidae																			
13	Olive-backed Sunbird *(Cinnyris jugularis)*	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-
14	Van Hasselt's Sunbird*(Leptocoma brasiliana)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-

TABLE 5.3.1-1

LIST OF WILDLIFE SPECIES FOUND IN PROJECT AREA AT SECTION 54 (CONT'D)

No	Class, Order, Family, Scientific Name	Status				Proposed Project areas														
		IUCN				AcR			CnA			DmA			EmA			Sin		
		Cr	En	Vu	Nt	Vc	Cc	Un	Vc	Cc	Un	Vc	Cc	Un	Vc	Cc	Un	Vc	Cc	Un
	Passeridae (Spallows)																			
15	House Sparrow *(Passer domesticus)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	X
16	Eurasian Tree-Sparrow *(Passer montanus)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-
	Pycnonotidae (Bulbuls)																			
17	Soothy-headed Bulbul *(Pycnonotus aurigaster)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	X	-	-	X
18	Streak-eared Bulbul *(Pycnonotus blanfordi)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	X	-	-	X
	Sturnidae (Starlings, Mynas)																			
19	Myna *(Acridotheres fuscus)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	X
20	White-vented Myna *(Acridotheres grandis)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-
21	Common myna *(Acridotheres tristis)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
22	Grey-headed Starling *(Sturnia malabarica)*	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	X
	Sylviidae (Old World Warblers)																			
23	Dark-necked Tailorbird *(Orthotomus atrogularis)*	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
24	Common Tailorbird *(Orthotomus sutorius)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-
25	Grey-breasted Prinia *(Prinia hodgsonii)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-
	Turdidae (Thrushes)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	Oriental Magpie Robin *(Copsychus saularis)*	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-
	Psittaciformes																			
	Psittacidae																			
27	Red-breasted parakeet *(Psittacula alexandri)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-
	Strigiformes																			
	Strigidae (Owls)																			
28	Spotted Owlet *(Athene brama)*	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	X
	Mammlia-Mammals																			
	Rodentia																			
	Sciuridae (Squirrels)																			
29	Indochinese Ground Squirrel*(Menetes berdmorei)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
	Reptilia-Reptiles																			
	Squamata (Lacertilia)																			
	Gekkonidae (Geckos)																			
30	Tokay Gecko *(Gekko gecko)*	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-
31	Garnot's House Gecko *(Hemidactylus garnotii)*	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-

TABLE 5.3.1-2

SPECIES LIST OF WILDLIFE SPECIES IN THE VICINITY OF QUARRY SITE

No	Class, Order, Family, Scientific Name	Status			
		IUCN			
		Cr	En	Vu	Nt
	Amphibia-Amphibians				
	Anutra (Salientia)				
	Microhylidae (Microhylid Frogs, Froglets)				
1	Chubby frog*(Microhyla heymonsi)*	-	-	-	-
2	Ornated Chorus Frog*(Microhyla ornata)*	-	-	-	-
	Ranidae (Typical Frogs)				
3	Marsh Frog *(Fejervarya limnocharis)*	-	-	-	-
	Aves-Birds				
	Charadriiformes				
	Charadriidae (Plovers)				
4	Red-wattled Lapwing *(Vanellus indicus)*	-	-	-	-
	Columbiformes				
	Columbidae (Doves, Pigeons)				
5	Spotted Dove *(Streptopelia chinensis)*	-	-	-	-
	Coraciiformes				
	Meropidae (Bee-eaters)				
6	*Bay-headed Bee-eater (Merops leschenaultia)*	-	-	-	-
7	Green Bee-eater *(Merops orientalis)*	-	-	-	-
8	Blue-tailed Bee-eater *(Merops philippinus)*	-	-	-	-
	Cuculidae (Cuckoos)				
9	Greater Coucal *(Centropus sinensis)*	-	-	-	-
10	Chestnut-winged Cuckoo *(Clamator coromandus)*	-	-	-	-
	Falconiformes				
	Accipitridae (Hawks, Kites, Eagles, Vultures)				
11	Shikra *(Accipiter badius)*	-	-	-	-
12	Black-shouldered Kite*(Elanus caeruleus)*	-	-	-	-
	Galliformes				
	Pheasants (Phasianidae)				
13	Rain Quail*(Coturnix coromandelica)*	-	-	-	-
	Turnicidae				
14	Yellow-leggedButtonquail *(Turnix tank)i*	-	-	-	-
	Grulformes				
	Rallidae (Rails)				
15	White-breasted Waterhen *(Amaurornis phoenicurus)*	-	-	-	-

TABLE 5.3.1-2

SPECIES LIST OF WILDLIFE SPECIES IN THE VICINITY OF QUARRY SITE (CONT'D)

No	Class, Order, Family, Scientific Name	Status			
		IUCN			
		Cr	En	Vu	Nt
	Passeriformes-Passeri				
	Alaudidae (Larks)				
16	Rufous-winged Bushlark *(Mirafra assamica)*	-	-	-	-
	Chloropseidae (Ioras, Leafbirds)				
17	Iora Common *(Aegithina tiphia)*	-	-	-	-
	Dicruridae (Drongos)				
18	Balck Drongo *(Dicrurus macrocercus)*	-	-	-	-
	Hirundinidae				
19	Swallow *(Hirundo rustica)*	-	-	-	-
	Laniidae (Shrikes)				
20	Grey-backed Shrike *(Lanius tephronotus)*	-	-	-	-
	Nectariniidae				
21	Olive-backed Sunbird *(Cinnyris jugularis)*	-	-	-	-
22	Van Hasselt's Sunbird*(Leptocoma brasiliana)*	-	-	-	-
	Oriolidae (Orioles)				
23	Black-naped Oriole*(Oriolus chinensis)*	-	-	-	-
	Passeridae (Spallows)				
24	House Sparrow *(Passer domesticus)*	-	-	-	-
25	Eurasian Tree-Sparrow *(Passer montanus)*	-	-	-	-
	Passeriformes				
26	Dark-necked Tailorbird *(Orthotomus atrogularis)*	-	-	-	-
	Phalacrocoracidae (Cormorants)				
27	Little Comorant *(Phalacrocorax niger)*	-	-	-	-
	Ploceidae (Weavers)				
28	Baya Weaver*(Ploceus philippinus)*	-	-	-	-
	Pycnonotidae (Bulbuls)				
29	Soothy-headed Bulbul	-	-	-	-
	(Soothy-headed Bulbul (Pycnonotus aurigaster)				
30	Streak-eared Bulbul *(Pycnonotus blanfordi)*	-	-	-	-
	Sturnidae (Starlings, Mynas)				
31	Myna *(Acridotheres fuscus)*	-	-	-	-
32	Myna *(Acridotheres javanicus)*	-	-	-	-
33	Common myna *(Acridotheres tristis)*	-	-	-	-
34	Grey-headed Starling *(Sturnia malabarica)*	-	-	-	-

TABLE 5.3.1-2

SPECIES LIST OF WILDLIFE SPECIES IN THE VICINITY OF QUARRY SITE (CONT'D)

No	Class, Order, Family, Scientific Name	Status			
		IUCN			
		Cr	En	Vu	Nt
	Sylviidae (Old World Warblers)				
35	Dark-necked Tailorbird *(Orthotomus atrogularis)*	-	-	-	-
36	Common Tailorbird *(Orthotomus sutorius)*	-	-	-	-
37	Dusky Warbler*(Phylloscopus fuscatus)*	-	-	-	-
38	Plain Prinia *(Prinia inornata)*	-	-	-	-
	Timaliidae (Babblers)				
39	Yellow-eyed Babbler*(Chrysomma sinense)*	-	-	-	-
	Turdidae (Thrushes)				
40	Oriental Magpie Robin *(Copsychus saularis)*	-	-	-	-
	Strigiformes				
	Strigidae (Owls)				
41	Spotted Owlet *(Athene brama)*	-	-	-	-
	Mammlia-Mammals				
	Rodentia				
	Sciuridae (Squirrels)				
42	Grey-bellied Squirrel *(Callosciurus caniceps)*	-	-	-	-
43	Finlayson's squirrel *(Callosciurus finlaysonii)*	-	-	-	-
	Reptilia-Reptiles				
	Squamata (Lacertilia)				
	Agamidae				
44	Blue-crested Lizard *(Calotes mystaceus)*	-	-	-	-
	Gekkonidae (Geckos)				
45	Garnot's House Gecko *(Hemidactylus garnotii)*	-	-	-	-
	Uromastycidae				
46	Buterfly Lizard *(Leiolepis belliana)*	-	-	-	-

Remark:

IUCN Red List
CR : Critically Endangered Species
En : Endangered Species
Vu : Vulnerable Species
Nt : Near Threatened Species

Abundance
Vc : Very common
Co : Common
Uc : Un common

5.3.2 Forest/Vegetation Cover

(1) Results of the Survey

The areas surveyed are sparsely and thinly covered with vegetation. Results of the surveys on forest/vegetation cover are summarized in ***Table 5.3.2-1*** and ***5.3.2-2***. All the tree species found are common in other areas of Mandalay Region. No big trees of significant value were found. Forest condition in the project area and vicinity are shown in ***Photo 5.3.2-1***.

TABLE 5.3.2-1

LIST OF TREE SPECIES FOUND IN PROJECT AREA AT SECTION 54

No	Family	No	Scientific name	Growth form	Proposed Project area					Red List	
					AcR	Emb	InsA	ConA	ProA	IUCN	Myanmar
1	ACANTHACEAE	1	*Hygrophila erecta* Hochr.	H		X					
2	AIZOACEAE	2	*Mollugo pentaphylla* Linn.	H					X		
3	AMARANTHACEAE	3	*Achyranthus aspera* Linn.	HUS		X		X	X		
4	ANACARDIACEAE	4	*Mangifera indica* Linn.	T	X	X		X	X		
5	APOCYNACEAE	5	*Plumeria acutifolia* Poir.	ExST				X			
		6	*Wrightia tomentosa* Roem. & Schult.	ST	X		X	X			
6	ARACEAE	7	*Typhonium trilobatum* Schoot.	H	X			X			
7	ASCLEPIADACEAE	8	*Calotropis gigantea* (L.) Dryander ex W.T. Aiton	S		X		X	X		
8	ASTERACEAE	9	*Acmella oleracea* (L.) R.K.Jansen	G					X		
9	BIGNONIACEAE	10	*Fernandoa adenophylla* Steenis	T	X			X	X		
		11	*Stereospermum neuranthum* Kurz	T			X				
10	BOMBACACEAE	12	*Bombax ceiba* Linn.	T		X		X	X		
11	BORAGINACEAE	13	*Heliotropium indicum* R. Br.	H		X		X			
12	BURSERACEAE	14	*Canarium subulatum* Guill.	T		X					
		15	*Garuga pinnata* Roxb.	T		X			X		
13	CAPPARIDACEAE	16	*Maerua siamensis* Pax	T			X	X			
14	CARICACEAE	17	*Carica papaya* Linn.	ExST					X		
15	CLEOMACEAE	18	*Cleome gynandra* Linn.	H				X			
16	COMBRETACEAE	19	*Terminalia dafeuillana* Pierre ex Laness.	T	X		X	X	X		
17	COMMELINACEAE	20	*Commelina benghalensis* Linn.	G				X			
18	COMPOSITAE	21	*Ageratum conyzoides* Linn.	H		X					
		22	*Aster cordifolius* Linn.	ExT		X					
		23	*Eupatorium odoratum* Linn.	ExH		X		X	X		
19	CONVOLVULACEAE	24	*Ipomoea alba* Linn.	HC		X			X		
20	CUCURBITACEAE	25	*Coccinia grandis* Voigt	HC				X	X		
21	CYPERACEAE	26	*Cyperus rotundus* Linn.	H				X			
22	EBENACEAE	27	*Diospyros mollis* Griff.	T			X	X	X		
23	EHRETIACEAE	28	*Coldenia procumbens* Linn.	H				X			
24	ESCALIONIACEAE	29	*Polyosma arguta* Craib	T	X		X	X	X		
25	EUPHORBIACEAE	30	*Euphorbia heterophylla* Linn.	ExH				X			
		31	*Homonoia riparia* Lour.	S/ST		X					
		32	*Phyllanthus amarus* Schum. & Thonn.	H				X			
		33	*Ricinus communis Linn.*	S/ST	X	X			X		
		34	*Securinega leucopyrus Muell. Arg.*	S		X			X		
26	GRAMINEAE	35	*Arundo donax* Linn.	G		X			X		
		36	*Bambusa arundinacea* Willd.	B			X	X	X		
		37	*Cenchrus echinatus* Linn.	G					X		
		38	*Cynodon dactylon* Pers.	G		X		X	X		
		39	*Saccharum arundinaceum* Retz.	G		X					

TABLE 5.3.2-1

LIST OF TREE SPECIES FOUND IN PROJECT AREA AT SECTION 54 (CONT'D)

No	Family	No	Scientific name	Growth form	Proposed Project area					Red List	
					AcR	Emb	InsA	ConA	ProA	IUCN	Myanmar
27	LABIATAE	40	*Hyptis suaveolens* Poit.	S		X					
		41	*Premna tomentosa* Willd.	T	X	X	X	X			X
28	LEGUMINOSAE-CAESALPINIACEAE	42	*Bauhinia saccocalyx* Pierre	ST	X		X	X			
	CAESALPINIACEAE	43	*Cassia siamea* Britt.	T				X			
		44	*Tamarindus indica* Linn.	T				X			
	LEGUMINOSAE-MIMOSACEAE	45	*Acacia tomentosa* Willd.	T			X				
	MIMOSACEAE	46	*Albizia lebbeckoides* Benth.	T			X	X			
		47	*Leucaena leucocephala* (Lamk.) de Wit	T		X		X			
		48	*Pithecellobium dulce* Benth.	ExT	X	X		X	X		
	LEGUMINOSAE-PAPILIONACEAE	49	*Abrus precatorius* Linn.	C				X			
	PAPILIONACEAE	50	*Clitoria ternatea* Linn.	ExC		X					
		51	*Dalbergia dongnaiensis* Pierre	T					X		
		52	*Millettia brandisiana* Kurz	T				X			
29	MALVACEAE	53	*Hibiscus vitifolius* Linn.	H				X	X		
		54	*Sida rhombifolia* L.	G				X			
30	MELIACEAE	55	*Azadirachta indica* Juss. var. siamensis Valeton	T			X	X	X		
31	MIMOSEAE	56	*Albizia myriophylla* Benth	T	X		X	X			
32	MORACEAE	57	*Ficus hirta* Vahl	S/ST					X		
		58	*Ficus hispida* Linn. f.	ST					X		
		59	*Ficus racemosa* Linn.	T		X					
		60	*Ficus religiosa* L.	T				X	X		
		61	*Morus indica* Linn.	ST	X	X	X	X			
33	MUSACEAE	62	*Musa acuminata* Colla	H		X		X	X		
34	MYRTACEAE	63	*Eucalyptus globulus* Labill.						X		
35	PALMAE	64	*Borassus flabellifer* Linn.	ExP		X					
36	POACEAE	65	*Eleusine indica* (L.) Gaertn.			X					
37	RHAMNACEAE	66	*Zizyphus mauritiana* Lamk.	ST	X	X		X	X		
38	RUBIACEAE	67	*Hymenodictyon excelsum* Wall.	T					X		
		68	*Oxyceros longiflora* (Lam.) T.Yomaz.	C	X	X	X	X	X		
39	RUTACEAE	69	*Citrus aurantifolia* Swing.	ExST	X	X		X			
40	SALVADORACEAE	70	*Azima sarmentosa* Benth. & Hook.	C					X		
41	SAPINDACEAE	71	*Cardiospermum helicacabum* Linn.	HC				X			
42	STERCULIACEAE	72	*Sterculia pexa* Pierre	ST			X	X	X		
43	VERBENACEAE	73	*Lantana salvifolia* Jacq.	S				X	X		
		74	*Vitex pinnata* Linn.	T	X	X		X	X		
	UNKNOWN	75	Unidentified species						X		

TABLE 5.3.2-2

LIST OF TREE SPECIES FOUND IN THE VICINITY OF QUARRY SITE

No	Family	No	Scietifit name	Growth form	Red List	
					IUCN	Myanmar
1	ACANTHACEAE	1	*Acanthus ebracteatus* Vahl	S		
2	AIZOACEAE	2	*Mollugo pentaphylla* Linn.	H		
3	AMARANTHACEAE	3	*Achyranthus aspera* Linn.	HUS		
		4	*Amaranthus spinosus* Linn.	ExH		
		5	*Psilotrichum ferrugineum* Moq.	H		
4	ANACARDIACEAE	6	*Mangifera indica* Linn.	T		
		7	*Spondias pinnata* Kurz	T		
5	APOCYNACEAE	8	*Wrightia tomentosa* Roem. & Schult.	ST		
6	ASCLEPIADACEAE	9	*Calotropis gigantea* (L.) Dryander ex W.T.	S		
			Aiton			
7	BARRINGTONIACEAE	10	*Barringtonia acutangula* Gaertn. subsp.	ST		
			spicata Payens			
8	BIGNONIACEAE	11	*Dolichandrone serrulata* (DC.) Seem.	T		
		12	*Fernandoa adenophylla* Steenis	T		
		13	*Stereospermum cylindricum* Pierre ex P. Dop.	T		
9	BOMBACACEAE	14	*Bombax anceps* Pierre	T		
		15	*Bombax ceiba* Linn.	T		
10	CAPPARIDACEAE	16	*Maerua siamensis* Pax	T		
11	COMBRETACEAE	17	*Terminalia nigrovenulosa* Pierre ex Laness.	T		
12	COMPOSITAE	18	*Eupatorium odoratum* Linn.	ExH		
13	CONVOLVULACEAE	19	*Ipomoea alba* Linn.	HC		
14	EBENACEAE	20	*Diospyros mollis* Griff.	T		
15	EHRETIACEAE	21	*Coldenia procumbens* Linn.	H		
16	ESCALIONIACEAE	22	*Polyosma arguta* Craib	T		
17	EUPHORBIACEAE	23	*Bridelia affinis* Craib	ST		
		24	*Croton argyratus* Bl.	S/ST		
		25	*Euphorbia hirta* Linn.	H		
		26	*Euphorbia lacei* Craib	ST		
		27	*Homonoia riparia* Lour.	S/ST		
		28	*Ricinus communis* Linn.	S/ST		
18	GRAMINEAE	29	*Arundo donax* Linn.	G		
		30	*Bambusa arundinacea* Willd.	B		
		31	*Cynodon dactylon* Pers.	G		
		32	*Saccharum arundinaceum* Retz.	G		
19	LABIATAE	33	*Hyptis suaveolens* Poit.	S		
20	LEGUMINOSAE-	34	*Bauhinia saccocalyx* Pierre	ST		
	CAESALPINIACEAE	35	*Cassia fistula* Linn.	T		
		36	*Cassia occidentalis* Linn.	ExUS		
		37	*Cassia siamea* Britt.	T		
		38	*Delonix regia* (Bojer) Raf.	T		
		39	*Tamarindus indica* Linn.	T		
	LEGUMINOSAE-MIMOSACEAE	40	*Acacia tomentosa* Willd.	T		
	MIMOSACEAE	41	*Albizia lebbeckoides* Benth.	T		
		42	*Albizia procera* Benth.	T		
		43	*Leucaena leucocephala* (Lamk.) de Wit	T		
		44	*Pithecellobium dulce* Benth.	ExT		
		45	*Samanea saman* Merr.	T		
	LEGUMINOSAE-PAPILIONACEAE	46	*Millettia brandisiana* Kurz	T		
	PAPILIONACEAE	47	*Phaseolus aureus* Roxb.	HC		

TABLE 5.3.2-2

LIST OF TREE SPECIES FOUND IN THE VICINITY OF QUARRY SITE (CONT'D)

No	Family	No	Scietifit name	Growth form	Red List	
					IUCN	Myanmar
21	MALVACEAE	48	*Gossypium herbaceum* Linn.	ExS		
		49	*Hibiscus vitifolius* Linn.	H		
		50	*Sida rhombifolia* L.	G		
22	MELIACEAE	51	*Azadirachta indica* Juss. var.	T		
			Valeton			
23	MIMOSEAE	52	*Albizia myriophylla* Benth	T		
24	MORACEAE	53	*Artocarpus lanceifolius* Roxb.	T		
		54	*Ficus auriculata* Lour. (Syn. Ficus			
			Miq.)			
		55	*Ficus hispida* Linn. f.	ST		
		56	*Ficus lacor* Buch.	T		
		57	*Ficus racemosa* Linn.	T		
		58	*Ficus religiosa* L.	T		
		59	*Morus indica* Linn.	ST		
25	MUSACEAE	60	*Musa acuminata* Colla	H		
26	MYRTACEAE	61	*Eucalyptus globulus* Labill.			
		62	*Eugenia cumini* Druce	T		
27	PALMAE	63	*Phoenix dactylifera* L.	P		
		64	*Borassus flabellifer* Linn.	ExP		
		65	*Wodyetia bifurcate* A.K. Irvine	P		
28	PERIPLOCACEAE	66	*Streptocaulon juventas* Merr.	C		
29	POACEAE	67	*Eleusine indica* (L.) Gaertn.			
30	POLYGONACEAE	68	*Polygonum tomentosum* Willd.	H		
31	RHAMNACEAE	69	*Zizyphus mauritiana* Lamk.	ST		
		70	*Zizyphus oenoplia* Mill.	C		
32	RUBIACEAE	71	*Hymenodictyon excelsum* Wall.	T		
		72	*Ochreinauclea maingayi*(	T		
		73	*Oxyceros longiflora* (Lam.)	C		
33	RUTACEAE	74	*Citrus aurantifolia* Swing.	ExST		
34	SALVADORACEAE	75	*Azima sarmentosa* Benth. & Hook.	C		
35	SOLANACEAE	76	*Datura metel* Linn.	US		
36	STERCULIACEAE	77	*Sterculia pexa* Pierre	ST		
37	TYPHACEAE	78	*Typha angustifolia* L.	G		
38	VERBENACEAE		*Vitex pinnata* Linn.	T		
39	UNKNOWN	79	Unidentified species1			
		80	Unidentified species2			

Remark: **Growth form**

B	:	Bamboo	H	:	Herb
C	:	Climber	HC	:	Herb Climber
ExH	:	Exotic Herb	P	:	Palm
ExP	:	Exotic Palm	S	:	Shrub
ExS	:	Exotic Shrub	S/ST	:	Shrub/Shrubby Tree
ExST	:	Extotic Shrubby Tree	ST	:	Shrubby Tree
ExT	:	Exotic Tree	T	:	Tree
G	:	Grass	US	:	Under Shrub

PHOTO 5.3.2-1 : FOREST CONDITION IN THE PROJECT AREA AND VICINITY

5.3.3 Aquatic Biota and Habitats

The Myitnge River or the Nam Tu River is originated from the Shan Plateau, East of Myanmar and connected to the Irrawaddy River at the old capital, Amarapura. This river used to play an important role as transportation route in an ancient time. In 2005, the Myamar government with assistance from China government had launched the nation largest hydro-electric power dam name "Yeywa Dam project" in lower part of Myitnge River, 50 Km southeast to the Mandalay. As demand for local electricity usage had rapidly increased for the central region of Myanmar. In order to reuse of discharge water after generating of electricity, therefore, the Deedoke dam was considered.

Since the Myitnge River is medium size river and located on remote area**.** Information related aquatic ecological components, such as abiotic factors **(**DO, pH, Hardness, Alkalinities, etc**)** and also list of aquatic organisms such as benthic organisms, fish and amphibians is rather few. Thence, the field surveys is needed for future impact assessment**.**

5.3.3.1 Aquatic Ecological Surveys

In the Central Myanmar Region, like Mandalay province, information about basic components on river aquatic ecosystem and fish species are rather scarce. Therefore, the Consultants conducted 2 field works on aquatic ecological survey in order to gather information representing of dry-season and the wet-season. It was expecting that the acquired information would finally utilize for establishing of benchmarks or tools for assess impacts that possibly present in aquatic ecosystem after the Project implementation on the Myitnge River. Moreover, the collected data that planed under scientific basis would finally provoke the appropriate impact mitigation measures.

Fieldworks on ecological survey were conducted twice during 25-26 April 2015 as representative of the dry season, and during 22-23 July 2015 as representative of the wet season. Both surveys were performed at the same seven stations as the water quality sampling was taken. All sampling stations were designed to cover both of upstream and downstream of the site where the Deedoke Dam was proposed.

In each particular sampling station, the aquatic ecosystem component such as planktons, benthos, and fish were sampled. Sampling procedure and specimens preservation would be described as followed;

Planktons and Benthos Samples

Planktons were collected by 50 µm mesh size plankton net. 50 liters of river water was filtered through plankton net and the remained 100 cc sampling water then fixed with 5% (V/V) formaldehyde solution. Preserved specimens then brought back to laboratory for taxonomic identification into species level and quantification by counting of number for each particular species. Acquires number of species and number for each particular species would later used for calculation of Species Diversity Index (Shannon-Wienner Diversity Index or H').

Benthos or benthic organisms were taken from the same spot as plankton and water qualities. Ekman's dredge which 0.02 m^2 sampling area was employed for sampling of benthic organisms. For each sampling station, 3 times of Ekman's dredge sampling was performed. Whole samplers were then sieved in a multiple layer sieve and remained organism then collected and preserved in 5% (V/V) formaldehyde solution. As same as plankton, the sampling specimens were brought back to laboratory for identification and quantification. Details of plankton and sediment sampling and analyses are presented in ***Appendix 5G***.

Fish Samples

Fish samples were also collected in parallel with the planktons and benthos samples with assistance of local fishermen. Therefore, various fishing equipment were used to catch the fish samples, such as seine net, cast net, scoop net, gill net, hooks and trawl. The collected fish samples were analyzed to identify their species. Details on the fish sampling and analysis are presented in ***Appendix 5H***.

Besides catching fish samples, the Consultant also visited Ong Jor market near the study area in order to (see ***Photo 5.3.3-1***):

- Observe quantities and species of fish being sold in the market.
- Interview some randomly-selected local fishermen to collect information on fishing grounds, fish spawning areas, seasonal variation of fish catches, abundant fish species, rare fish species and perceived impacts of the proposed dam on fisheries.

PHOTO 5.3.3-1 : FISH SPECIES OBSERVATION AT ONG JOR MARKET

5.3.3.2 Results of the Study

(1) Existing Environmental Condition of the River

San, 1987 recorded 87 species of fish from 23 families represented in Myitnge River. The dominant of fish species in term of abundant are Cyprinids family.

At present, flow regimes in Myitnge River are completely regulated by the electrical operation of the Yeywa hydropower scheme. The completely stagnant of water in reservoir of the Yeywa Dam had effected to flow regimes and silt loads in downstream of Myitnge River. Moreover, dam also act as barrier to obstruct upstream and downstream migration of fish. Consequently, the hydroelectric production cycle from the power plant would induce unnatural change to aquatic ecosystem in downstream of Myitnge River.

The less difference of annual flow regimes between hot and dry season, especially on lower Myitnge River, due to discharge of electric production by the Yeywa Dam has caused both positive and negative impact to downstream aquatic ecosystem. The most important positive impact is to maintain stability of aquatic ecosystem. Since the less variation in flow regimes would prevent bank erosion, flooding and also freeze the natural progress in ecological succession. This stable aquatic ecosystem would provide enough food sources for local communities located on downstream wetlands along the river banks. However, there are also several negative impacts from the electric production activities such as epidemic of unwanted plant species, alteration of fish and some aquatic organisms communities and also their reproductive cycle. The nearly constant flow regimes between seasons instead of high flow regimes in wet season and low flow regimes during dry season might cause abnormality in fish reproductive cycle. Fish, especially the migratory species and species that use flooding area as spawning ground had long been evolved their breeding cycle to fit with regular annual flow cycle. Alteration might both lost of new generation by spawning when the environment not supply enough food for young fish or to cease the reproductive cycle. Normally the stagnant water form reservoir would accumulate with high level of nutrients and water temperature would be usually lower than the actual. This type of environment factor is the most preferable condition for some submersed plant species. Thence, outgrowth of such this species would be occurred and finally the plant can seize entire river bed as their habitats especially at the downstream under dam reservoir. Submersed plant epidemic had been report from several rivers in Thailand, USA, Australia and other countries.[2]

In our aquatic ecological surveys during April 2015, it was apparently seen that several bottom surface of the Myitnge River had been covered with dense patches of the pond weed (*Potamogenton* sp.). All was seen at river bed downstream to the Yeywa Dam to sections far beyond the proposed dam site (see ***Photo 5.3.3-2***).

[2] Truelson, R.L., and Warrington, P.D., ***Effects of Storage Reservoirs on Downstream Water Quality and Aquatic Vegetation-A Literature Review***, Revised Edition, March 1994, Water Quality Branch, Environmental Protection Department, Ministry of Environment, Land, and Parks


PHOTO 5.3.3-2 : THE POND WEED (*Potamogenton* sp.) WHICH WAS COMMONLY FOUND COVERING AT RIVER BED DOWNSTREAM TO THE YEYWA DAM

The other effect of clear and swiftly current down under the storage dam is lower in fish production. It is subsequent to epidemic of submersed weeds on the river bed. Abundance of pondweed would diminish phytoplankton biomass due to faster nutrients absorbance. In aquatic foodweb, phytoplankton was acting as main food supply to fish larvae and also some planktonic filtering fish species. Shortage in food supply would cause reduction on number of small species that would finally effect to entire food chain, especially the top consumer which usually be the high price fish species. Another reason of lower in fish production was due to fish has less area of spawning ground. One reason for constructing dam is to prevent flooding. Since mass storage of water body in dam reservoir with controlled daily discharge would play an important role on preventing of flood phenomena. Unfortunately, flooding had provided vast area of spawning and nursery of fish and also provided hiding area from predators. Lacking of excellent spawning and nursery ground would inevitably effect to less of recruitments and finally to fish production of upcoming year. Other effect of daily change in hydrologic fluctuation instead of annual is to alter fish reproductive cycle. As fish assemblage on particular river system had long been evolve their reproductive cycle to fit with river annual hydrologic cycle. The new hydrologic cycle does not only affect fish abundance but other biological components such as phytoplankton, zooplankton and benthic organisms are also under influence of this changing too. Thence, alteration of hydrologic would destroy the actual reproductive cycle that usually occur when availability of food sources are being at peak period.

The good supporting evidence of lower fish production came from the interviewing of fishermen. In both of the field surveys whether in April or July 2015, the consultant saw less fishing activities and if any fishing activities were seen, fishermen would be asked to stop and their catch would be observed. This observation was also in concordance with information from the village headmen that subsistence fishing was not commonly practiced. Moreover, the same village headmen also informed that fishing practiced would greater in reservoir of the Yeywa Dam Reservoir, the Irrawaddy River and some tributaries of the Myitnge River. This was also in concordance with our fish survey of less species compared to species listed by San (1987). Hence, it might be possibly said that the Myitnge river within the project area contain noticeably poor in fishery resources.

(2) Results of the Dry-Season Surveys

Planktons and Benthos

The results of plankton and benthos study are presented in ***Table 5.3.3-1*** and ***5.3.3-2*** and can be summarized as follows:-

Plankton

For the whole project, total 7 Divisions 12 Classes 19 Orders 32 families and 73 species of plankton was listed. Plankton taxonomic composition was comprised of phytoplankton which act as primary producer (3 Divisions 6 Classes 12 Orders 20 families and 54 species) and zooplankton which play the role of food for fish (4 Divisions 6 Classes 7 Orders 12 families and 19 species). Density of plankton ranged between 71,400-425,600 units/m^3. The lowest density found in station SW6 while the highest density belonged to station SW1. Species Diversity Index ranged between 0.5-2.88, the lowest was in SW1 while the highest was found in SW7. Species Diversity Index helps us to determine whether the conditions in survey station would be suitable for species to living on or not. From the survey, the SW1 had contained *Oscillatoria* which was the most dominant in number that over every species. It is implied that the SW habitat has most favorable condition for growth of blue-green algae or Cyanobacteria, which prefer to live in high level of Nitrogen (Eutrophication). This is due to water in Dam reservoir has accumulate high amount of Nitrogen. While in the bigger river such as SW7 which is located on the Irrawaddy River has better condition for growth of numerous of plankton species, thence more species and which nearly equal in number then was observed.

When considering on dominant species of phytoplankton, the most dominant in total number was *Oscillartoria* which was commonly found on the upper to middle of the Myitnge River. The second dominant belonged to genus *Synedra* (Bacillariophyceae). The common name of this group is diatom which is classified as good phytoplankton that be eaten by zooplankton and larvae of several economic important species. However, the number of this diatom species tended to be greater in the lower part of Myitnge River. The third abundant in number was *Spirogyra* (Cyanophyceae) which prefer to live in water that contain high level of Nitrogen as *Oscillartoria*.

Benthos

From this survey, total 3 phyla 5 classes 8 orders 12 families of benthos were indentified. They were comprised of aquatic earthworm 2 families (Phylum Annelida), 2 families of freshwater snail and clam (Phylum Mollusca) and 1 families of aquatic insect larvae. Species abundance ranged between 0-3 species per station. Benthis organisms was not found in the SW4, while the most abundant (3 species) were found on station SW1, SW2 and SW6. Densities of benthos ranged between 0-396 individuals/m^2. Station SW2 contained the highest density (396 individual/m^2). The most abundant benthic fauna was the water worm, *Nias* which was found abundant in nearly most of sampling stations. Abundance of the nias water worm indicated that the river bottom contained slightly high level of organic matter.

Details of plankton and benthic organisms for each sampling station can be shown as follows:-

Station SW1**:** 16 species of phytoplankton in 3 divisions were found in this station. Total quantities were 383,800 units/m^3. *Oscillatoria* sp. was phytoplankton with the highest abundance (250,800 units/m^3). As for zooplankton, 8 species in 4 phyla were identified. Total quantities were 41,800 units/m^3. Protozoa, *Difflugia lobostoma* was zooplankton with the highest abundance (11,400 units/m^3).

The phytoplankton to zooplankton ratio was 9.18. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 1.88, it can be said that the aquatic ecology in this station had moderate diversity.

Benthic organisms found in this station were 3 species with 110 individuals/m^2 of total quantities. *Eiseneiella* sp. and *Chironomus* sp. had the highest abundance as 44 individual/m^2 of each species.

Station SW2**:** 16 species of phytoplankton in 3 divisions were found in this station. Total quantities were 179,400 units/m^3. *Oscillatoria* sp. was phytoplankton with the highest abundance (51,750 units/m^3). As for zooplankton, 7 species in 2 phyla were identified. Total quantities were 44,850 units/m^3. Protozoa, *Difflugia lobostoma* was zooplankton with the highest abundance (20,700 units/m^3).

The phytoplankton to zooplankton ratio was 4. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.75, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 3 species with 396 individuals/m^2 of total quantities. *Nais* sp. had the highest abundance as 44 individual/m^2.

Station SW3 : 12 species of phytoplankton in 3 divisions were found in this station. Total quantities were 123,750 units/m^3. *Synedra ulna* was phytoplankton with the highest abundance of (29,700 units/m^3). As for zooplankton, 5 species in 1 phyla were identified. Total quantities were 39,600 units/m^3. Protozoa, *Arcella vulgaris* was zooplankton with the highest abundance of (14,850 units/m^3).

The phytoplankton to zooplankton ratio was 3.13. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.62, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 2 species with 242 individuals/m^2 of total quantities. *Chironomus* sp. had the highest abundance as 198 individual/m^2.

Station SW4 :14 species of phytoplankton in 3 divisions were found in this station. Total quantities were 104,550 units/m^3. *Oscillatoria* sp. was phytoplankton with the highest abundance (22,550 units/m^3). As for zooplankton, 5 species in 1phyla were identified. Total quantities were 16,400 units/m^3. Protozoa, *Difflugia lobostoma* was zooplankton with the highest abundance (6,150 units/m^3).

The phytoplankton to zooplankton ratio was 6.38. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.63, it can be said that the aquatic ecology in this station had high diversity.

For benthic organisms, there was no species found at this sampling time.

***Station SW5*:**10 species of phytoplankton in 3 divisions were found in this station. Total quantities were 68,400 units/m^3. *Synedra ulna* was phytoplankton with the highest abundance (14,400 units/m^3). As for zooplankton, 4 species in 2 phyla were identified. Total quantities were 18,000 units/m^3. *Coleps* sp. was zooplankton with the highest abundance (7,200 units/m^3).

The phytoplankton to zooplankton ratio was 3.8. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.52, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 2 species with 66 individuals/m^2 of total quantities. *Chironomus* sp. had the highest abundance as 44 individual/m^2.

Station SW6: 10 species of phytoplankton in 3 divisions were found in this station. Total quantities were 58,800 units/m^3. *Spirogyra crassa* was phytoplankton with the highest abundance (12,600 units/m^3). As for zooplankton, 2 species in 1phyla were identified. Total quantities were 12,600 units/m^3. Protozoa, *Difflugia lobostoma*. was zooplankton with the highest abundance (8,400 units/m^3).

TABLE 5.3.3-1
RESULT OF PLANKTON SAMPLING AND ANALYSIS (APRIL 2015)

units[1/]/m^3

Plankton						Stations						
Division	**Class**	**Order**	**Suborder**	**Family**	**Genus**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**
PHYTOPLANKTON												
Division Cyanophyta												
	Class Cyanophyceae (Blue-Green Algae)											
		Order Nostocales										
				Family Oscillatoriaceae								
					Lyngbya sp.		6,900				4,200	14,100
					Oscillatoria sp.	250,800	51,750	9,900	22,550	10,800		
		Order Chroococcales										
				Family Chroococcaceae								
					Chroococcusminutus	19,000	13,800		8,200	7,200		
					Gleocapsa sp.			4,950				
					Microcystisaeruginosa			9,900		3,600	8,400	7,050
Division Chlorophyta												
	Class Chlorophyceae (Green Algae)											
		Order Volvocales										
				Family Chlamydomonadaceae								
					Chlamydomonasangulosa	3,800	6,900		2,050			
				Family Volvocaceae								
					Eudorinaelegans				4,100			21,150
					Pandarinamorum							7,050
		Order Chlorococcales or Chroococcales										
				Family Hydrodictyaceae								
					Pediastrum duplex	3,800						
					P. simplex				2,050			
				Family Coelastraceae								
					Coelastrummicroporum	7,600	6,900					
		Order Oedogoniales										
				Family Oedogoniaceae								
					Oedogoniumcrispum					3,600	4,200	
		Order Zygnematales										
				Family Zygnemataceae								
					Mougeotiascalaris	7,600	3,450				4,200	7,050
					Spirogyra crassa	19,000	17,250	4,950	4,100		12,600	35,250
				Family Desmidiaceae								
					Closteriummoniliferum	3,800						
				Family Scenedesmaceae								
					Actinastrumhantzschii			9,900	2,050	7,200		7,050
		Order Ulothrichales										
				Family Ulothrichaceae								
					Ulothrixaequalis	3,800	6,900		4,100			
	Class Euglenophyceae (Euglenoid)											
		Order Euglenales										
				Family Euglenaceae								
					Euglena caudatus						4,200	
					E. ehrenbergii			4,950				
					E. fusca			4,950				
					E. spirogyra							7,050
					Trachelomonasvolvocina						8,400	14,100
					T. scabra							7,050
Division Chromophyta												
	Class Bacillariophyceae (Diatom)											
		Order Biddulphiales (Centric Diatom)										
			Suborder Coscinodiscineae									
				Family Coscinodiscaceae								
					Coscinodiscus sp	11,400	3,450	4,950				
		Order Bacillariales (Pennate Diatom)										
			Suborder Fragilariineae									
				Family Fragilariaceae								
					Fragilariacapucina	11,400	6,900	24,750	16,400	3,600		
					F. construens	3,800	6,900					
					Synedra ulna	15,200	24,150	29,700	16,400	14,400		
			Suborder Bacillarineae									
				Family Cymbellaceae								
					Cymbellatumida			4,950				
					Gomphonema sp.		6,900					
				Family Naviculaceae								
					Frustulia vulgaris		3,450		8,200		4,200	
					Gyrosigma sp.				4,100	3,600		
					Navicula spp.	3,800						
					Pinnularia sp.	3,800						
				Family Rhopalodiaceae								
					Rhopalodiagibba						4,200	
				Family Surirellaceae								
					Surirellaelegans				4,100			7,050
	Class Fragilariophyceae											
		Order Tabellariales										
				Family Tabellariaceae								
					Tabellariafrocculosa		6,900	9,900	6,150	7,200	4,200	
	Class Dinophyceae (Dinoflagellates)											
		Order Peridiniales										
				Family Peridiniaceae								
					Peridinium sp.	15,200	6,900			7,200		7,050

TABLE 5.3.3-1

RESULT OF PLANKTON SAMPLING AND ANALYSIS (APRIL 2015) (CONT'D)

unit[1/]/m³

Plankton						Stations						
Division	**Class**	**Order**	**Suborder**	**Family**	**Genus**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**
ZOOPLANKTON												
Phylum Arthropoda												
	Class Crustacea (Crustaceans)											
		Subclass Brachiopoda										
			Order Diplostraca									
				Family Sididae								
					Diaphanosoma sp.	3,800						
Phylum Annelida												
	Class Oligochaeta											
			Order Haplotaxida									
				Family Tubificidae		7,600			2,050			
					*Tubifex*sp.							
Phylum Protozoa												
	Class Sarcodina											
		Subclass Rhizopoda										
			Order Testacida									
				Family Arcellidae								
					Arcellamegastoma	3,800		4,950				
					A. vulgaris		3,450	14,850				
				Family Difflugiidae								
					Centropyxisaculeata					3,600		
					C. ecornis	3,800	6,900					
					Difflugiaacuminata	3,800						
					D. tuberculata		3,450					
					D. lobostoma	11,400	20,700	4,950	6,150		8,400	7,050
					D. lebes			9,900	2,050			
	Class Ciliata											
		Subclass Holotricha										
			Order Gymnostomatida									
				Family Colepidae								
					*Coleps*sp.					7,200	4,200	7,050
				Family Heterotrichida								
					Paramecium sp.		3,450			3,600		
		Subclass Pertrichia										
			Order Partrichida									
				Family Vorticellidae								
					Vorticella sp.			4,950	4,100			
				Family Vaginicolidae								
					Pyxicolaaffinis							7,050
Phylum Rotifera (Rotifer)												
	Class Monogononta											
			Order Ploima									
				Family Brachionidae								
					Colurellacolurus	3,800						
					Keratellacochlearis							7,050
				Family Trichocercidae								
					Trichocercapusilla	3,800						
				Family Synchaetidae								
					Synchaetaoblonga		3,450			3,600		
	Class Digononta											
				Family Philodinidae								
					Rotaria sp.		3,450		2,050			
Total quantity												
	Phytoplankton					383,800	179,400	123,750	104,550	68,400	58,800	141,000
	Zooplankton					41,800	44,850	39,600	16,400	18,000	12,600	28,200
	Total					425,600	224,250	163,350	120,950	86,400	71,400	169,200
Total number of species												
	Phytoplankton					16	16	12	14	10	10	12
	Zooplankton					8	7	5	5	4	2	4
	Total					24	23	17	19	14	12	16
Phytoplankton /Zooplankton						**9.18**	**4.00**	**3.13**	**6.38**	**3.80**	**4.67**	**5.00**
Species Diversity Index						**1.88**	**2.75**	**2.62**	**2.63**	**2.52**	**2.39**	**2.59**

Remark : [1/]cell, filament or colony) for phytoplankton and cell, colony or individual for zooplankton

Source : Field survey by TEAM Consulting Engineering and Management Co. Ltd., April 2015

TABLE 5.3.3-2

RESULT OF BENTHOS SAMPLING AND ANALYSIS (APRIL 2015)

Unit : individuals/m^2

Phylum	Stations						
	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7
PHYLUM ANNELIDA							
Class Oligochaeta							
Order Pleseiora							
Family Naididae							
Nais sp.	22	264				110	22
Family Lymbricidae							
Eiseneiella sp.	44	88					
PHYLUM ARTHROPODA							
Class Insecta							
Order Diptera							
Family Chironomidae							
Chironomus sp.	44	44	198		44	22	
PHYLUM MOLLUSCA							
Class Gastropoda							
Order Mesogastropoda							
Family Thiaridae							
Melanoides sp.			44		22		22
Class Bivalvia							
Order Veneroida							
Family Corbiculidae							
Corbicula sp.						22	
Total	**110**	**396**	**242**	**0**	**66**	**154**	**44**
Total number of species	**3**	**3**	**2**	**0**	**2**	**3**	**2**

Remark : gravel bottom

Source : Field survey by TEAM Consulting Engineering and Management Co. Ltd., April 2015

The phytoplankton to zooplankton ratio was 4.67. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.39, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 3 species with 154 individuals/ m^2 of total quantities. *Nais* sp. Had the highest abundance as 110 individual/m^2.

Station SW7: 12 species of phytoplankton in 3 divisions were found in this station. Total quantities were 141,000 units/m^3. *Spirogyra crassa* was phytoplankton with the highest abundance (35,250 units/m^3). As for zooplankton, 4 species in 2 phyla were identified. Total quantities were 28,200 units/m^3. At this station, there was dominant species of zooplankton.

The phytoplankton to zooplankton ratio was 5. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.59, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 2 species with 44 individuals/ m^2 of total quantities. At this station, there was dominant species of benthos organism.

Fisheries

Very few fish species was observed from this surveys, only two fish species, the Nile tilapia (*Oreochromis niloticus*) and red-finned loaches (*Acanthocobitis* sp.) were observed from Myitnge River (***Table 5.3.3-3*** and ***Photo 5.3.3-3***). The 2.5 kg of Nile tilapia probably were caught by the participating local fishermen. This poor catching rate was also good confirmation for low fisheries resource in the river.

TABLE 5.3.3-3

RESULTS OF FISH SAMPLINGS STUDY DURING 25-26 APRIL 2015

No.	Family	Scientific Name	No. of fish caught	Weight (g)	Total length (cm)
1	Cichlidae	*Oreochromis niloticus*	2	244-2529	7-18
2	Cobitidae	*Acanthocobitis rubripinnis*	2	5.0	4.6-5.0

Source : Field survey by TEAM Consulting Engineering and Management Co. Ltd., April 2015

<table>
<tr><td></td><td></td></tr>
<tr><td>The nile Tilapia (Oreochromis niloticus)</td><td>Red finned loach,(Acanthocobitis rubripinnis)</td></tr>
</table>

PHOTO 5.3.3-3 : FISH SPECIES CAUGHT IN MYITNGE RIVER DURING 25-26 APRIL 2015

Survey on fish selling at the Ong Jor market was made once and only 3 species of freshwater (***Photo 5.3.3-4***) were observed. Species were the shad (*Tenualosa ilisha*), snakehead (*Channa gachua*) and the mud carp (*Henicorhynchus* sp.). According to the retailers, all sold fish was caught from reservoir of the Yeywa Dam.

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>Tenualosa ilisha</td><td>Channa gachua</td><td>Henicorhynchus sp.</td></tr>
</table>

PHOTO 5.3.3-4 : FISH SPECIES FOUND IN LOCAL MARKET (ONG JOR MARKET) DURING 25-26 APRIL 2015

(3) Results of the Wet-Season Surveys during 22-23 July 2015

Planktons and Benthos

Results from the second filed surveys of plankton and benthos are presented in ***Table 5.3.3-4*** and ***5.3.3-5*** which can be summarized as following:-

Total 6 Divisions 10 Classes 18 Orders 28 families and 44 species of plankton were identified. Plankton taxonomic composition comprised phytoplankton which act as primary producer (3 Divisions 6 Classes 12 Orders 19 families and 29 species) and zooplankton which play the role of food for fish (4 Phylum 6 Classes 7 Orders 9 families and 15 species). Density of plankton ranged between 130,000-1,580,000 units/m^3. The lowest density was found in station SW2 while the highest density belongedto station SW1. Species Diversity Index ranged between 0.51-2.88, the lowest in SW1 while the highest was found in SW7. Species Diversity Index helps us to determine whether the conditions in survey station would be suitable for species to living on or not. From the survey, the SW1 had more dominance with *Oscillatoria* implying that this area contains high level of nitrogen. Highest biodiversity index of the SW7 had revealed this station contained the most favorable condition for both phytoplankton and zooplankton.

When considering on dominant species of plankton, the most dominant in total number was *Oscillartoria* which commonly found on the upper to middle of the Myitnge river. The second dominant belonged to genus *Synedra* (Bacillariophyceae) which are same as the previous survey, however, the third abundant in number was *Centropyxis acornis* which are Protozoa which prefer to live in water containing high level of silt.

Benthos

From this survey, total 3 phyla 5 classes 8 orders 11 families of benthos were identified. There were aquatic earthworm 1 family (Phylum Annelida), 5 families of freshwater snail and clam (Phylum Mollusca) and 5 families of aquatic insect larvae and shrimp. Species abundance ranged between 0-4 species per station. Benthis organisms was not found in the SW6, while the most abundant (4 species) found on station SW2, SW4 and SW7. Density of benthos ranged between 0-1,408 individuals/m^2 and Station SW1 containing highest density (1,408 individuals/m^2). The most abundant benthic fauna was the *Tubifex* water worm which was mostly found in SW1. Other common species of benthos belonged to the freshwater snail genus *Melanoide*s which was found on every study sites on the Myitnge river except the SW6 and the Irrawaddy river (SW7).

TABLE 5.3.3-4

RESULT OF PLANKTON SAMPLING AND ANALYSIS (JULY 2015)

units$^{1/}$/m^3

Plankton						Station						
Division	**Class**	**Order**	**Suborder**	**Family**	**Genus**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**
Phytoplankton												
Division Cyanophyta												
	Class Cyanophyceae (Blue-Green Algae)											
		Order Nostocales										
				Family Oscillatoriaceae								
					Lyngbya sp.	6,000	5,200					10,250
					Oscillatoria sp.	1,404,000	10,400	31,800	102,600	68,250	58,000	20,500
		Order Chroococcales										
				Family Chroococcaceae								
					Chroococcus minutus	12,000			5,700	10,500		
					Microcystis aeruginosa			5,300	11,400		11,600	10,250
		Order Stigonematales										
				Family Stigonemataceae								
					Stigonema sp.	12,000	10,400			10,500	11,600	
Division Chlorophyta												
	Class Chlorophyceae (Green Algae)											
		Order Volvocales										
				Family Chlamydomonadaceae								
					Chlamydomonas angulosa				11,400	5,250		10,250
				Family Volvocaceae								
					Eudorina elegans		5,200				5,800	20,500
				Family Coelastraceae								
					Coelastrum microporum	6,000	10,400	5,300			5,800	
		Order Chaetophorales										
				Family Chaetophoraceae								
					Chaetophora sp.			10,600		21,000	5,800	
		Order Oedogoniales										
				Family Oedogoniaceae								
					Oedogonium crispum					5,250		
		Order Zygnematales										
				Family Zygnemataceae								
					Mougeotia scalaris	6,000	10,400					
					Spirogyra crassa		15,600	26,500	17,100	52,500	34,800	
					S. weberi					21,000	11,600	
				Family Desmidiaceae								
					Closterium gracile	6,000			5,700			
				Family Scenedesmaceae								
					Actinastrum hantzschii			5,300	5,700			
		Order Ulothrichales										
				Family Ulothrichaceae								
					Ulothrix aequalis	12,000		5,300	11,400			
	Class Euglenophyceae (Euglenoid)											
		Order Euglenales										
				Family Euglenaceae								
					Euglena caudatus						5,800	
					E. spirogyra						5,800	
					Trachelomonas volvocina		10,400	10,600			5,800	20,500
					T. scabra							10,250
Division Chromophyta												
	Class Bacillariophyceae (Diatom)											
		Order Bacillariales (Pennate Diatom)										
			Suborder Fragilariineae									
				Family Fragilariaceae								
					Fragilaria capucina	6,000		21,200	28,500	84,000	81,200	10,250
					F. construens	6,000						
					Synedra ulna	12,000	15,600	84,800	91,200	131,250	162,400	20,500
			Suborder Bacillarineae									
				Family Naviculaceae								
					Frustulia vulgaris		10,400	5,300	5,700			
					Gyrosigma sp.				5,700			10,250
					Pinnularia sp.					5,250		10,250
				Family Rhopalodiaceae								
					Rhopalodia gibba	6,000						
				Family Surirellaceae								
					Surirella elegans			5,300				
	Class Fragilariophyceae											
		Order Tabellariales										
				Family Tabellariaceae								
					Tabellaria frocculosa			10,600	5,700	10,500	34,800	
	Class Dinophyceae (Dinoflagellates)											
		Order Peridiniales										
				Family Peridiniaceae								
					Peridinium sp.						5,800	20,500

TABLE 5.3.3-4

RESULT OF PLANKTON SAMPLING AND ANALYSIS (JULY 2015) (CONT'D)

units[1/]/m^3

Plankton (Division / Class / Order / Suborder / Family / Genus)	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7
Zooplankton							
Phylum Annelida							
Class Oligochaeta							
Order Haplotaxida							
Family Tubificidae							
Tubifex sp.					5,250		
Phylum Protozoa							
Class Sarcodina							
Subclass Rhizopoda							
Order Testacida							
Family Arcellidae							
Arcella megastoma	12,000		5,300		10,500		
A. vulgaris				5,700			10,250
Family Difflugiidae							
Centropyxis aculeata					5,250	11,600	
C. ecornis	6,000	5,200	10,600	5,700	26,250	11,600	20,500
Difflugia acuminata							
D. tuberculata		15,600	5,300	11,400		17,400	
D. lobostoma	6,000	5,200	5,300				10,250
Class Ciliata							
Subclass Holotricha							
Order Gymnostomatida							
Family Colepidae							
Coleps sp.	6,000					5,800	20,500
Family Heterotrichida							
Paramecium sp.					5,250		10,250
Subclass Pertrichia							
Order Partrichida							
Family Vorticellidae							
Vorticella sp.				5,700	5,250		
Phylum Rotifera (Rotifer)							
Class Monogononta							
Order Ploima							
Family Brachionidae							
Keratella cochlearis				5,700			10,250
K. tecta				11,400			
Family Trichocercidae							
Trichocerca pusilla	6,000					5,800	10,250
Order Flosculariacea							
Family Testudinellidae							
Filinia terminalis			5,300			5,800	
Total quantity							
Phytoplankton	1,494,000	104,000	227,900	307,800	425,250	446,600	174,250
Zooplankton	36,000	26,000	31,800	45,600	57,750	58,000	92,250
Total	1,530,000	130,000	259,700	353,400	483,000	504,600	266,500
Total number of species							
Phytoplankton	12	10	13	13	12	15	12
Zooplankton	5	3	5	6	6	6	7
Total	17	13	18	19	18	21	19
Phytoplankton /Zooplankton	**41.50**	**4.00**	**7.17**	**6.75**	**7.36**	**7.70**	**1.89**
Species Diversity Index	**0.51**	**2.49**	**2.38**	**2.28**	**2.83**	**2.34**	**2.88**

Remark : [1/]cell, filament or colony) for phytoplankton and cell, colony or individual for zooplankton

Source : Field survey by TEAM Consulting Engineering and Management Co. Ltd., July 2015

TABLE 5.3.3-5

RESULT OF BENTHOS SAMPLING AND ANALYSIS (JULY 2015)

Unit : individuals/m^2

Phylum	Station						
	SW1	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**
PHYLUM ANNELIDA							
Class Oligochaeta							
Order Plesiopora							
Family Tubificidae							
Tubifex sp.	1,386	66	154	66	110		
PHYLUM ARTHROPODA							
Class Insecta							
Order Diptera							
Family Chironomidae							
Ablabesmyia sp.		22					
Family Ceratopogonidae							
Culicoides sp.				22			
Order Coleoptera							
Family Noteridae							
Hydrocanthus sp.							22
Family Gyrinidae							
Gyretes sp.							22
Class Malacostraca							
Order Decapoda							
Family Palaemonidae							
Macrobrachium sp.				22			
PHYLUM MOLLUSCA							
Class Gastropoda							
Order Mesogastropoda							
Family Viviparidae							
Filopaludina sp.							
Family Thairidae							
Melanoides sp.	22	88	88	110	22		
Order Basommatophora							
Family Lymnaeidae							
Lymnaea sp.		22					
Class Bivalvia							
Order Veneroida							
Family Corbicullidae							
Corbicula sp.							22
Order Unionoida							
Family Amblemidae							
Pisbryoconcha sp.							22
Total	**1,408**	**198**	**242**	**220**	**132**	**0**	**88**
Total number of species	**2**	**4**	**2**	**4**	**2**	**0**	**4**

Remark : gravel bottom

Source : Field survey by TEAM Consulting Engineering and Management Co. Ltd., July 2015

Details of plankton and benthic organisms for each sampling station can be shown as follows :-

Station SW1**:** 12 species of phytoplankton in 3 divisions were found in this station. Total quantities were 1,494,000 units/m^3. *Oscillatoria* sp. was phytoplankton with the highest abundance (1,404,000 units/m^3). As for zooplankton, 5 species in 2 phyla were identified. Total quantities were 36,000 units/m^3. Protozoa, *Arcella megastoma* was zooplankton with the highest abundance (12,000 units/m^3).

The phytoplankton to zooplankton ratio was 41.5.The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 0.51, it can be said that the aquatic ecology in this station had slight diversity.

Benthic organisms found in this station were 2 species with 1,408 individuals/ m^2 of total quantities. *Tubifex* sp. and *Chironomus* sp. had the highest abundance as 1,386 individual/m^2.

Station SW2**:** 10 species of phytoplankton in 3 divisions were found in this station. Total quantities were 104,000 units/m^3. *Spirogyra crassa* and *Synedra ulna* were phytoplankton with the highest abundance (15,600 units/m^3 of each species). As for zooplankton, 3 species in 1 phylum were identified. Total quantities were 26,000 units/m^3. Protozoa, *Difflugia tuberculata* was zooplankton with the highest abundance (15,600 units/m^3).

The phytoplankton to zooplankton ratio was 4. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.49, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 4 species with 198 individuals/m^2 of total quantities. *Melanoides* sp. had the highest abundance as 88 individual/m^2.

Station SW3 : 13 species of phytoplankton in 3 divisions were found in this station. Total quantities were 227,900 units/m^3. *Synedra ulna* was phytoplankton with the highest abundance of (84,800 units/m^3). As for zooplankton, 5 species in 2 phyla were identified. Total quantities were 31,800 units/m^3. Protozoa, *Centropyxis ecornis* was zooplankton with the highest abundance of (10,600 units/m^3).

The phytoplankton to zooplankton ratio was 7.17. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.38, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 2 species with 242 individuals/ m^2 of total quantities. *Tubifex* sp. had the highest abundance as 154 individual/m^2.

Station SW4 :13 species of phytoplankton in 3 divisions were found in this station. Total quantities were 307,800 units/m^3. *Oscillatoria* sp. was phytoplankton with the highest abundance (102,600 units/m^3). As for zooplankton, 6 species in 2 phyla were identified. Total quantities were 45,600 units/m^3. Protozoa, *Difflugia tuberculata* and *Keratella tecta* were zooplankton with the highest abundance (11,400 units/m^3 of each species).

The phytoplankton to zooplankton ratio was 6.75. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.28, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 4 species with 220 individuals/m^2 of total quantities. *Melanoides* sp. had the highest abundance as 110 individual/m^2.

Station SW5 **:**12 species of phytoplankton in 3 divisions were found in this station. Total quantities were 425,250 units/m^3. *Synedra ulna* was phytoplankton with the highest abundance (131,250 units/m^3). As for zooplankton, 6 species in 2 phyla were identified. Total quantities were 57,750 units/m^3. *Centropyxis ecornis* was zooplankton with the highest abundance (26,250 units/m^3).

The phytoplankton to zooplankton ratio was 7.36. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.83, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 2 species with 132 individuals/m^2 of total quantities. *Tubifex* sp. had the highest abundance as 110 individual/m^2.

Station SW6: 15 species of phytoplankton in 3 divisions were found in this station. Total quantities were 446,600 units/m^3. *Synedra ulna* was phytoplankton with the highest abundance (162,400 units/m^3). As for zooplankton, 6 species in 2 phyla were identified. Total quantities were 58,000 units/m^3. Protozoa, *Difflugia tuberculate* was zooplankton with the highest abundance (17,400 units/m^3).

The phytoplankton to zooplankton ratio was 7.7. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.34, it can be said that the aquatic ecology in this station had high diversity.

For benthic organisms, there was no species found at this sampling time.

Station SW7: 12 species of phytoplankton in 3 divisions were found in this station. Total quantities were 174,250 units/m^3. *Oscillatoria sp. Eudorina elegans Trachelomonas volvocina Synedra ulna* and *Peridinium sp.*were phytoplankton with the highest abundance (20,500 units/m^3 of each species). As for zooplankton, 7 species in 2 phyla were identified. Total quantities were 92,250 units/m^3. *Centropyxis ecornis* and *Coleps* sp. were zooplankton with the highest abundance (20,500 units/$m^3$of each species).

The phytoplankton to zooplankton ratio was 1.89. The amount of phytoplankton was higher than the amount of zooplankton as normal in food chain. Species diversity index (SDI) was 2.88, it can be said that the aquatic ecology in this station had high diversity.

Benthic organisms found in this station were 4 species with 88 individuals/m^2 of total quantities. At this station, there was dominant species of benthos organism.

Fisheries

In the second field surveys, total 46 fish species were observed. 41 fish species were observed at Ong Jor Market. 2 Species, the nile Tilapia and the bagal's *Rohtee barb* were found in the Myinge river and the 6 species of carp and snakehead were found in the Ayeyarwady River. Only bagal's Rohtee barb was caught by the participating local fishermen. All listed species can be summarized in ***Table 5.3.3-6***.

TABLE 5.3.3-6

RESULTS OF FISH SAMPLINGS STUDY DURING 21-22 JULY 2015

Family	Scientific name	San (1987)1/	Ong Jor Market2/	2nd field Survey2/	Longitudinal migratory3/
Cyprinidae	*Changunius changunio*	/	/	-	-
	Barbonymus gonionotus	-	/	-	-
	Puntius chola	/	/	-	-
	Puntius tor	/	/	-	-
	Puntius curmuca	/	/	-	-
	Puntius chrysopoma	/	/	-	-
	Puntius sarana	/	/	-	-
	Puntius ticto	/	/	-	-
	Puntius sophore	/	/	/	-
	Rohtee cotio	/	-	-	-
	Rohtee belangeri	/	/	/	-
	Rohtee alfrediana	/	/	-	-
	Garra lamta	/	-	-	-
	Osteochilus hasseltii	/	-	-	-
	Labeo microphthalmus	/	-	-	-
	Labeo angra	/	/	-	-
	Labeo pangusia	/	-	-	-
	Labeo stoliczkae	/	-	-	-
	Labeo rohita	/	/	-	-
	Laeo boga	/	-	-	-
	Labeo calbasu	/	/	-	-
	Labeo nandina	/	-	-	-
	Amblypharymgodon atkinsoni	/	/	-	-
	Cirrhinus mrigala	/	/	-	-
	Chela sardinella	/	-	-	-
	Rasbora eithovenii	/	-	-	-
	Rasbora rasbora	/	-	-	-
	Danio equipinnatus	/	/	-	-
	Barilius guttatus	/	-	-	-
	Barilius gatensis	/	-	/	-
	Esomus danricus	/	-	-	-
	Epalzeorhynchos siamensis	/	-	-	-
	Laubuca laubuca	/	-	-	-
	Catla catla	/	/	-	-
	Cyprinus carpio	-	/	-	-
	Aspidoparia mora	/	-	-	-
Cobitidae	*Noemacheilus ribidipinnis*	/	-	-	-
	Acanthopsis choirothynchos	/	/	-	-
	Lepidocephalus thermalia	/	-	-	-
	Botia histrionica	/	-	-	-
	Botia berdmorei	/	-	-	-
Characidae	*Piaractus brachypomus*	-	/	-	-
Clariidae	*Clarias batrachus*	/	-	-	-
Schilbeidae	*Clupisoma garua*	/	-	-	-
	Eutropiichthys vacha	/	-	-	-
	Pseudeuteropius acutirostris	/	/	-	-
	Pseudeuteropius taakree	/	/	-	-

TABLE 5.3.3-6

RESULTS OF FISH SAMPLINGS STUDY DURING 21-22 JULY 2015 (CONT'D)

Family	Scientific name	San (1987)[1/]	Ong Jor Market[2/]	2nd field Survey[2/]	Longitudinal migratory[3/]
Pangasiidae	*Pagasius myanmar*	-	/	-	-
Heteropneustidae	*Heteropneustes fossilis*	/	-	-	-
Siluridae	*Wallago attu*	/	/	-	-
	Ompok bimaculatus	/	-	-	-
	Ompok pabo	/	-	-	-
Bagridae	*Mystus bleekeri*	/	-	-	-
	Mystus vittatus	/	-	-	-
	Mystus aor	/	-	-	-
	Mystus cavasius	/	-	-	-
	Mystus corsula	/	-	-	-
	Mystus micropthalmus	/	/	-	-
	Mystus leucophasis	/	-	-	-
Trachysuridae	*Trachysurus jatius*	/	/	-	-
Sisoridae	*Gagata cenia*	/	-	-	-
	Erethistes conta	/	-	-	-
	Bagarius bagarius	/	/	-	-
	Glyptosternum pectinopterum	/	-	-	-
	Glyptosternum conirostre	/	-	-	-
Tetraodontidae	*Tetraodon cutcutia*	/	-	-	-
Synbranchidae	*Fluta alba*	/	-	-	-
Mastacembelidae	*Macrognathus aculeatus*	/	/	-	-
	Mastacembelus armatus	/	/	-	-
	Mastacembelus zebrinus	/	/	-	-
	Mastacembelus unicolor	/	/	-	-
Ophiocephalidae	*Ophiocephalus marulius*	/	-	-	-
	Ophiocephalus striatus	/	/	/	-
	Ophiocephalus punctatus	/	/	-	-
	Ophiocephalus gachua	/	/	/	-
Belonidae	*Xenentodon cancila*	/	-	-	-
Notopteridae	*Notopterus notopterus*	/	/	-	-
Dorosomidae	*Dorosoma chacunda*	/	-	-	/
Engrauridae	*Engraulis telera*	/	-	-	/
Clupeidae	*Ilisha sladeni*	/	-	-	/
	Corica soborna	/	-	-	-
	Gadasia variegata	/	-	-	-
	Hilsa ilisha	/	-	-	/
Mugilidae	*Rhinomugil corsula*	/	-	-	-
Anabantidae	*Anabas testudineus*	/	/	-	/
	Trichogaster pectoralis	/	-	-	-
	Colisa labiosa	/	-	-	-
Gobiidae	*Glossogobius giuris*	/	/	-	/
Centropomidae	*Chanda ranga*	/	/	-	-
Nandidae	*Badis badis*	/	-	-	-
Cichlidae	*Oreochromis niloticus*	-	/	/	-
Anguillidae	*Anguilla bengalensis*	-	/	-	/
		86	41	6	8

Remark: [1/]San, S. 1987. Taxonomic studies of the fished of the Myitnge River. Master of Sciences thesis, The Mandalay University.
[2/]Field survey by TEAM Consulting Engineering and Management Co. Ltd., July 2015
[3/]http://www.fishbase.org/search.php

When considering on fish species listed, and analyzing by using fishbase for information of longitudinal migratory or rivering migratory only 8 species was subject to the rivering migratory. The species was comprised of the Silver shark minnow (*Osteochilus hasseltii*), the gizzard shad (*Dorosoma chacunda*), Anchovy (*Engraulis telera*), the Illish (*Ilisha sladeni*), the river shad (*Hilsa ilisha*), walking perch (*Anabas testudineus*), the yellow goby (*Glossogobius giuris*) and the bengal sea eel (*Anguilla bengalensis*) and the only 3 species that possibly occurs on the constructing site which are the shark minnow, the Bengal sea eel and the walking perch.

Noticing from the second field survey was about finding of juvenile Nile tilapia (ca. 1.5-2.0 cm Total length) on the SW1 and SW2. Actually the Nile tilapia is nesting species and male usually incubating fertilized eggs on buccal cavity and will take care their offspring till the young fish being strong enough to survive in environment which last about 2 weeks after hatching. Present of young Nile tilapia might lead to suggestion that the Nile tilapia had use the pool area as spawning and nursing ground. Same as the Irrawaddy river, which many of juvenile fish species were caught.

	
Carp *Puntius sorphore*	Minnow, *Barilius gatensis*
	
Spiny eel, *Mastacembelus zebrinus*	Yellow tail Rasbora, *Rasobra eithivenii*
	
Glass perchelets, *Chanda ranga*	Striped snakehead, *Channa striata*

PHOTO 5.3.3-5 : FISH SPECIES CAUGHT IN MYITNGE RIVER DURING 21-22 JULY 2015

Fishes species found within the project area and their spawning behaviour

A total of 86 species in 27 families of freshwater fish had been listed within the project area. However, only 3 species were found from both field surveys. Information on water quality and habitats availability in Myitnge River indicated that 5 species of fish in family Cyprinidae including:- *Hypsibarbus myitkyinae*, *Osteobrama belengerii*, *Osteocheilus hasselti*, *Raiamas gatensis* and *Systomus orphoides* are probably appeared within the proposed construction area.

Spawning time, spawning habitats and nursery area of fished in the project area are indicated in ***Table 5.3.3-7***. It is obviously seen that peak of spawning time of fish is ranging between late of summer to early rainy season. Prefer spawning habitats and nursery area were flood areas. Hence, existence of upper dams had cut off supplying massive water volume to prevent flooding of downstream. This prevention along with alteration of water cycle would affect most of downstream fish species in fewer of spawning and nursery area.

TABLE 5.3.3-7

SPAWNING TIME, SPAWNING HABITATS AND NURSERY AREA OF FISHES IN THE PROJECT AREA

Family	Scientific name	Migratory	Peak of spawning	Type of spawning grounds	Nursery ground
Cyprinidae	*Hypsibarbus myitkyinae*	River	Late dry season	Gravels in headwater	Flood Area
	Systomus orphopides	Lateral	Late rainy season	Flood Area	Flood Area
	Osteobrama belangeri	Lateral	Late rainy season	Flood Area	Flood Area
	Barilius gatensis	Lateral	early rainy season	Open water	River
	Esomus danricus	Lateral	Late dry season	Flood Area	Flood Area
	Lepidocephalus thermalia	Lateral	Late rainy season	Flood Area	Flood Area
Clariidae	*Clarias batrachus*	Lateral	Late dry season	Flood Area	Flood Area
	Ophiocephalus striatus	Lateral	early rainy season	Flood Area	Flood Area
	Ophiocephalus gachua	Lateral	early rainy season	Flood Area	River
Cichlidae	*Oreochromis niloticus*	Lateral	All year	Flood Area	Flood Area
Anabantidae	*Anabas testudineus*	Lateral	Late dry season	Flood Area	Flood Area

Data from ***Table 5.3.3-7*** show that nearly all species within the project area are lateral migration which means of fish migrate to lateral of main channel for feeding, spawning and nursery purposed. Only one species of *Hypsibarbus* needs head water stream with rocky and gravel bottom for spawning. In addition, fish performs short migration route to headwater stream of tributaries not the main river channel. As there are not any tributaries within the project area and only one found down the dam site. Therefore, construction of fish passage for this project could be skipped. According to previous report and interview of local fishermen, they expected that construction of dam would benefit their community by increasing of fish catching as the Yeywa dam. So instead of constructing of fish passage, the project should consider more on enhancing of fish productivity in newly established dam.

(4) Conclusions of the Study

a) Station on the Myitnge river (SW1-SW6) had less difference on biotic component comparing to the Irrawaddy river (SW7)

When considering on the Species Diversity Index (SDI) which ranging between 0.51-2.83 and 2.59-2.88 of Myitnge and Ayeyarwady River respectively, it can be said that the aquatic ecosystem of the bigger river was better on providing of living resources for all kind of animals. However, constantly controlled flow regimes from dam discharge as found in Myitnge River might be suitable for less species of aquatic animal which need long period to for adaptation to new environmental condition.

b) Storage water in dam accompany with high nitrogen loaded would lead to Eutrophication of the dam's downstream river.

The dominant group of phytoplankton such as *Oscillatoria* sp. *Synedra ulna* and *Spirogyra crassa* belonged to Cyanophaceae or blue-green algae which prefer high concentration of nutrients to live. Blooming of these microalgae would cause serious problems in future.

Furthermore, the eutrophication is also in concordance with domination of oligochaete worms and the true midge larva. These organisms prefer to live in high organic containing sediments which later would easily to become the polluted area.

c) Fish uses the downstream pool of under the Yeywa dam as spawning an nursing ground

Finding of young Nile Tilapia at SW1 and SW2 during the second filed survey is good supporting evidence to claim that at the pool area of the Myitnge River would at least, be utilized by this species as spawning and nursing ground. This finding is so important of the project to concerning on conserving of the downstream area as sanctuary or preserved area for fish spawning and nursing.

d) Strong, swiftly and low temperature discharge from dam reservoir had cause less fishing abilities and also less the fishing effort.

		
Rohtee, *Rohtee alfrediana*	Indian Giant carp, Catla catla	Pecu (left), *Piractus brachysomus* Rohu (Center), *Labeo rohita*
		
The Myanmar river Pangasius, *Pangasius myanmar*	Wallago, Wallago attu Nile tilapia *Oreochromis niloticus* Walking catfish, *Clarias batrachus*	Silver barb, *Barbonymus gonionotus*
		
Spiny eel, *Mastacembelus favus*	Mixed of the Nile Tilapia Flathead catfish (*Bagarias bagarius*)	Fish retailer at the Ong Jor market

PHOTO 5.3.3-6 : FISH SPECIES FOUND IN LOCAL MARKET (ONG JOR MARKET) DURING 21-22 JULY 2015

5.4 SOCIO-ECONOMIC COMPONENTS

5.4.1 Administrative Organizations and Limits

Village Administration

In accordance with Myanmar governance, village is the last level of local administration under the supervise village tract of township. Since, during the project construction and operation periods, project developer will have to liaise with the village administrative authorities of the village and townships within the project area. The project site managers and supervisors would be suggested to contact the authorities concerned in the villages prior to initiating the implementation in order to establishing an effective collaboration with the administration system.

Myanmar's village administration system is a general pattern among all village tracts of township in Myanmar including the villages in the study area of project.

Village Administrative Structure

The village administrative structure is composed of 1 village headman, appointed by the villagers following the traditional power-separation and self-governance introduced by the British colony system3. Village headman also has about 1-3 lieutenants, depending on the size of village. Moreover, the village has the additional governance structure by mutually representation for 1 group leader from 10 households; in the event that the village consists of 100 households, they will be grouped into 10 groups with 10 leaders, who will support on behave of village headman. The village administrative structure is shown in ***Figure 5.4.1-1*** below.

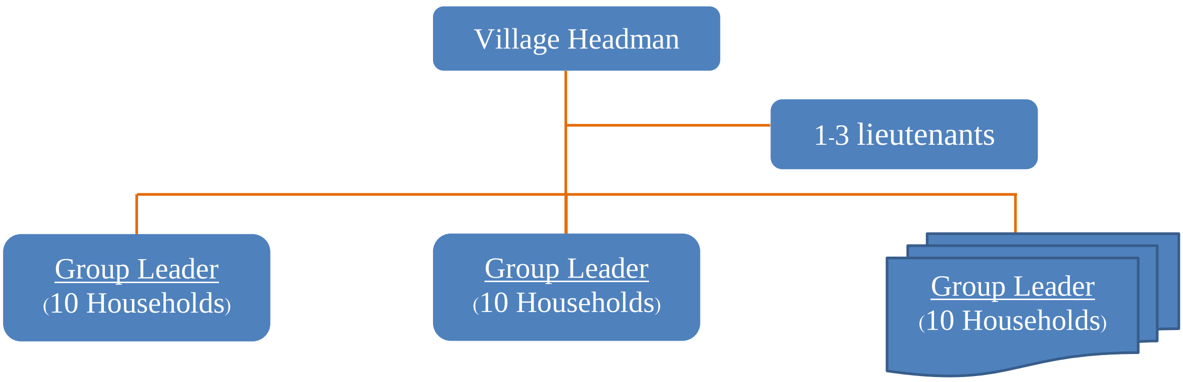


FIGURE 5.4.1-1 : VILLAGE ADMINISTRATIVE STRUCTURE

[3] **Reference**: *Steinberg*, D. I. (2009). *Burma/Myanmar: What Everyone Needs to Know*. Oxford, UK: Oxford University Press.

5.4.2 Land Use

The study of land use in areas of the project alternative sites, related facilities, transmission line and inundated area was carried out during April 19-24, 2015. All obtained information was used for assessing impact upon land use arising from the project development.

Information on existing land use of the study area was established using the following sources of secondary information:

- Satellite image of GOOGLE EARTH (http://earth.google.com)
- Geographical Information System (GIS) of Mandalay Region

In overview, the land uses in the project area and its vicinity are dominated by degraded forest areas and agricultural land. The degraded forest areas cover upland plains, mountains and hills and are thinly covered with bushes, shrubs, and weeds with very few trees. Rural settlements are scattered on plains along the river banks and existing roads. Most of the agricultural land is upland crop cultivation area and is not irrigated. Banana, mango, and lemon trees can be observed in small patches along the Myitnge River banks. These are vegetation along the river banks give the river banks a green appearance.

Detailed land use surveys were conducted covering area in the vicinity of quarry site, project dam site, area along transmission line from power house to Yeywa Substation and inundated area.

(1) Project Dam Site

The study area of about 173.66 acre is characterized by eight types of land use: (i) field crop; (ii) perennial area; (iii) mixed orchard plantation; (iv) pasture and farm land; (v) forest area; (vi) idle land; and (vii) natural water reservoir.The land use types are summarized and illustrated in ***Table 5.4.2-1*** and ***Figure 5.4.2-1***, respectively.

TABLE 5.4.2-1

LAND USE TYPES IN THE PROJECT DAM SITE

Description		Area (acre)	Percentage
A2	Field Crop	39.43	22.71
A3	Perennial Crop	12.70	7.31
A4	Mixed Orchard Plantation	37.57	21.63
A7	Pasture and Farm Land	2.13	1.23
F	Forest Area	51.96	29.92
I	Idle Land	9.00	5.18
W1	Natural Water Reservoir	20.87	12.02
Total		**173.66**	**100.00**

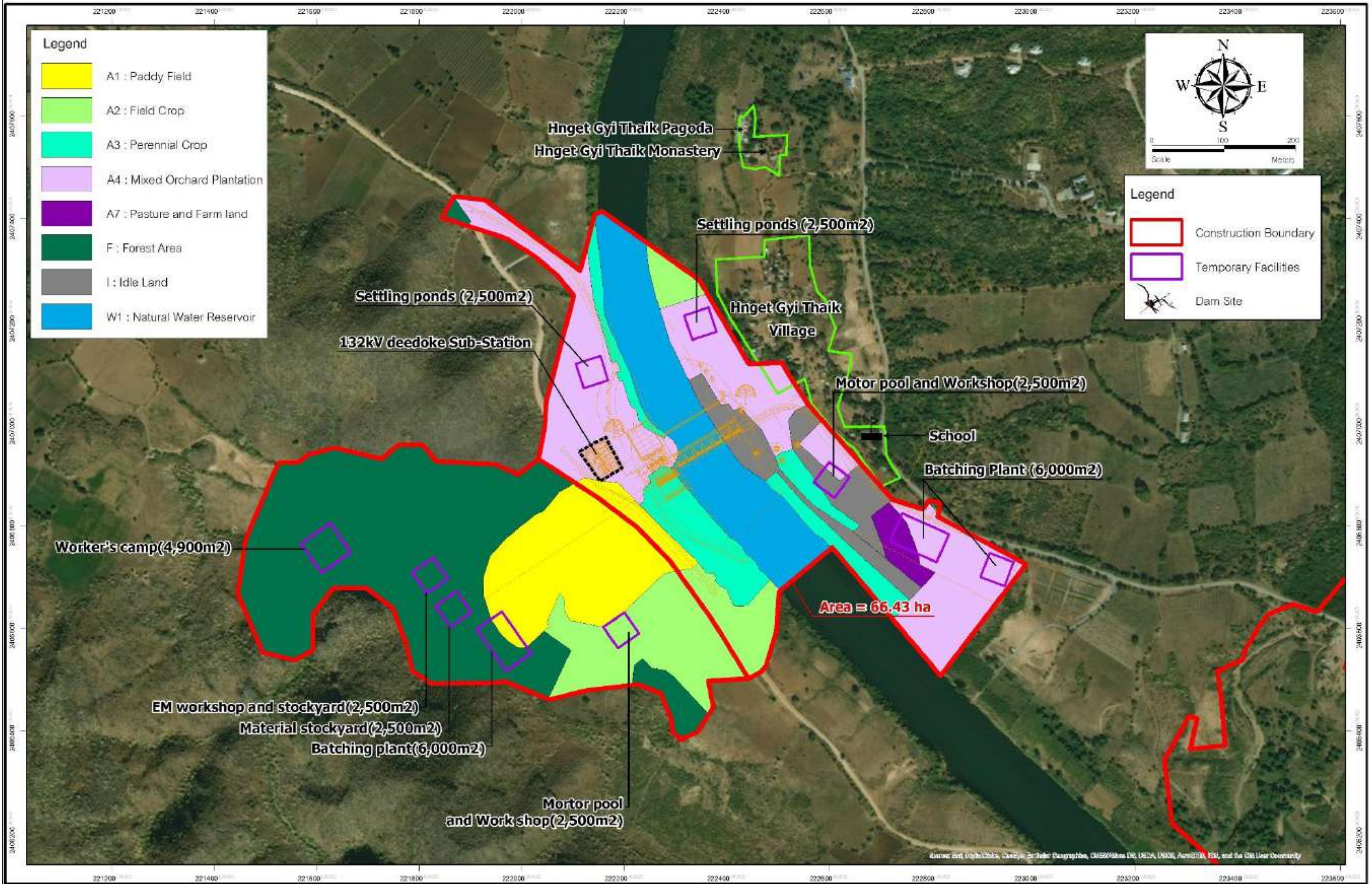


FIGURE 5.4.2-1 : EXISTING LAND USE IN PROJECT DAM SITE

Land use condition of project site as follows;

(a) Site Installation area, most of the left bank side comprises forest area and agriculture area as shown in ***Photo 5.4.2-1***.

PHOTO 5.4.2-1 : LAND USE CONDITION AT THE PROPOSED DAM SITE INSTALLATION

(b) Nearby construction site area, most of the right bank side is community, religious place (the distance between the project construction site and religious place closed to project construction site is about 535 m. as presented in ***Figure 5.4.2-2***) and agricultural area as shown in ***Photo 5.4.2-2*** to ***Photo 5.4.2-5*** while the left bank side is composed of forest area, idle land and agricultural area as shown in ***Photo 5.4.2-6*** to ***Photo 5.4.2-7***. In addition, there is a cultural place "shrine of white horse god" which found in the proposed construction area as shown in ***Photo 5.4.2-7***.

PHOTO 5.4.2-2 : THE MONASTERY AT HNGET GYI THAIK VILLAGE

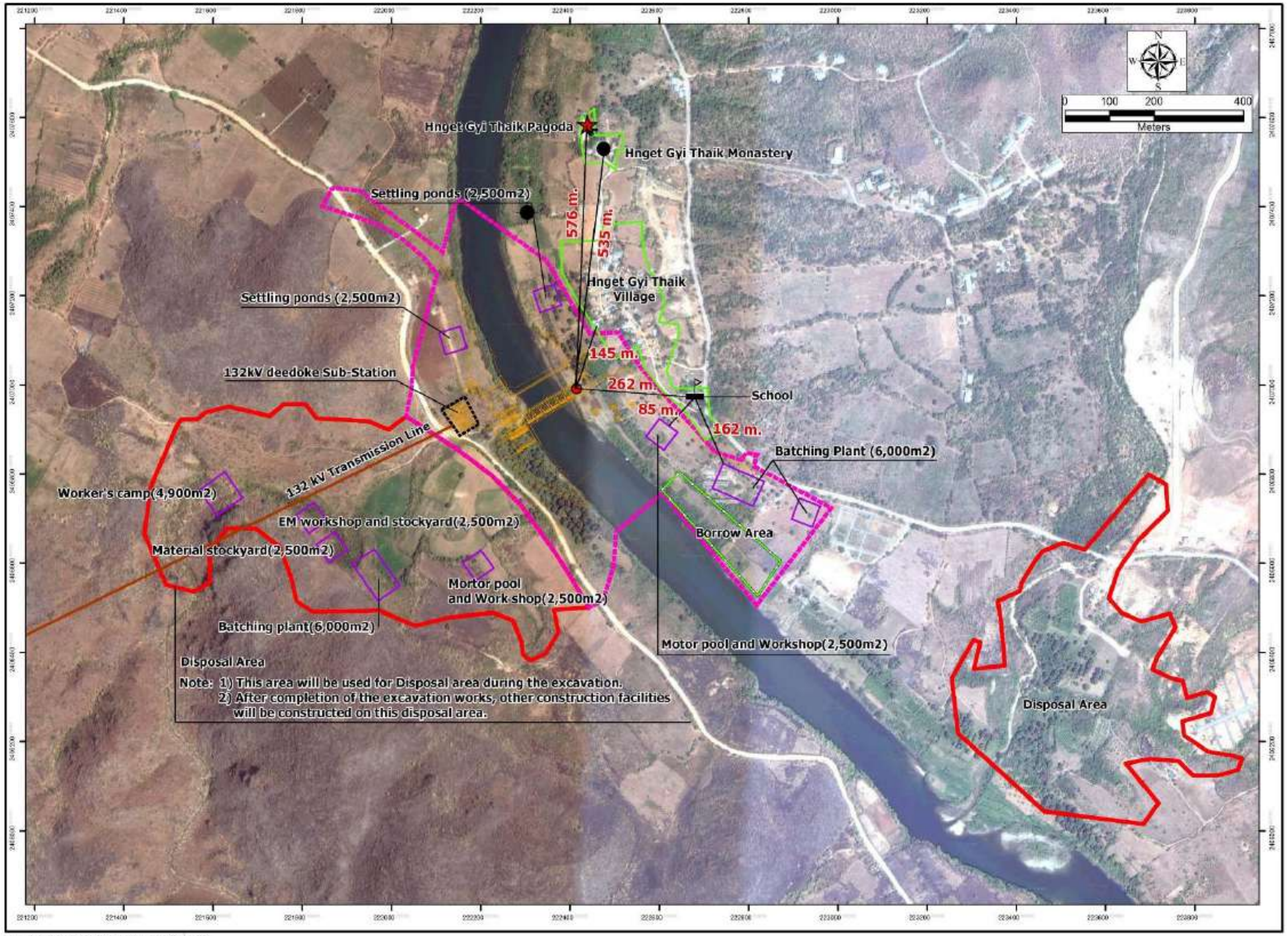


FIGURE 5.4.2-2 : THE DISTANCE BETWEEN THE PROJECT CONSTRUCTION SITE AND RELIGIOUS PLACE CLOSED TO PROJECT CONSTRUCTION SITE




PHOTO 5.4.2-3 : HNGET GYI THAIK VILLAGE


PHOTO 5.4.2-4 : UPSTREAM AREA OF HNGET GYI THAIK VILLAGE


PHOTO 5.4.2-5 : DOWNSTREAM AREA OF HNGET GYI THAIK VILLAGE




PHOTO 5.4.2-6 : LAND USE CONDITION ON THE LEFT BANK OF MYITNGE RIVER AT THE PROPOSED CONSTRUCTION SITE


Existing condition close to dam crest on right side of Myitnge River


Shrine of white horse god at the left bank of Myitnge River

PHOTO 5.4.2-7 : LAND USE CONDITION CLOSE TO DAM CREST ON THE RIGHT BANK OF MYITNGE RIVER AT THE PROPOSED CONSTRUCTION SITE

(c) Access Road, most of the right bank side is community and agricultural area as shown in ***Photo 5.4.2-8*** In addition, there is a primary school closed to the proposed access road for site 54 as shown in ***Photo 5.4.2-9***.

PHOTO 5.4.2-8 : LAND USE CONDITION ON THE RIGHT BANK OF MYITNGE RIVER AT THE PROPOSED ACCESS ROAD FOR SITE

PHOTO 5.4.2-9 : PRIMARY SCHOOL CLOSE TO THE PROPOSED ACCESS ROAD FOR SITE

(2) Related Facilities

The study area of about 36.32 acres is characterized by two types of land use: (i) idle land and (ii) rock pit. The land use types are summarized and illustrated in ***Table 5.4.2-2*** and ***Figure 5.4.2-3***, respectively.

TABLE 5.4.2-2

LAND USE TYPES IN AREA IN THE RELATED FACILITIES

Description		Area (acre)				Total Area (acre)	Percentage
		Quarry 1	Quarry 2	Crashing Plant	Deedoke Camp		
I	Idle Land	-	-	-	11.86	11.86	32.65
M3	Rock Pit	9.88	11.37	3.21	-	24.46	67.35
Total		**9.88**	**11.37**	**3.21**	**11.86**	**36.32**	**100.00**

Source : Field Survey by TEAM Consulting Engineering and Management Co., Ltd., April 2015.

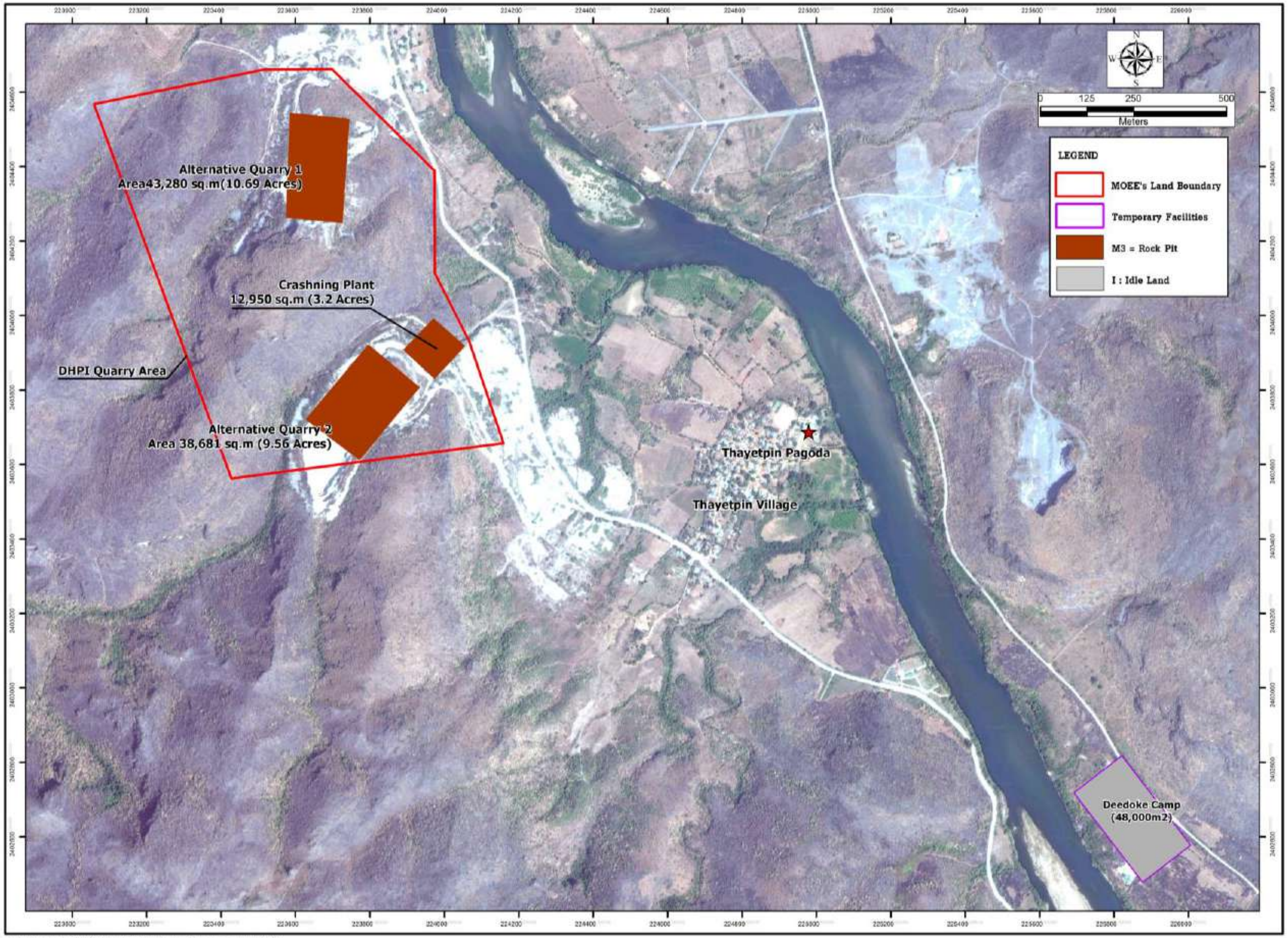


FIGURE 5.4.2-3 : EXISTING LAND USE QUARRIES AND BASE CAMP AREA

Land use condition of area nearby the related facilities as follows;

Land use condition on the right bank side of Myitnge River is shown in ***Photo 5.4.2-10*** while land use condition of the left bank of Myitnge River is shown in ***Photo 5.4.2-11***.

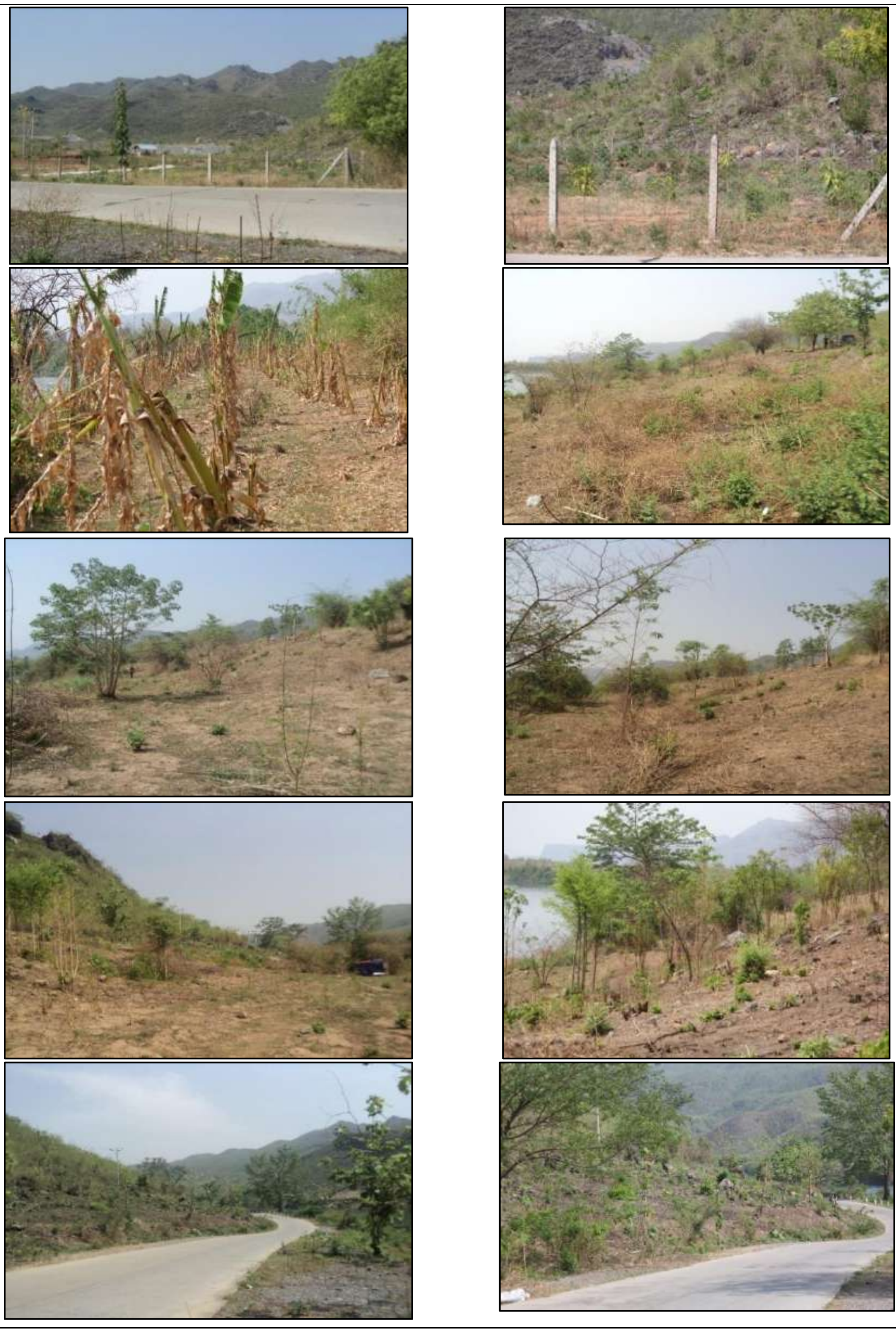


PHOTO 5.4.2-10 : LAND USE CONDITION ON THE RIGHT BANK OF MYITNGE RIVER

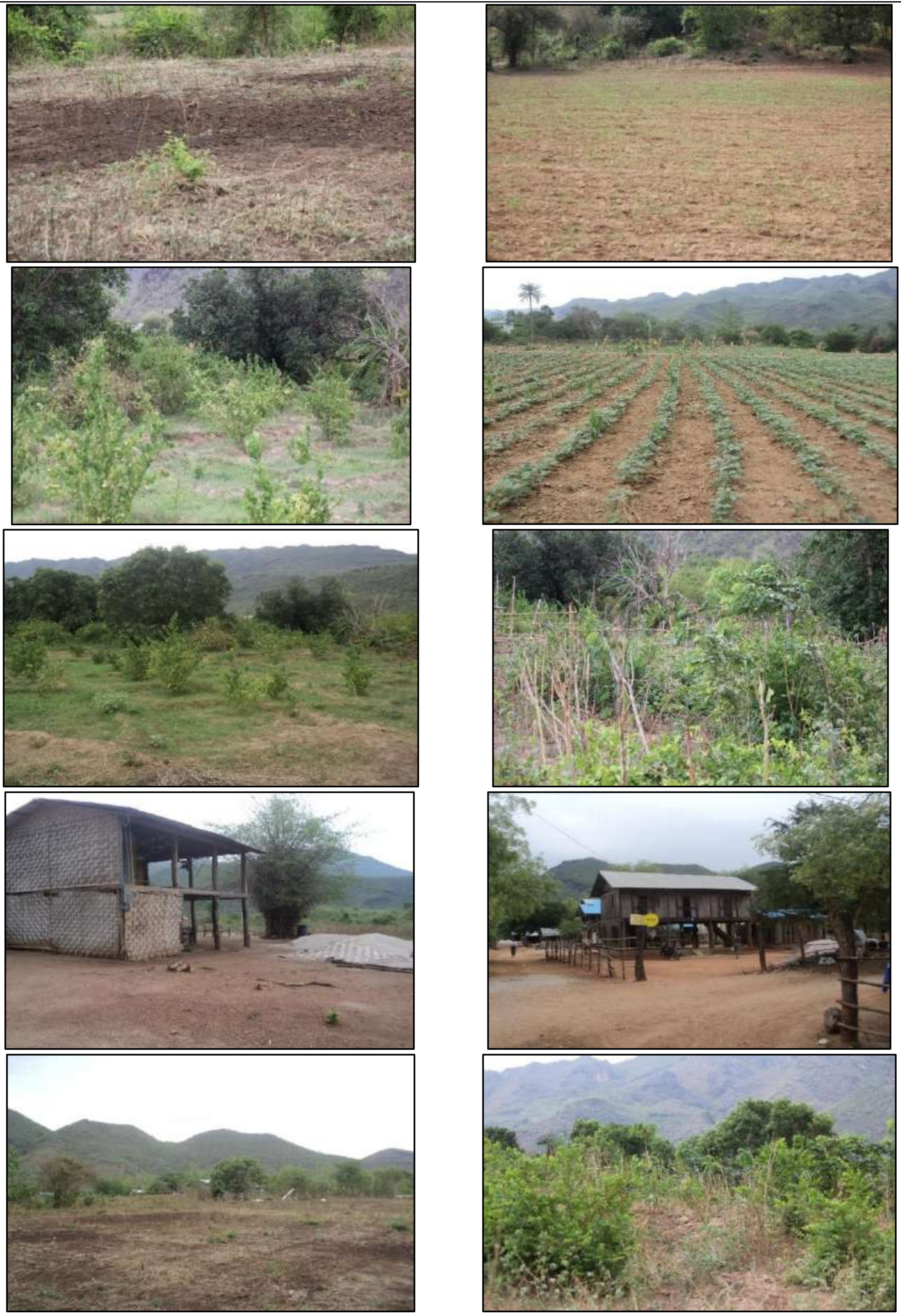


PHOTO 5.4.2-11 : LAND USE CONDITION ON THE LEFT BANK OF MYITNGE RIVER

(3) Area within 25 m strips on both sides of the proposed Transmission Line Alignment

The study area of about 247 acres is characterized by nine types of land use: (i) road; (ii) cantonments; (iii) governmental institute; (iv) fallow land; (v) field crop; (vi) virgin land; (vii) mixed orchard plantation; (viii) forest area; and (ix) quarry site. The land use types are summarized and illustrated in ***Table 5.4.2-3*** and ***Figure 5.4.2-4,*** respectively.

TABLE 5.4.2-3

LAND USE TYPES IN AREA IN 25 M STRIPS OF THE PROPOSED TRANSMISSION LINE ALIGNMENT

Description	Area (acre)	Percentage
Road	1.79	0.72
Cantonments	1.96	0.79
Governmental Institute	2.41	0.98
Fallow land	7.47	3.03
Field Crop	61.78	25.02
Virgin land	51.66	20.92
Mixed Orchard Plantation	2.42	0.98
Forest Area	117.12	47.43
Quarry site	0.33	0.13
Total	**246.95**	**100.00**

Source : Field Survey by TEAM Consulting Engineering and Management Co., Ltd., April 2015.

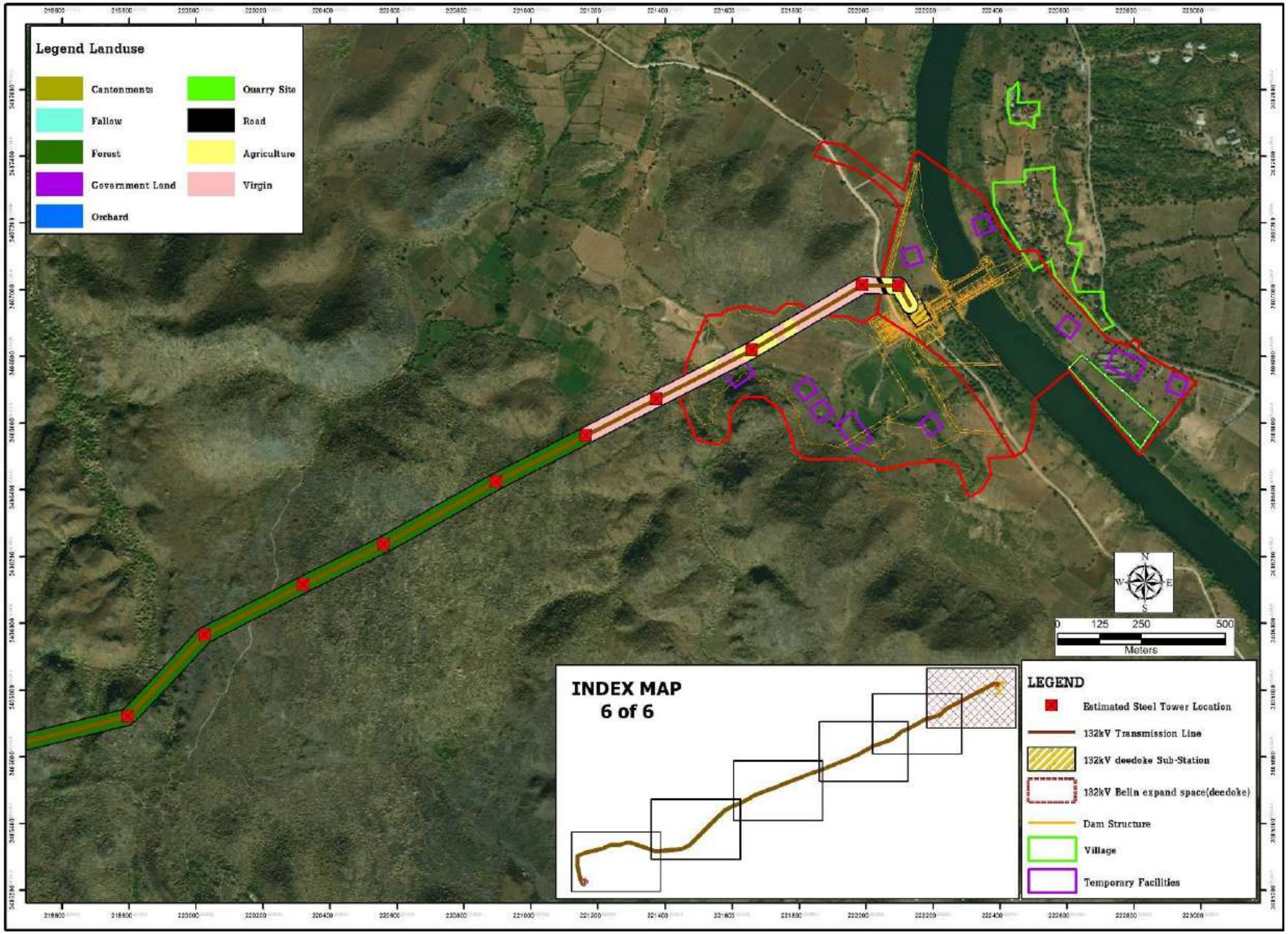


FIGURE 5.4.2-5 : EXISTING LAND USE WITHIN 25 M STRIPS ON BOTH SIDES OF THE PROPOSED TRANSMISSION LINE ALIGNMENT

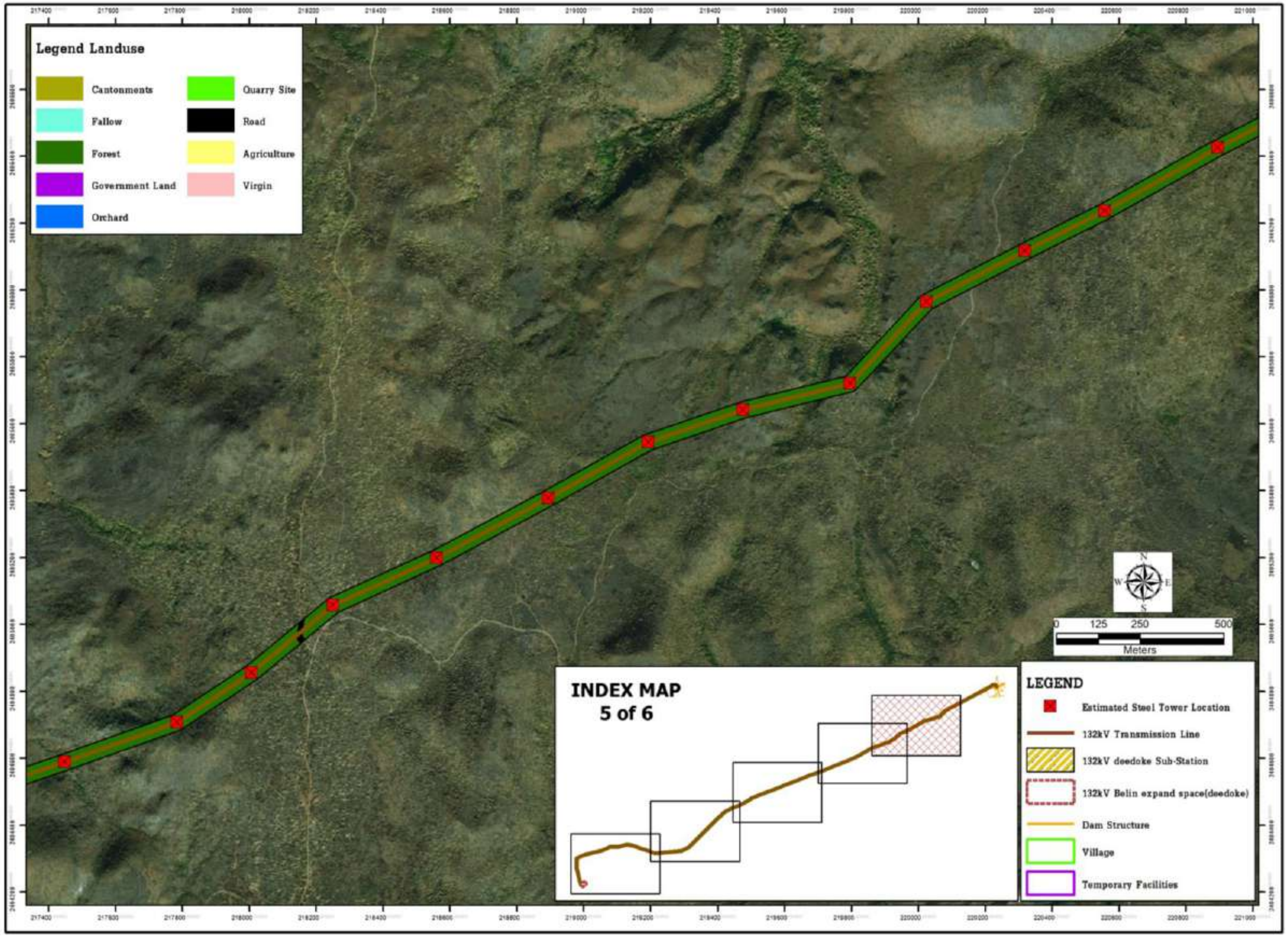


FIGURE 5.4.2-5 : EXISTING LAND USE WITHIN 25 M STRIPS ON BOTH SIDES OF THE PROPOSED TRANSMISSION LINE ALIGNMENT (CONT'D)

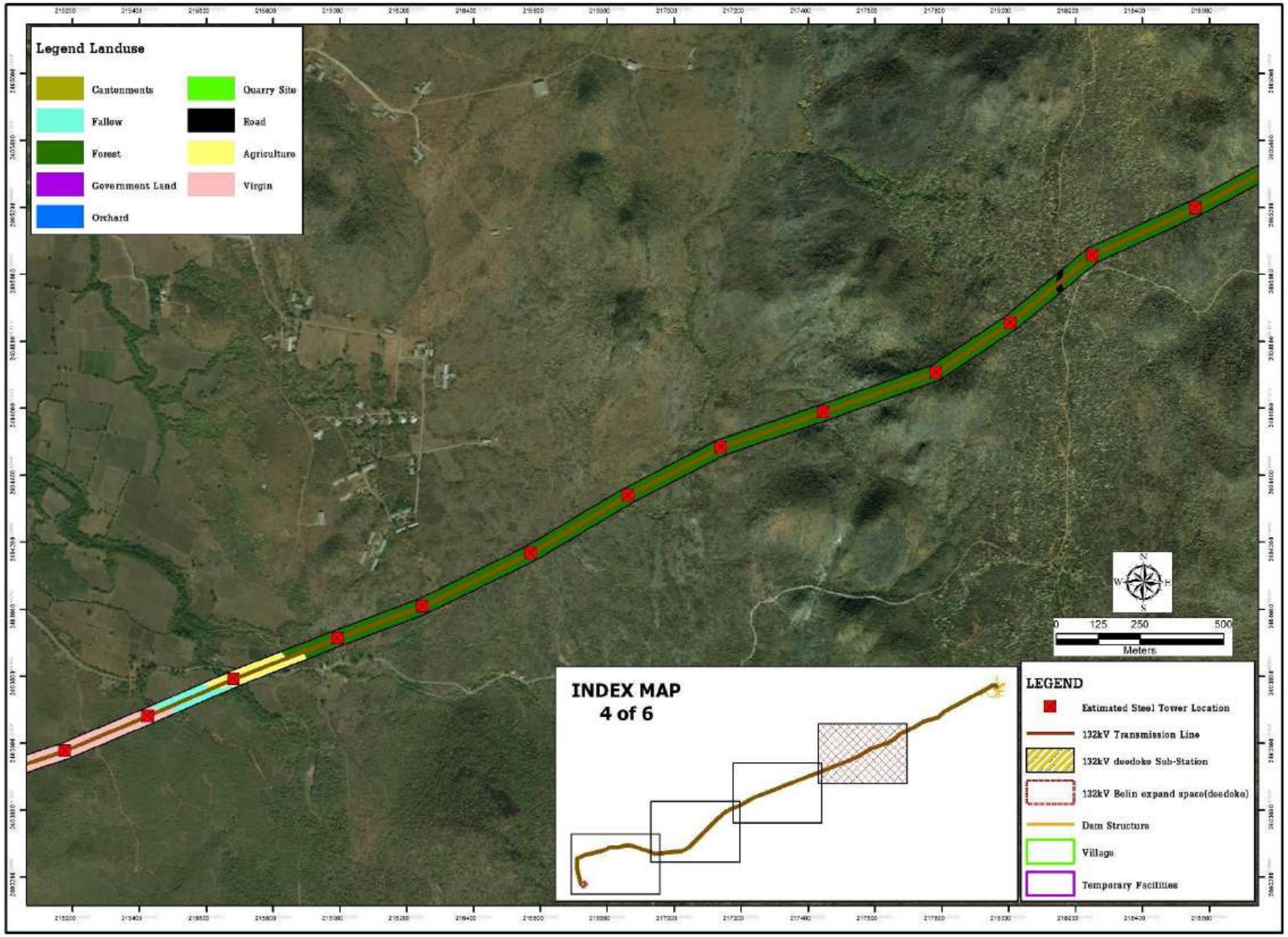


FIGURE 5.4.2-5 : EXISTING LAND USE WITHIN 25 M STRIPS ON BOTH SIDES OF THE PROPOSED TRANSMISSION LINE ALIGNMENT (CONT'D)

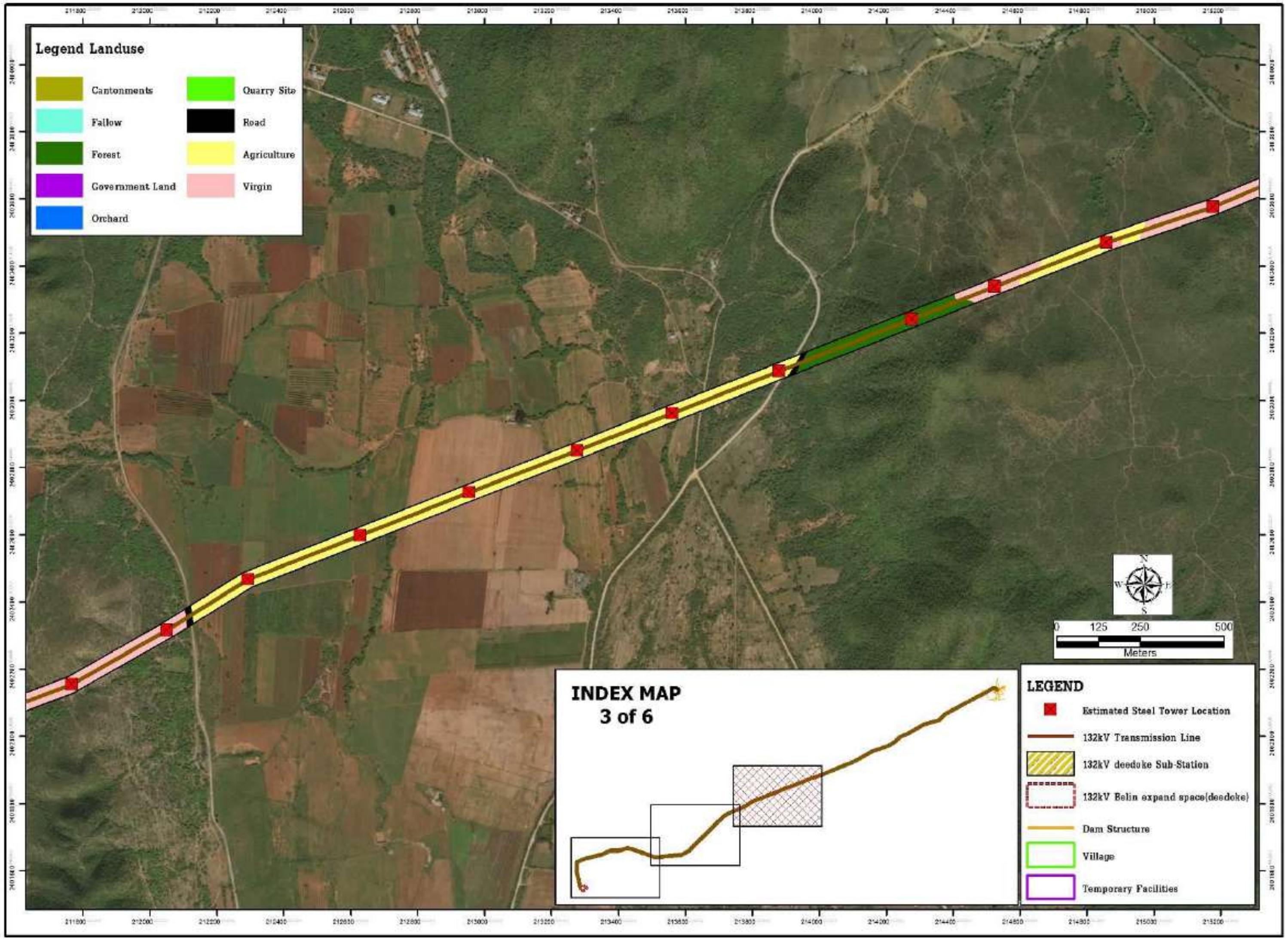


FIGURE 5.4.2-5 : EXISTING LAND USE WITHIN 25 M STRIPS ON BOTH SIDES OF THE PROPOSED TRANSMISSION LINE ALIGNMENT (CONT'D)

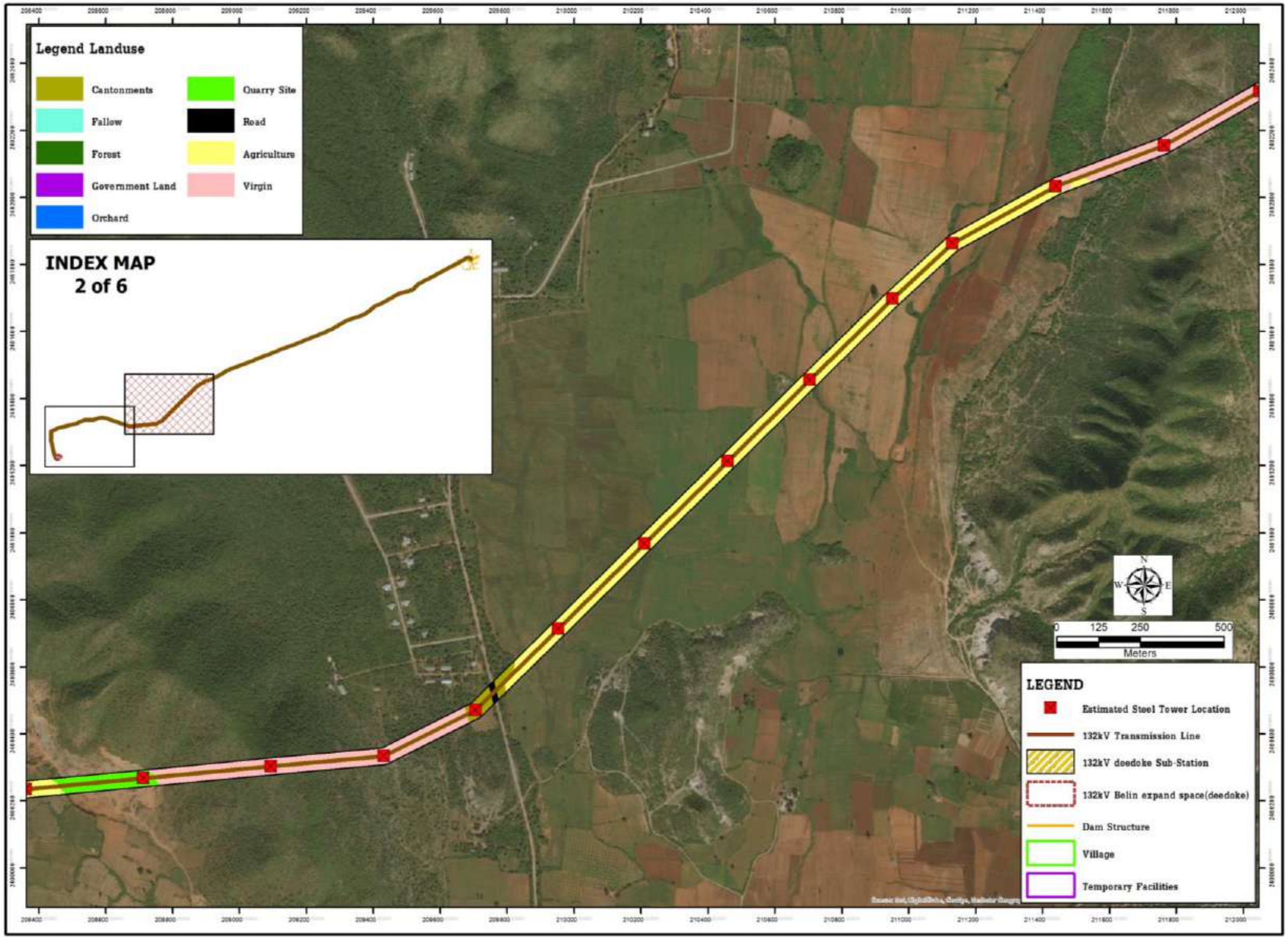


FIGURE 5.4.2-5 : EXISTING LAND USE WITHIN 25 M STRIPS ON BOTH SIDES OF THE PROPOSED TRANSMISSION LINE ALIGNMENT (CONT'D)

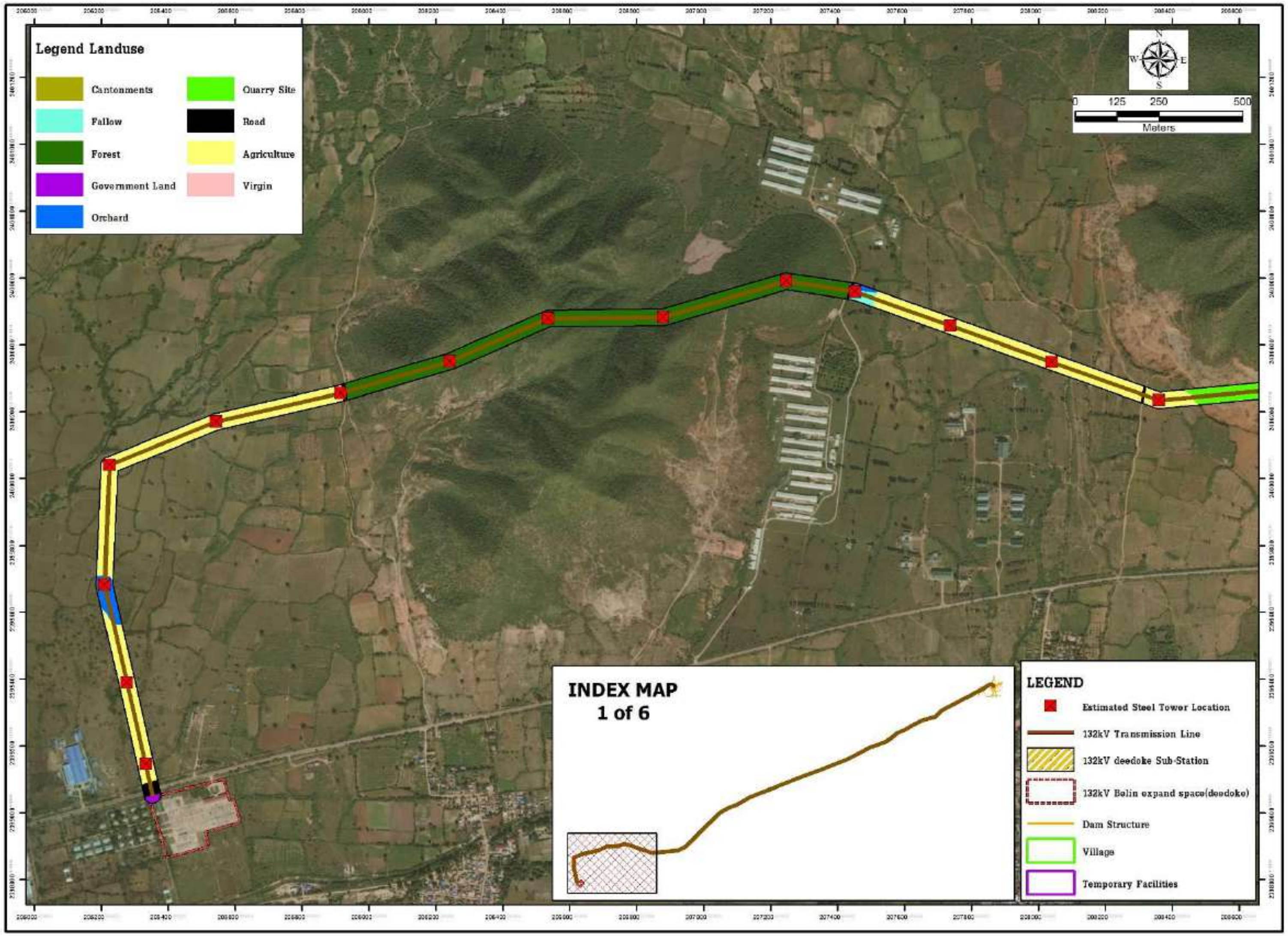


FIGURE 5.4.2-5 : EXISTING LAND USE WITHIN 25 M STRIPS ON BOTH SIDES OF THE PROPOSED TRANSMISSION LINE ALIGNMENT (CONT'D)

As shown in ***Figure 5.4.2-5*** and ***Photo 5.4.2-12***, the transmission line route is planned avoiding national parks, conservation forests, populated areas, buildings and so on.

PHOTO 5.4.2-12 : EXISTING LAND USE ALONG THE PROPOSED TRANSMISSION LINE ALIGNMENT

(4) Inundated Area

The study area of about 280.85 acres is characterized by ten types of land use: (i) community area; (ii) religious place; (iii) governmental institute; (iv) paddy field; (v) field crop; (vi) perennial area; (vii) mixed orchard plantation; (viii) forest area; (ix) idle land; and (x) natural water reservoir. The land use types are summarized and illustrated in ***Table 5.4.2-4*** and ***Figure 5.4.2-5***, respectively.

TABLE 5.4.2-4

LAND USE TYPES IN INUNDATED AREA

Land Use		L2R (Right Bank)		L2L (Left Bank)	
Code	**Description**	**Area (Acre)**	**Number of Tree**	**Area (Acre)**	**Number of Tree**
A1	Paddy Field	1.94		12.92	
A2	Field Crop	4.22		17.18	
A3	Perennials	20.02		10.12	
A4	Mixed Orchard	66.79	1,300 Lemon Trees	40.38	2,800 Lemon Trees
	(Lemon, Banana,		2,000 Banana Clumps		3,500 Banana Clumps
	Mango)		700 Mango Trees		900 Mango Trees
F	Forest	4.40	-	10.89	-
I	Idle Land	66.71	-	7.71	-
W	Waterbody	1.68		15.89	
Total		**165.76**	-	**115.09**	-
		280.85			

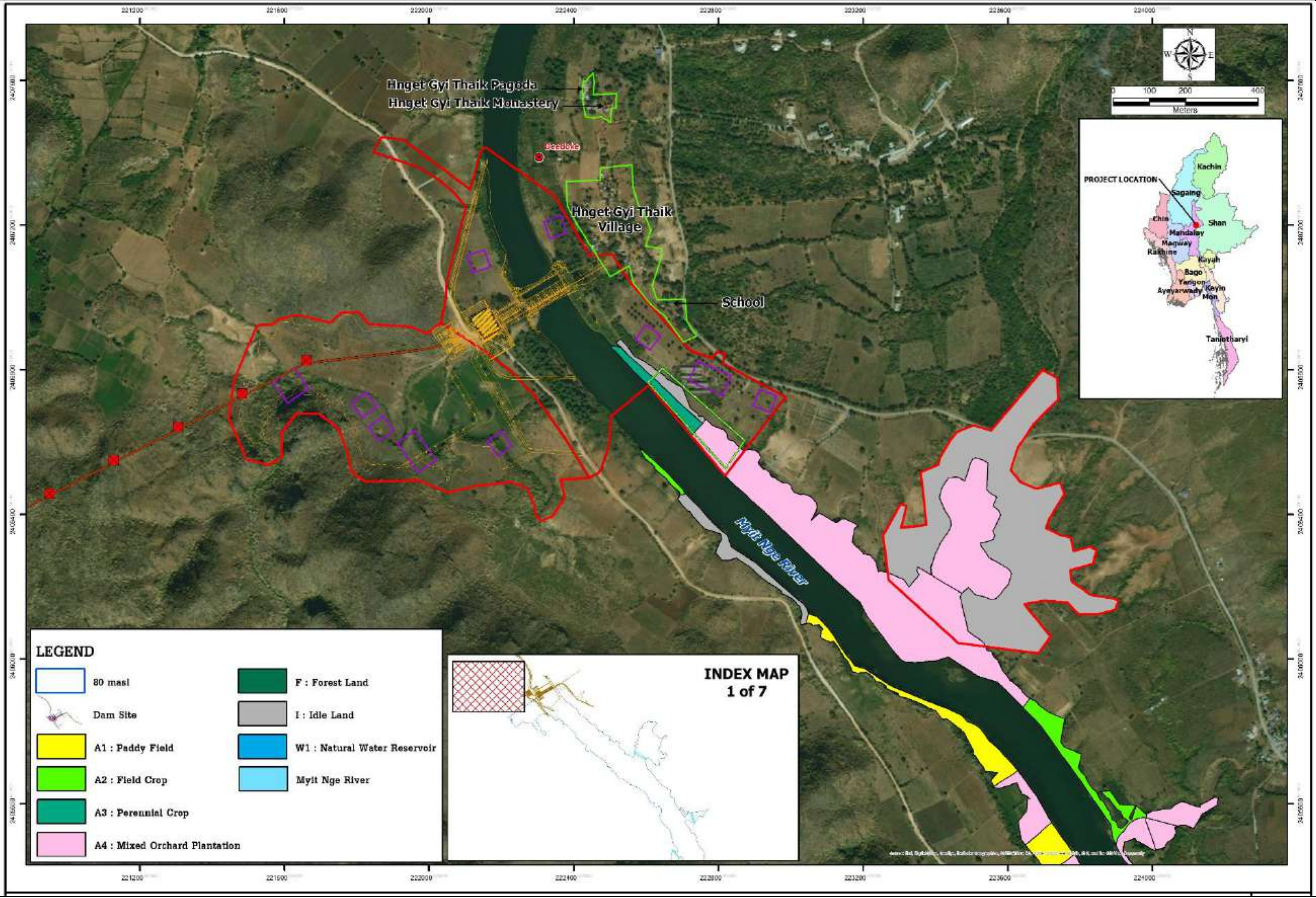


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA

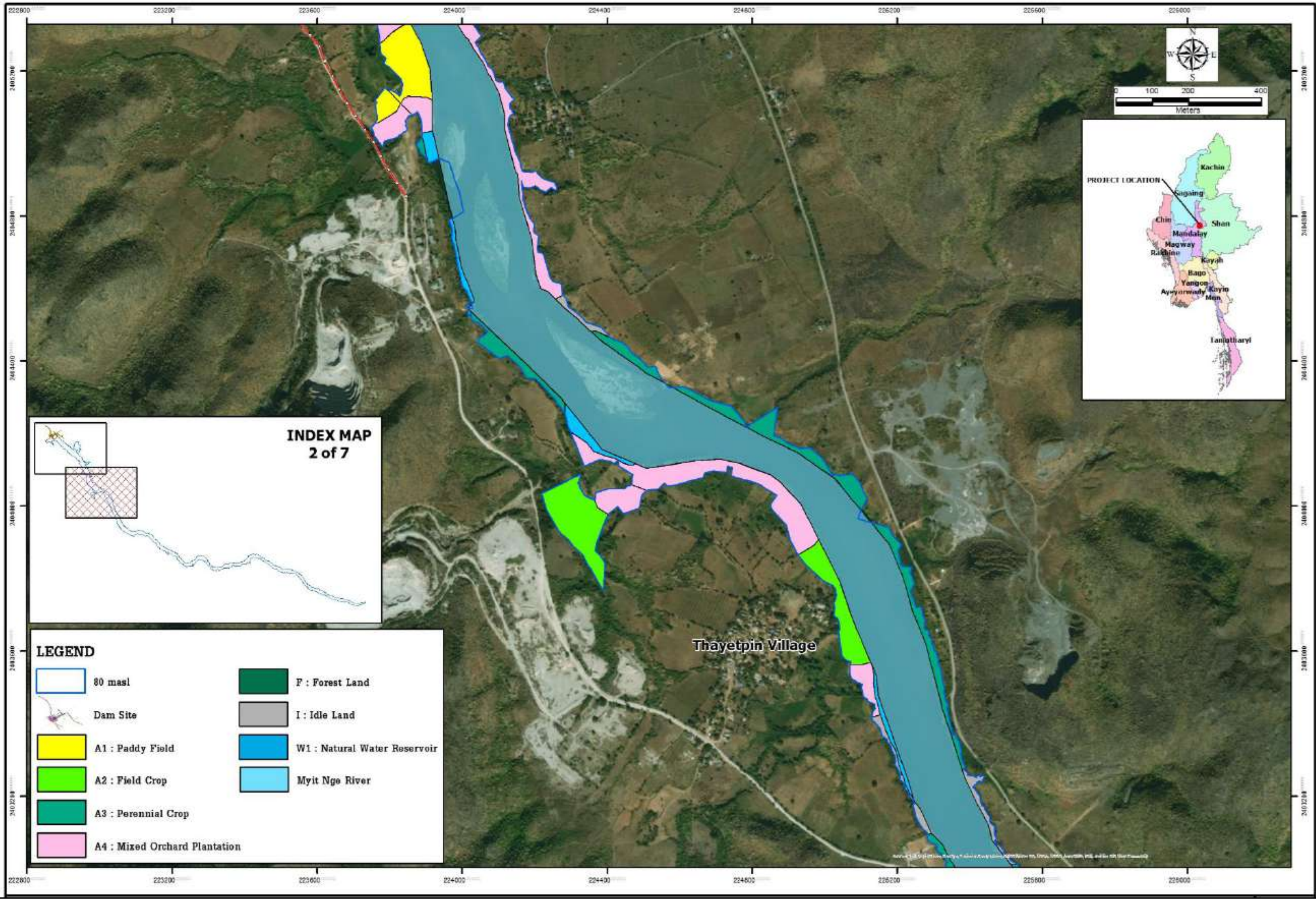


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA (CONT'D)

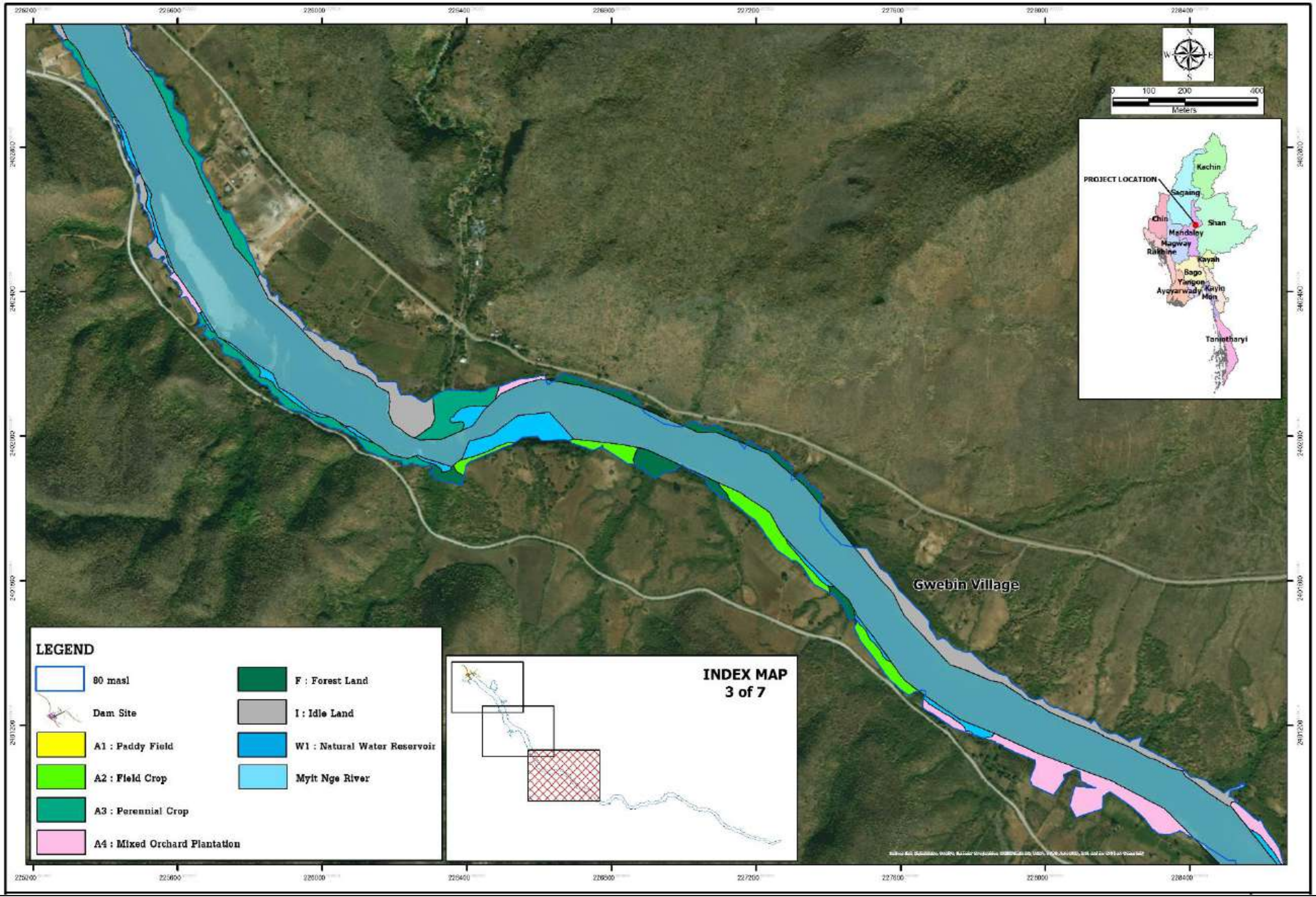


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA (CONT'D)

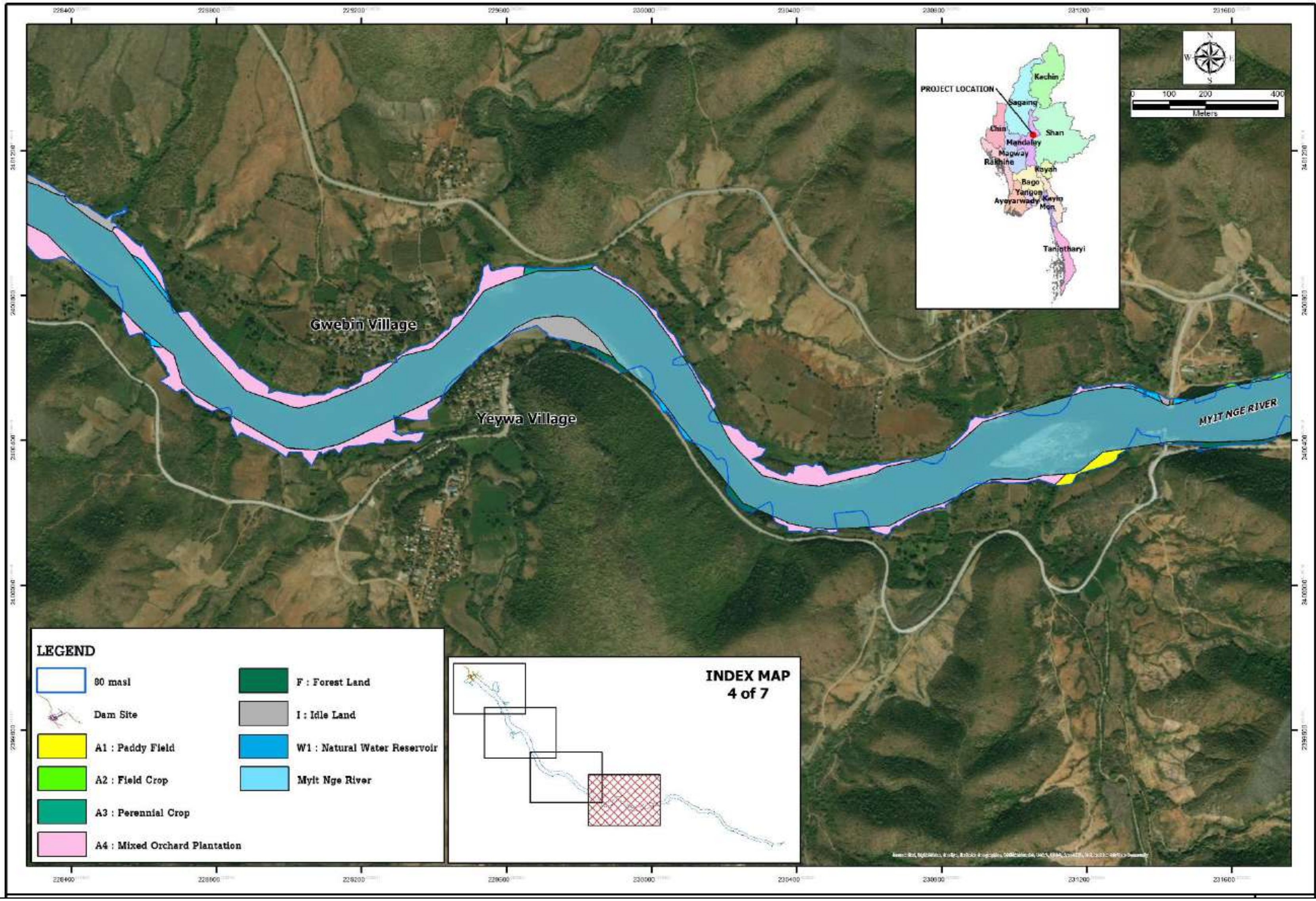


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA (CONT'D)

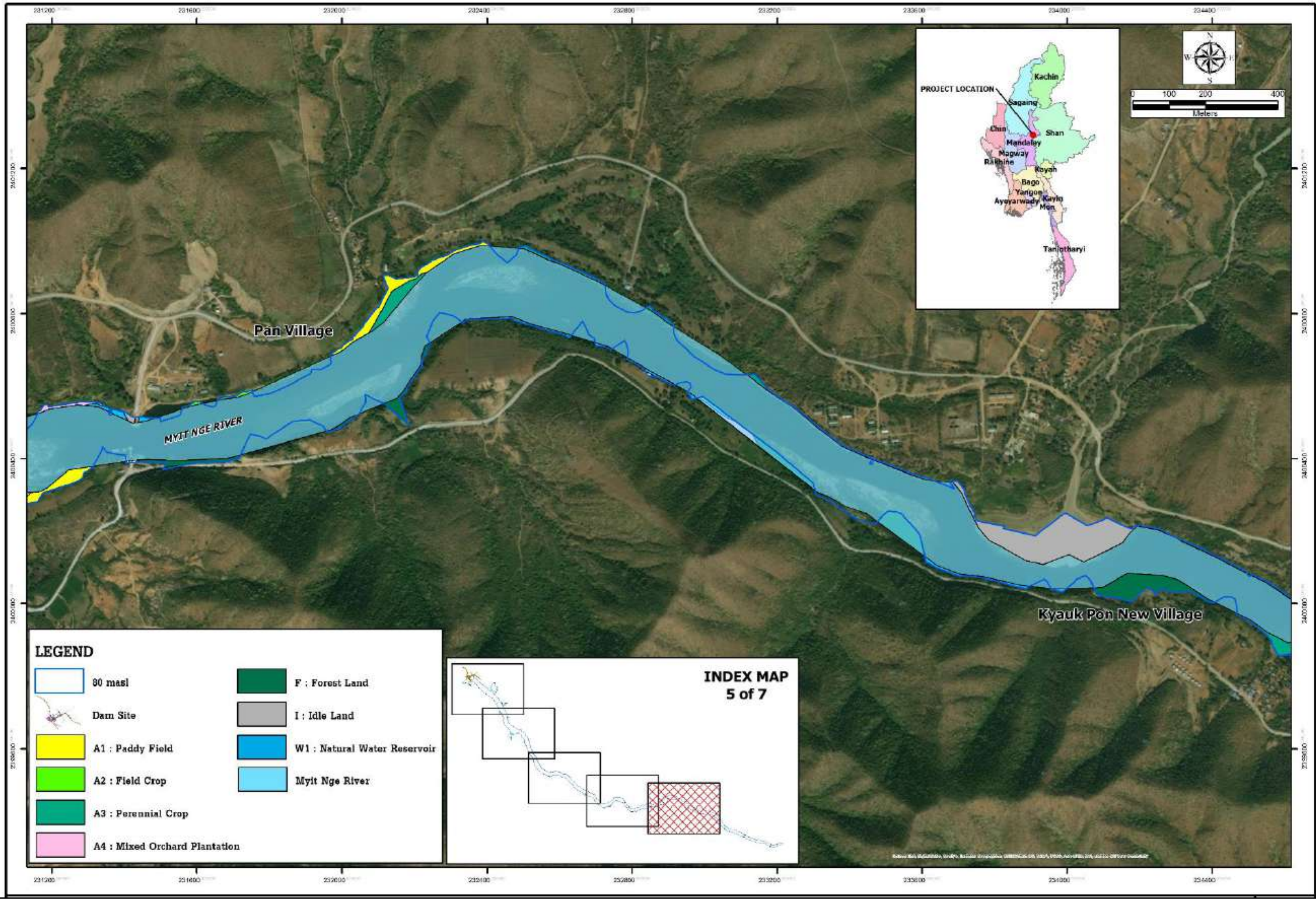


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA (CONT'D)

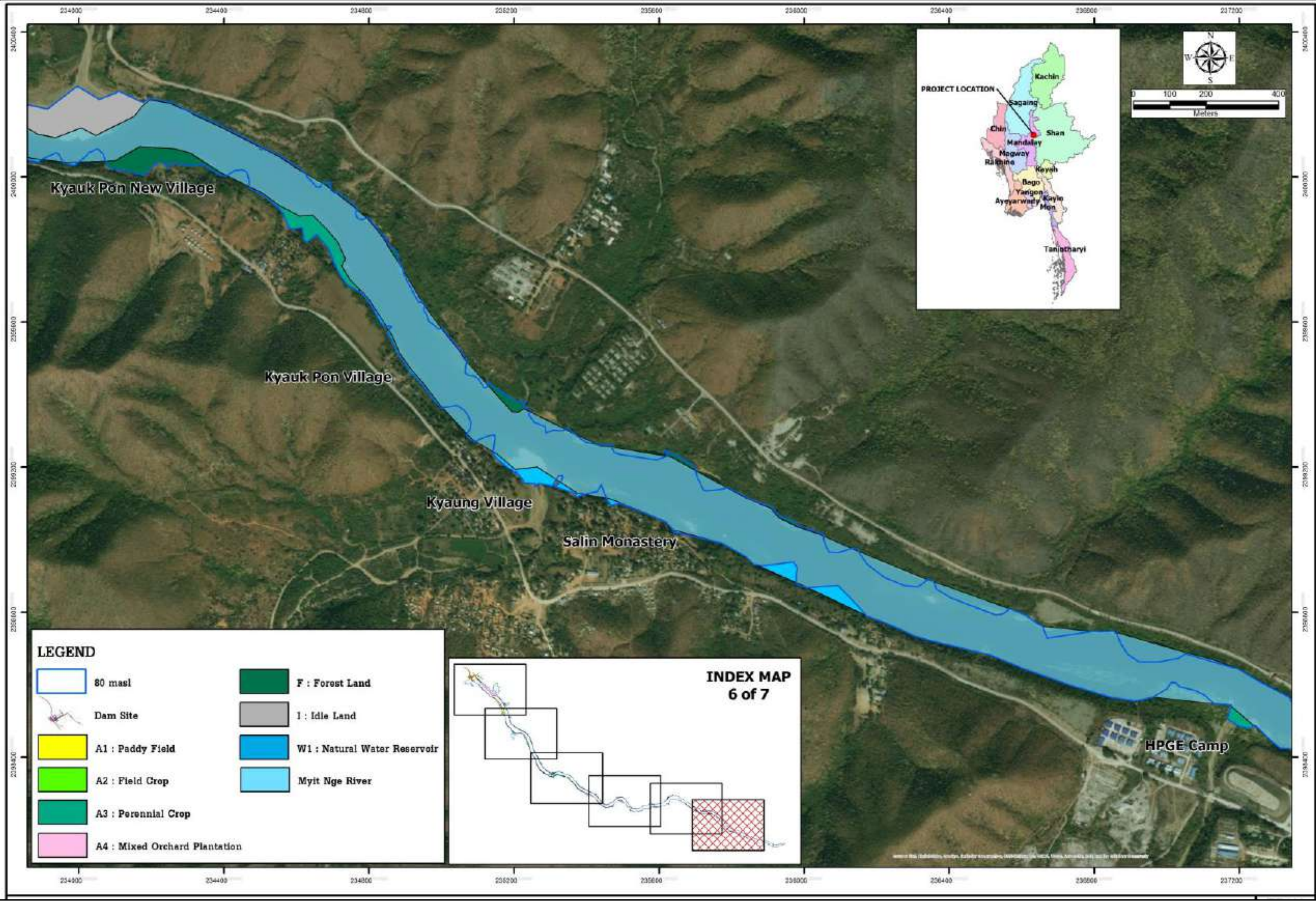


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA (CONT'D)

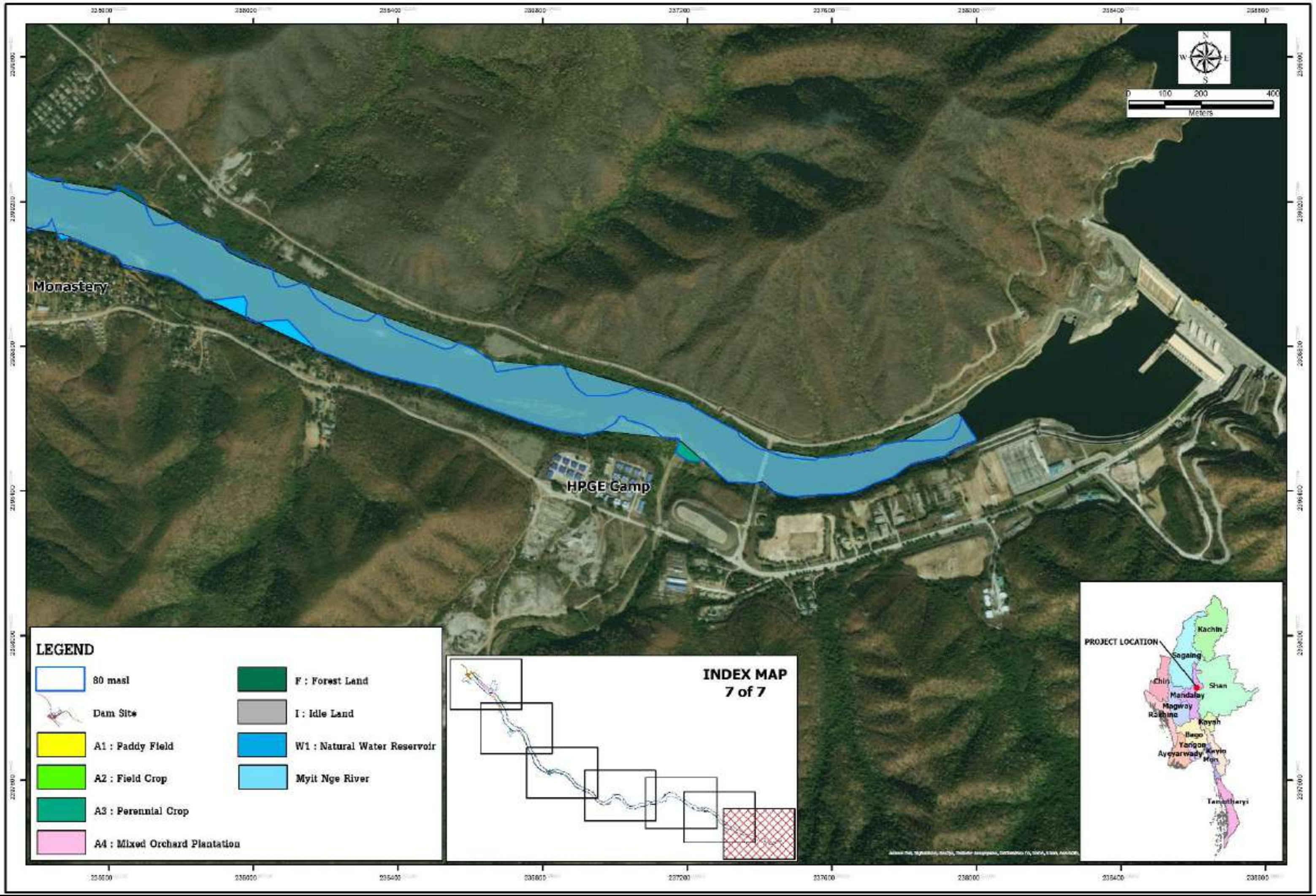


FIGURE 5.4.2-5 : EXISTING LAND USE IN INUNDATED AREA (CONT'D)

Land use condition at the upstream area as follows;

Upstream area, land use condition at the upstream area is shown in ***Photo 5.4.2-13 and Photo 5.4.2-14***.

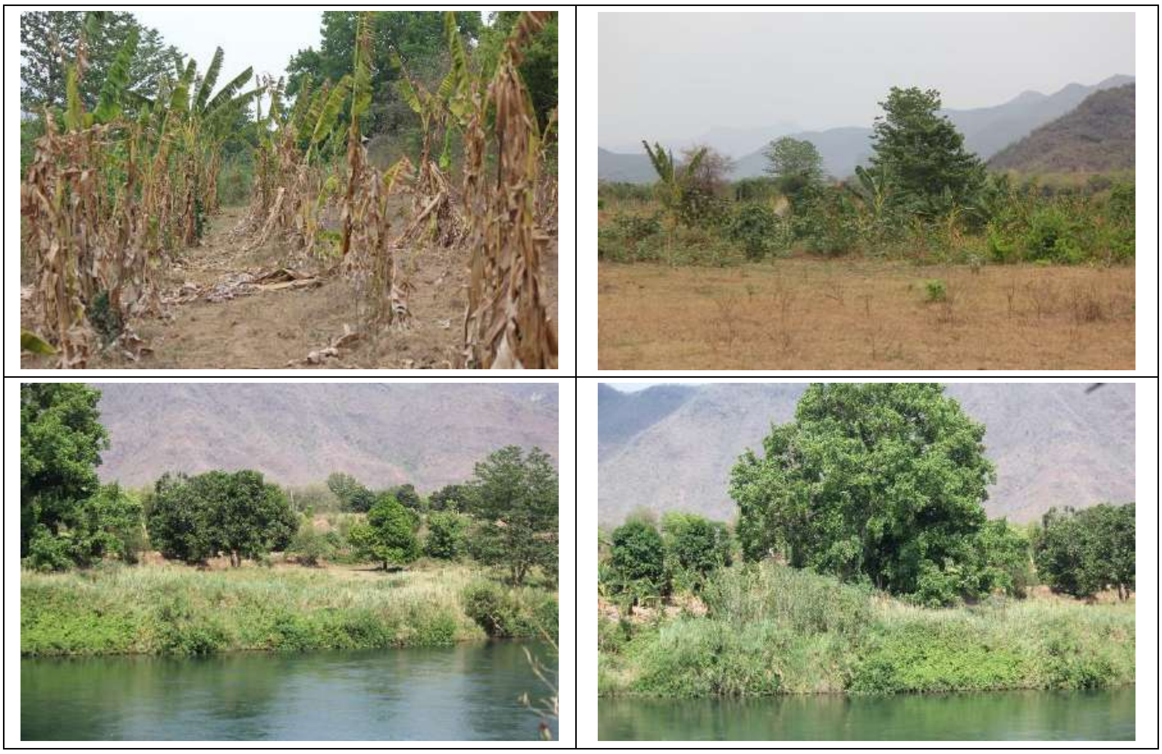


PHOTO 5.4.2-13 : UPSTREAM AREA WHICH WILL BE AFFECTED FROM BACKWATER EFFECT (RIGHT BANK)

PHOTO 5.4.2-14 : UPSTREAM AREA WHICH WILL BE AFFECTED FROM BACKWATER EFFECT (LEFT BANK)

5.4.3 Social Profile

5.4.3.1 Studied Villages

The collection of baseline information on social profile covered four existing villages near the main construction area and the proposed main quarry; namely (i) Hnget Gyi Thaik; (ii) Ma Gyi Inn; and (iii) War Net, all in Pyin Oo Lwin Township; and (iv) Thayet Pin in Kyaukse Township, Mandalay Region.The project site is in the administrative area of Hnget Gyi Thiak village. The four villages may be affected to some extent by the Project through land acquisition, environmental disturbances caused by construction and material transport activities, and inaccessibility to the river for use of river water.

The locations of four villages are indicated in a map in ***Figure 5.4.3-1***. Hnget Gyi Thaik and War Net and Thayet Pin villages are located between the roads and the river while Ma Gyi Inn village is located next to the road, its agriculture area is located on the river bank. Hnget Gyi Thiak village and Thayet Pin village have been established as settlements more than 200 years ago, while Ma Gyi Inn village and War Net village have been settled around 100 years and 52 years, respectively. All four villages have the cluster pattern of settlement as shown in ***Photo 5.4.3-1***.

5.4.3.2 Information Collection

Information on social, economic, and health profiles of the four villages was collected from secondary and primary sources. The secondary information was compiled from statistical records, maps, publications, and online database. The primary information was collected through interviewing sampled persons representing the village and household levels.

At the village level, the interviewed persons were key-informants, including the village headmen and elders of the four villages. At the household level, the interviews covered 134 samples out of a total of 435 households. The sampling number and its distribution are shown in ***Table 5.4.3-1*** and were derived using the statistical-based sampling methodology recommended in the references listed below[4].

TABLE 5.4.3-1

DISTRIBUTION OF SAMPLE SIZE FOR THE SOCIO-ECONOMIC SURVEY IN 4 VILLAGES

Township	Villages	Population	No. of household	Sample size (household)
Pyinoolwin	Hnget Gyi Thaik	317	70	32
	Ma Gyi Inn	420	83	32
	War Net	767	180	10
Kyaukse	Thayet Pin	514	102	60
2 Townships	**4 villages**	**2,018**	**435**	**134**

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

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[1] Israel, Glenn D. 1992.Sampling the Evidence of Extension Program Impact.Program Evaluation and Organizational Development, IFAS, University of Florida.PEOD-5. October
Normann, D.W., F.D. Worman, J.D. Sietbert and E. Modiakgotla, 1995.*The Farming systems Approach to Development and Appropriate Technology Generation*, Food and Agriculture Organization (FAO) of the United Nations, Rome.
Farming Systems Research and Development: Guidelines for Developing Countries. Boulder, Colorado, USA: Westview Press: quoted by Normann et al., 1995.

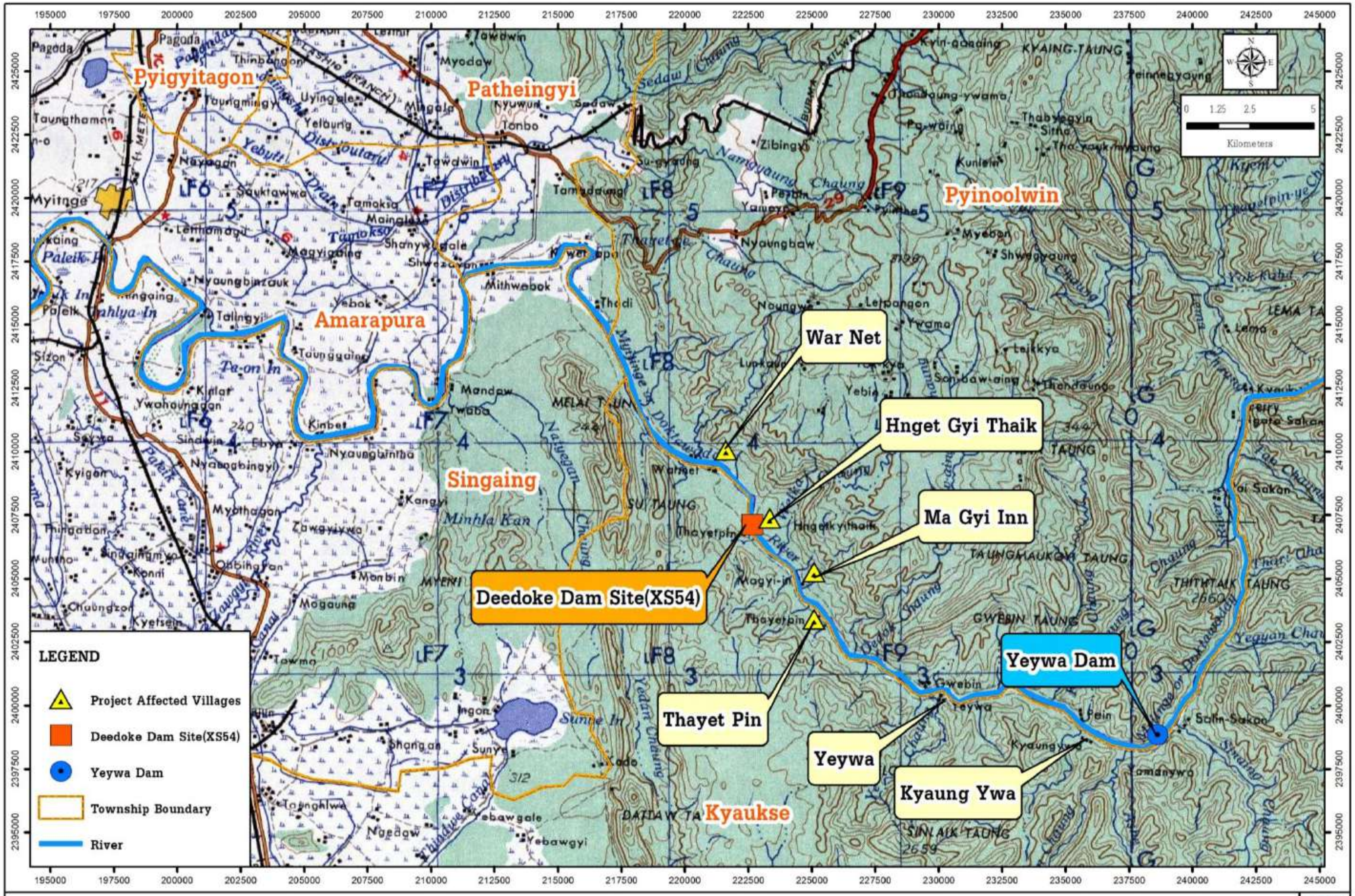


FIGURE 5.4.3-1 : PROJECT LOCATION AND PROJECT AFFECTED VILLAGES

	
Thayet Pin Village	**Hnget Gyi Thaik**
	
Ma Gyi Inn Village	**War Net Village**

PHOTO 5.4.3-1 : VILLAGE SETTLEMENT PATTERN

5.4.3.3 Demography

The four villages are inhabited by 2,018 people living in 435 households giving an average household size of about 4.64 persons. The population consists of 1,061 male and 957 female giving a male to female ratio of 1.11 to 1. This sex ratio is significantly different than the sex ration at the Mandalay Region of 0.90 male to 1 female (2014) and the sex ratio at the national level of 0.99 male(s) to 1female (2014 est.)

Table 5.4.3-1 gives data at the village level. With 767 people, War Net is the largest village. It is noted that the number of males in War Net is significantly higher than the number of females compared to the other villages. This two male dominated village is responsible for the regional and high sex ratio compared to the national average.

In terms of population change, the birth rate in this area is higher than mortality rate. Only a small number of villagers have migrated for outside employment. Apparently, villagers are able to work in the service sector as well as earning their living on agriculture within the townships.

TABLE 5.4.3-2

POPULATION IN THE PROJECT STUDY AREA

Name of Village	Population (April 2015)			House (April 2015)	Family Size (Person/house)
	Total	Male	Female		
Hnget Gyi Thaik	317	154	163	70	5
Ma Gyi Inn	420	160	260	83	5
War Net	767	477	290	180	4
Thayet Pin	514	270	244	102	5
4 Villages	**2,018**	**1,061**	**957**	**435**	**5**

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.3.4 Education

Out of the total 2,018 persons, 331 persons (about 16%) still attend school and university. Most of the remaining population have finished school. Data on their educational attainment was obtained but the informants believed that most of the population completed only primary education. ***Table 5.4.3-3*** gives information on education of the villagers in each village.

TABLE 5.4.3-3

EDUCATION LEVEL IN THE PROJECT STUDY AREA

Education	Hnget Gyi Thaik	Ma Gyi Inn	War Net	Thayet Pin	Total
Total Population	317	420	767	514	2,018
Currently study (person)	61	87	85	98	331
- Pre-school	15	10	18	22	65
- Primary School	42	50	59	50	201
- Secondary and High school	-	20	4	20	44
- University	4	7	4	6	21

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.3.5 Vulnerable Groups

Vulnerable groups were identified in all four villages of the study area as shown in ***Table 5.4.3-4***. The number of vulnerable persons is small compared to the total population. The majority of them are household heads who are over sixty year old. According to key-informants, there is no special program or activity to support these vulnerable people in this area. By social structure, they are taken care of by relatives and neighbors and are living in the communities without difficulties.

TABLE 5.4.3-4

IDENTIFIED VULNERABLE GROUP IN THE PROJECT STUDY AREA

Vulnerable Groups	Hnget Gyi Thaik	Ma Gyi Inn	War Net	Thayet Pin
Disabled in family	2	0	1	6
Head of household over 60 years	3	10	25	35
Head of household are women	10	6	20	12
Persons living alone	1	2	1	1

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.3.6 Minority Groups

Only one family in Thayet Pin village is ethnic Mon. The remaining villagers are Burmese, practicing Buddhism and speaking Burmese language. Therefore, minority group should not be an issue in the project development.

5.4.3.7 Gender Situation

In general, men and women are equal in Myanmar. Therefore, there are no gender issues within the study area. Roles, work division and decision making between men and women are determined by physical conditions, social structure and norms. Decision making on some aspects are on a joint or sharing basis by both male and female as shown in ***Table 5.4.3-5***. Once a decision is made in a family by one party, it will always be respected by another party. For example, men and women are making decisions together on participation in activities in their community, property purchasing and religious activities. While men play a major role in farming and have more political interest, women roles are dominant in food and children's education.

TABLE 5.4.3-5

GENDER ISSUES IN THE PROJECT STUDY AREA

Decision Making	Hnget Gyi Thaik	Ma Ggyi Inn	War Net	Thayet Pin
Children's education	♂	♀♂	♀♂	♀
Cooking	♀	♀	♀	♀
Political	♂	♂	♂	♂
Communicate/Negotiation	♂	♂	♂	♂
Participation in activities in community	♀♂	♀♂	♀♂	♀♂
Participation in activities in religion	♀	♀	♀	♀♂
Purchase of properties	♂	♀♂	♀♂	♀♂
Agriculture Activities	♂	♂	♀♂	♂

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.3.8 Religion

Buddhism is the only religion adopted by the villagers.

5.4.3.9 Political and Social Organizations

Villages in Myanmar may have a number of social groups set up for the purposes of community development and improvement of income and quality of life. Outside civil groups or NGOs also encourage villagers to learn to collaborate and participate.

Key social groups in villages are: mother and child group, women group, youth group, funeral group, social-welfare group, saving group, religious group, health fund, environmental, water quality and health group; malaria prevention group, and TB prevention group.

However, the four villages in the project area have no formal social groups and community based organizations. Villagers meet to form a group when required for particular activities. For example, they meet to respond to local needs related to religious and funeral activities. Each informal and ad-hoc group consists of members who have the same interest and are normally led by the village elders. These groups are usually active, occasionally.

5.4.4 Economic Profile

5.4.4.1 Employment

Table 5.4.4-1 shows data on household occupations in the four villages. Agriculture is the main occupation for most households in the four villages, varying from 50% of households in Hnget Gyi Thaik and 100% in Thayet Pin. Other occupations are trading or small businesses, working with the government, and wage labor. The wage-laborers are usually casual workers earning daily wages. Most small traders open grocery shops in the villages, and some are engaged in buying-selling agricultural products. Only few households earn income from working for government offices in the area.

TABLE 5.4.4-1

HOUSEHOLD OCCUPATION IN THE PROJECT STUDY AREA

Village	Occupation[1/]							
	Agriculture		Trade[2/]		Government officials		Wage labor	
	No. of hh	% of hh	No. of hh	% of hh	No. of hh	% of hh	No. of hh	% of hh
Hnget Gyi Thaik	35	50.00	7	10.00	1	1.43	40	5.14
Ma Gyi Inn	50	60.24	20	24.10	2	2.41	20	24.10
War Net	180	100.00	5	2.78	6	3.33	180[2/]	100.00
Thayet Pin	70	68.63	32	31.37	4	3.92	100	98.04

Remarks : 1/ Some household have more than on occupation
2/ Grocery shop, Purchase of agricultural products etc.
3/ Agriculture sector

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

In line with the occupations, most villagers are self-employed in their farms or small businesses. Most of casual workers in the villages are unskilled labors and skilled labors are few. Daily wages paid to casual workers are not significantly difference between male and female adults, and between boys and girls (see ***Table 5.4.4-2***). Boys and girls get less wages than adults which could be considered normal.

For casual workers, jobs are usually available in the dry season and involve gathering of firewood, charcoal making, construction, and driving (see ***Table 5.4.4-3***). Also, there are patterns of seasonal work in the area; in dry season, villagers of the War Net would gather wood log and make them valuable charcoal. Instead, the villagers of Thayet Pin would work as the construction labor and the driver, when the weather is not suit for agriculture, during 3 months of dry season.

TABLE 5.4.4-2

EMPLOYMENT IN THE PROJECT STUDY AREA

Gender	Wage/day	
	Skilled labor (USD)	Unskilled labor (USD)
Boy	3.38-3.49	1.74
Girl	3.38-3.49	1.74
Male	5.23-6.10	4.36
Female	5.23-6.10	4.36

Remark : Rate of exchange 1,147 kyat = 1 USD
Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

TABLE 5.4.4-3

SEASONAL WORKS AND LABOR

Village	No. of villager	Period	Type of work
Hnget Gyi Thaik	none	-	-
Ma Gyi Inn	none	-	-
War Net	36	Dry season	gathering of firewood, charcoal making
Thayet Pin	30	3 months in dry season	construction labor, driver

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.4.2 Traditional Production System

The villagers used conventional practice in agriculture. However, they use cows in threshing harvested Pea (see ***Photo 5.4.4-1***). In non-agricultural production, weaving of baskets from bamboo is still practiced in most households. The Consultant did not find any other traditional production systems apart from the basketry.

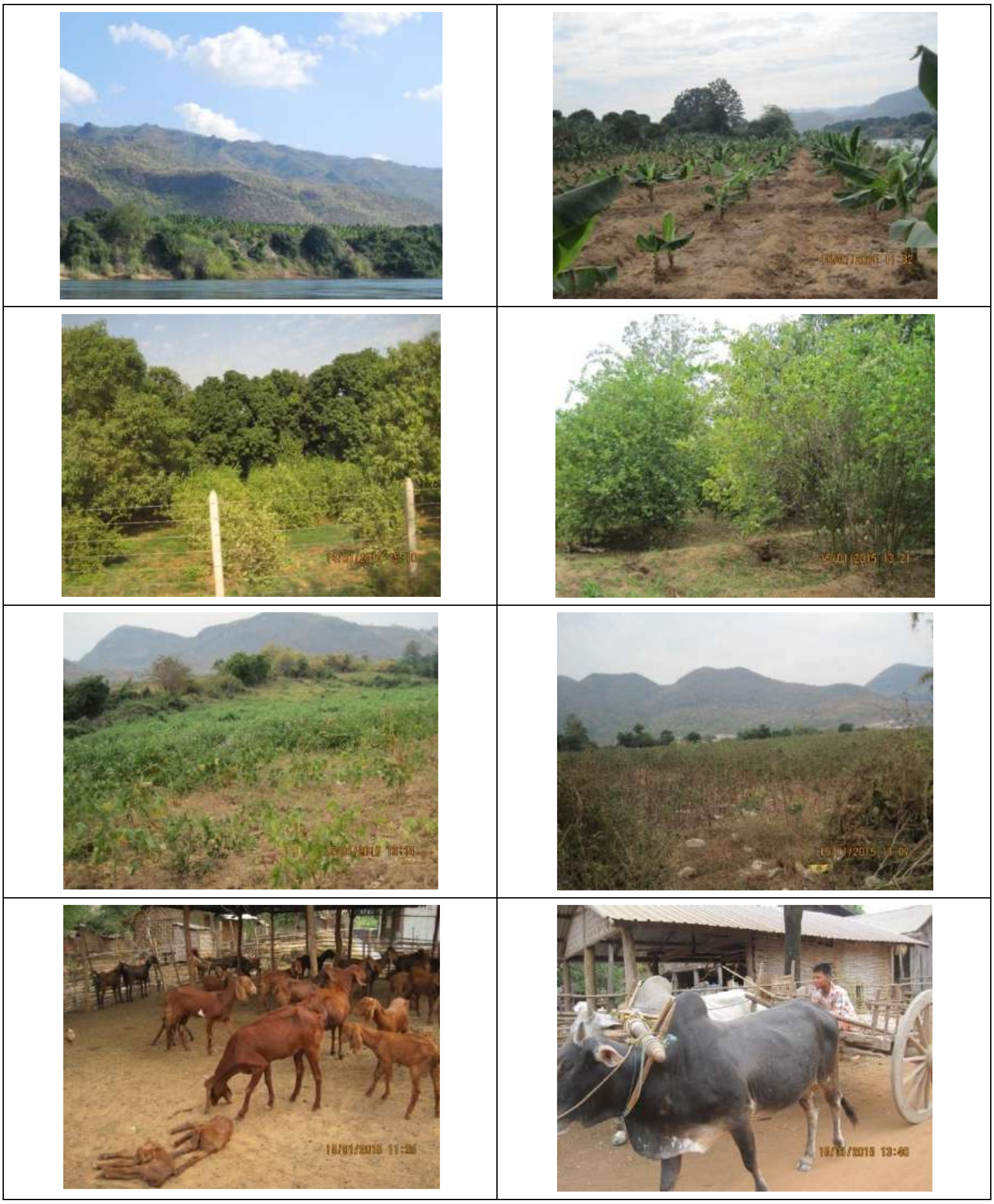


PHOTO 5.4.4-1 : AGRICULTURAL LAND AND LIVESTOCK

5.4.4.3 Household Income and Expenditure

Table 5.4.4-4 presents average annual household income and expenditure of the four villages expressed in USD equivalent at the exchange rate of 1,147 kyat to 1 USD on 17 June 2015. The four villages are not significantly different in average annual household incomes, varying from the lowest 2,045 USD equivalent for War Net to the highest 2,258 USD equivalent for Thayet Pin. In all the villages, the off-farm income was higher than the farm income, accounting for 53% to 58% of the total household income.

TABLE 5.4.4-4

AVERAGE ANNUAL HOUSEHOLD INCOME AND EXPENDITURE, USD EQUIVALENT

USD/hh/year

Income and Expenditure	Hnget Gyi Thaik	Ma Gyi Inn	War Net	Thayet Pin
Average household income	**2,109**	**2,171**	**2,045**	**2,258**
Farm income	991	1,015	985	950
Off farm income	1,118	1,155	1,060	1,308
Average household expenditure	**1,960**	**2,064**	**1,940**	**1,996**
Farm expenditure	210	280	208	327
Household expenditure	1,750	1,784	1,732	1,669
Sufficiency of the household income (% of household)				
Sufficient	53.57	65.00	30.00	58.93
Insufficient	46.43	35.00	70.00	41.07
Debt (% of household)	46.43	45.00	50.00	42.86
Saving (% of household	0.00	0.00	10.00	3.57

Remark : Rate of exchange 1,147 kyat = 1 USD

Source : Household Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

The average annual household expenditure was slightly less than the average annual household income in all four villages, varying from the lowest 1,940 USD equivalent for War Net and the highest 2,064 USD equivalent for Ma Gyi Inn. Therefore, most households in the villages would have no saving and households with debt would be common. The data in ***Table 5.4.4-5*** shows that 40% to 50% of households were in debt and only households in Thayet Pin (3.57%) and War Net (10%) had some saving.

TABLE 5.4.4-5

MAJOR HOUSEHOLD EXPENDITURE

Expenditure	% of Household Expenditure
Food	32.30
Culture/religion	2.55
Social activities	3.74
Tax	1.62
Education	10.79
Cooking Fuel	2.76
Clothes	3.16
Medical Care	2.68
Transportation Cost e.g. Fuel	3.68
House repair	24.14
Communication e.g. Mobile Phone	1.97
Public facilities	3.16
Luxurious items	6.91

Source : Household Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.4.4 Cost of Living

There is no data to assess whether the cost of living in the four villages is comparable to other places in the country which could be used as benchmarks. However, high transportation cost due to poor access roads would make costs of food items supplied by outside sources higher than costs at the supply sources.

5.4.4.5 Land Ownership

Land in the four villages is used for farming and housing. Farm land accounts for three quarters of the total land area while residential area accounts for the remaining quarter. The average land holding per household is around 2.55 to 3.33 acres which are comparable to the national average figure of 2.7 acres per household[5]. ***Table 5.4.4-6*** gives information on land use and average land holding as well as land ownership.

For land ownership, only few households in the four villages have no land. Land ownership documents could be Land Certificate or Tax Receipt for agricultural land.

TABLE 5.4.4-6

VILLAGE AREA AND LAND HOLDING

Name of Village	Farm area (acre)	Residential area (acre)	Area/ household (acre)	Total area (acre)	Type of Land Document
Hnget Gyi Thaik	183	50	3.33	233	Land certificate
Ma Gyi Inn	250	25	3.31	275	Tax Receipt for agricultural land
War Net	350	150	2.78	500	Land certificate
Thayet Pin	172	88	2.55	260	Land certificate

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

In addition, Land price can be categorized into 2 types: Agricultural land which consists of paddy or orchard, and residential area. Agricultural land is measured by acre while residential land is measured by square meter. The price of both categories varies greatly by location, and especially the road accessibility.

5.4.4.6 Local Businesses

Local businesses are small grocery shops in the villages. Clients are people in the villages. Some household of 4 villagers purchase of agricultural product from the villagers and collect for sat to merchants in Mandalay.

[5] Myanmar Agriculture in 2011:Old Problems and New Challenges**,** Ash Center for Democratic Governance and Innovation, Harvard Kennedy School, November 2011
A Strategic Agricultural Sector and Food Security Diagnostic for Myanmar prepared for USAID/Burma, Michigan State University (MSU) and the Myanmar Development Resource Institute's Center for Economic and Social Development (MDRI/CESD), July 2013
Case Study on Land in Burma, Giles Henley for the Overseas Development Institute (ODI), March 2014

5.4.4.7 Agriculture

Agricultural activities within the four villages vary depending on sizes of land plots. Lime, mango and pea are dominant for 2 to 2.5 acre land plots, and banana, cotton and sesame for 1 to 2 acre land plots as shown in ***Table 5.4.4-7***. Only lime and banana yield fruits all year round while the rests are seasonal. These agricultural activities are for commercial purpose for household income generation.

TABLE 5.4.4-7

AGRICULTURE ACTIVITY

Type of Plants	Seeding-Harvest Period	Land Size (acre/hh)
Lime	Throughout the year	2-3
Mango	Jan-Apr	2.3
Pea	Aug-Dec	2-2.5
Banana	Throughout the year	1.76
Cotton	Apr-Sep	1-2
Sesame (1-2 crop/year)	May-Jul	1-2

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

Apart from growing crops and fruit trees, all households in the four villages also engage in livestock raising such as pig, poultry, cattle, and goat. Every household raises chicken from 5 to 50 heads mainly for household consumption (see ***Table 5.4.4-8***). Some households raise pigs from 1 to 5 heads for sale. A significant number of households of War Net and Ma Gyi Inn raise goats for household consumption and sale. Cattle are raised for various purposes including use in farm activities, sale and household consumption. Some pictures of agricultural land and livestock activities are shown in ***Photo 5.4.4-1***.

TABLE 5.4.4-8

LIVESTOCK

Livestock	Hnget Gyi Thaik		Ma Gyi Inn		War Net		Thayet Pin		Purpose
	% of hh	Head/hh	% of hh	Head/hh	% of hh	Head/hh	% of hh	Head/hh	
Swine	7.00	5	3.00	4	2.00	2	10.00	1	sale
Poultry	100.00	10-50	100.00	10-50	100.00	10-100	100.00	5	Consumption/sale
Cow	100.00	2-3	60.00	3	6.00	2-300	50.00	2	Farm activity/sale/ consumption
Goat	0.00	0	3.00	20	6.00	80	0.00	0	Consumption/sale

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

5.4.4.8 Forestry

The project area has no forest areas. Therefore, the villages have no forest-based livelihood opportunities apart from firewood collection from vacant land.

5.4.4.9 Fisheries/Aquaculture

No households in the four villages engage in fisheries or aquaculture. After completion of the Project, the expanded river behind Deedoke Dam may open up opportunities in fisheries and aquaculture.

5.4.4.10 Industries

No industries in the project area.

5.4.4.11 Mineral Development

No mining activities in the project area apart from rock quarrying.

5.4.4.12 Tourism

Tourism practically does not exist in the project area. Yeywa Dam is not open for tourists. The dam and the expanded river may open up tourism opportunities.

5.4.5 Health Profile

5.4.5.1 Access to health services

Table 5.4.5-1 lists health and medical facilities that the villagers could access. Mandalay Hospital is the service center for serious medical cases.

TABLE 5.4.5-1

HEALTH FACILITIES

Item	Hnget Gyi Thaik village	Thayet Pin village
Hospital	Mandalay hospital (24 miles)	Mandalay hospital (36 miles)
Small hospital	Jong Mee (17 miles) 10 nurses, 1 doctor, 16 beds	Jong Mee (21 miles) 10 nurses, 1 doctor, 16 beds
Health care center	None	within village 1 health officer
Private clinic	Ong Jor (12 miles)	Ong Jor (17 miles)
Pharmacy shop	Ong Jor (12 miles)	Ong Jor (17 miles)

Source: Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

In addition, regarding access to healthcare services in the rural communities, the rural residents within the vicinity nearby the dam site in the Pyin Oo Lwin Township are largely depending on the Shwe Pin SubCenter under the Pyin Sar R.H.C. (*Baseline survey by ICEM, 2018*).

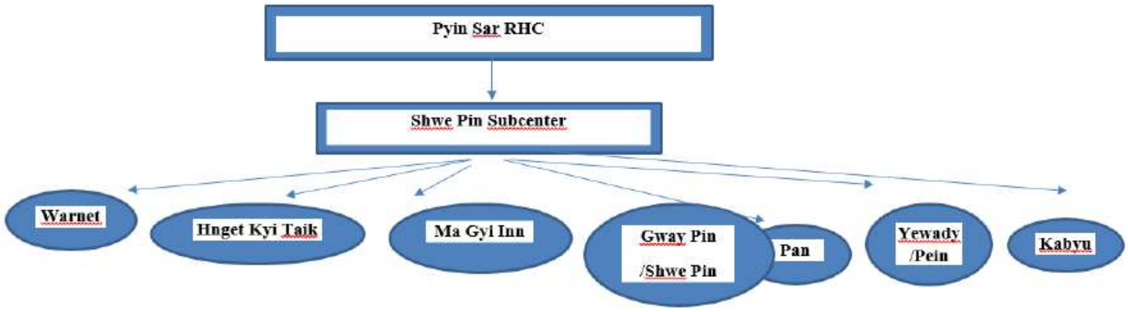


FIGURE 5.4.5-1 : THE PRIMARY HEALTHCARE CENTERS FOR THE VILLAGES NEARBY THE PROPOSED DAM SITE IN THE PYIN OO LWIN TOWNSHIP

1) The Shwe Pin Subcenter

The health statistics of these villages are collected from the ***Shwe Pin SC*** which is directly providing primary healthcare services to the rural community residing the immediate vicinity along the proposed dam site in the Pyin Oo Lwin Township.

PHOTO 5.4.5-1 : SHWE PIN/ GWAY PIN VILLAGE SUB-RURAL HEALTH CENTER, PYIN OO LWIN TOWNSHIP

The following tables present the health profile of the respective villages in (2014-2018) and the profile is structured around the following variables shown below:

- Number of births
- Number of deaths and causes of death
- Under 5 mortalities
- Neonatal mortality
- Maternal mortality
- Nutrition status
- Man power
- Water usage
- Toilet numbers including
- EPI (Immunization coverage)

(i) War Net Village and Pan village

TABLE 5.4.5-2

THE HEALTH PROFILE OF WAR NET VILLAGE

Descriptions	2014	2015	2016	2017	2018
Total Birth	12	16	22	19	11
Mortality		2		3	1
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	-	-	-	-	-
Malnutrition	-	2 (7 months) (3 years)	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water and Well	River Water and Well	River Water and Well	River Water and Well	River Water and Well
Toilet	57	82	138	138	138
EPI Coverage	80%	95%	93%	97%	

Death (Cause of Death)			
Name	**Diseases**	**Ages**	**Years**
U Pwa Gyi	**Heat Stroke**	53	2015
Ma Khine	**Accident**	6	2015
U Mg	**General debility**	91	2017
Daw San Khin	**General debility**	45	2017
U Mg Khine	**Alcohol overdose**	42	2017
Daw Htoo	**General debility**	80	2018

(ii) Hnetgyi Theik village

TABLE 5.4.5-3

THE HEALTH-RELATED DATA OF HNETGYI THEIK VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	5	9	10		
Mortality	1	1			
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	1	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	-	-	-	-	-
Malnutrition	-	Ma Ngu War (11 months)	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water and Well	River Water and Well	River Water and Well	River Water and Well	River Water and Well
Toilet	16	21	63	57	57
EPI	94%	96%	93%	97%	
Death (Cause of Death)					
Name	**Diseases**		**Ages**	**Years**	
Htun Shwe Yee	**POU**		3 years	2014	
Daw Let Ma	**General Debility**		70	2015	
Daw Tin Own	**General Debility**		92	2018	

(iii) Ma Gyi Inn village

TABLE 5.4.5-4

THE HEALTH-RELATED DATA OF MA GYI INN VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	10	8	11	17	4
Mortality			3		
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	-	-	-	-	-
Malnutrition	-	1 (11 months)	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water and Well	River Water and Well	River Water and Well	River Water and Well	River Water and Well
Toilet	43	69	75	82	82
EPI	93%	96%	93%	96%	
Cause of Death					
Name	**Diseases**		**Ages**	**Years**	
U Zin Win	**Heart Failure**		48	2016	
U Tin Soe	**Alcoholics**		52		
Daw Nyunt Yee	**Heart Failure**		65		

(iv) Shwe Pin village

TABLE 5.4.5-5

THE HEALTH-RELATED DATA OF SHWE PIN VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	6	10	10	12	4
Mortality	3	2	2		
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	-	-	-	-	-
Malnutrition	-	-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water and Well=1	River Water and Well=3	River Water and Well=3	River Water and Well=3	River Water and Well=3
Toilet	49	70	80	85	85
EPI	6 (94%)	8 (97%)	10 (94%)	7 (97%)	

Cause of Death			
Name	**Diseases**	**Ages**	**Years**
U Chone	**CVA to H/T**	78	2014
Daw Kalae	**TB**	63	
U Than Tun Aung	**Murder Case**	30	
U Khin Mg	**General Debility**	73	2015
U Nan Tin	**CVA to H/T**	70	
U Myint Than	**CVA to H/T**	75	2016
U Wai Lu	**CVA to H/T**	52	

(v) Ye Watty village

TABLE 5.4.5-6

THE HEALTH-RELATED DATA OF YE WATTY VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	5	7	7	11	4
Mortality		1	3	1	1
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	1	1	-
Neonatal Mortality	-	-	-	-	-
Nutrition	-	-	-	-	-
Malnutrition	-	-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water and Well	River Water and Well	River Water and Well	River Water and Well	River Water and Well
Toilet	19	41	50	50	
EPI Coverage	93%	96%	93%	97%	

Death (Cause of Death)			
Name	**Diseases**	**Ages**	**Years**
Ma Khet Thit Oo	**Accident**	6	2015
Aye Aye Win	**Heat Stroke**	4months	2016
Hnin Thazin	**High fever for fit**	3 years and 5 months	2017
U Sein Kyi	**Ca Liver**	79	2018

(vi) Kabyu village

TABLE 5.4.5-7
THE HEALTH-RELATED DATA OF KABYU VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	9	9	9	8	2
Mortality	2		3	2	-
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	1	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	-	-	-	-	-
Malnutrition	-	-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water	River Water	River Water	River Water and Well=5	River Water and Well=5
Toilet	28	57	61	61	61
EPI	0	0	94%	98%	
Death (Cause of Death)					

Name	Diseases	Ages	Years
U Kyaw Soe	**Alcoholics**	38	2014
U Aung Aung	**Epilepsy**	14	
U Aung Ko	**Accident**	20	2016
Zin Myo	**High fever for fit**	4	
Daw Aye Nyunt	**General debility**	80	
U Kyaw Soe	**Head injury**	51	2017
Daw Tin Hla	**General debility**	93	

2) The profile of Pyin Oo Lwin General Hospital (secondary healthcare center)

The Pyin Oo Lwin Hospital is 300 bedded General hospital and is taking care of not only curative services but also public health care services through the rural health centers for the rural communities under its township.

PHOTO 5.4.5-2 : PYIN OO LWIN GENERAL HOSPITAL (300 beds)

(i) Hospital Employment Condition

Regarding the current manpower of the Pyin Oo Lwin hospital, the numbers of healthcare professionals are shown in ***Table 5.4.5-8***.

TABLE 5.4.5-8

HEALTHCARE PROFESSIONALS IN THE PYIN OO LWIN GENERAL HOSPITAL

Professionals	Sanction	Appointed	Vacancies
Medical Superintendent (MS)	1	1	-
Sr. Consultant	21	10	11
Deputy Medical Superintendent (DMS)	1	-	1
Jr. Consultant	21	9	12
Assistance Surgeon (Dental)	87	84	3
Matron	8	6	2
Sister	18	17	1
Senior nurse (Dental)	112	86	26
Nurse	232	61	171
Technicians	58	47	11
General	181	106	75
Sub Total	601	317	284
Total	**740**	**427**	**313**
Temporary worker	**-**	**2**	**-**

The hospital health professionals are being hired as government servants. According to the current manpower, there are shortages of human resources in both medical doctors and nurse in the hospital.

(ii) Outpatient service

According to the Hospital statistics, in 2014-2018, the numbers of total outpatients being received by the Pyin Oo Lwin General hospital are average ***more than 7,000 per year*** and ***majority*** is found ***Obstetrics and Gynecology (OG) patients*** as shown in ***Table 5.4.5-9***.

TABLE 5.4.5-9

THE RECORDS OF OUTPATIENT DEPARTMENT

No	Specialties	2014	2015	2016	2017	2018 (up to may)
1	Medical Unit (MU)	10,049	10,138	6,126	6,376	3,362
2	Surgery Unit (SU)	2,984	3,620	2,095	2,097	1,163
3	Orthopedics Unit (OU)	4,510	4,530	4,129	4,479	1,785
4	Obstetrics and Gynecology (OG)	**10,678**	**14,320**	**13,620**	**19,361**	**7,347**
5	Pediatric Unit (PU)	4,648	4,415	3,445	6,296	1,591
6	Eye Unit (EU)	4,141	4,549	5,685	3,484	1,380
7	ENT (Eye, Nose and Throat) Unit	3,357	3,567	3,113	3,337	691
8	Renal Unit (RU)	1,459	1,724	2,145	1,578	792
9	Neurology (NU)	1,285	795	340	210	116
10	Cardiology Unit	1,718	763	631	1,089	955
11	Psychiatric Unit	1,910	2,939	3,697	3,162	994
12	Physiotherapy Unit	10,899	9,964	10,537	8,037	4,059
13	Dental Unit	5,547	5,865	5,945	5,449	2,502
14	Skin Unit	1,096	2,714	3,041	1,100	-
15	Sexual Transmitted / HIV	778	2,544	4,664	5,228	2,161
16	Tuberculosis	540	917	432	255	107
17	General	1,438	10,979	24,633	30,919	10,543
Total		**67,037**	**84,343**	**94,278**	**102,457**	**39,548**

(iii) Inpatient service

Looking at the ***inpatient status*** between 2014 and 2015, the ***majority*** was from the ***medical units***. And then starting from 2016 until May 2018, increasing numbers are found out in the ***pediatrics units*** as shown in ***Table 5.4.5-10***.

TABLE 5.4.5-10

THE RECORDS OF INPATIENT DEPARTMENT

No	Specialties	2014	2015	2016	2017	2018
1	Medical Unit (MU)	**2,923**	**3,709**	3,721	3,390	1,348
2	Surgery Unit (SU)	2,105	2,533	2,598	2,088	933
3	Orthopedics Unit (OU)	1,279	1,550	1,636	1,580	704
4	Obstetrics and Gynecology (OG)	2,433	3,214	3,917	3,745	1,382
5	Pediatric Unit (PU)	2,256	3,265	**4,020**	**3,946**	**1,535**
6	Eye Unit (EU)	328	303	385	297	123
7	ENT (Eye, Nose and Throat) Unit	110	46	55	215	175
8	Renal Unit (RU)	123	215	161	214	76
9	Neurology (NU)	1,248	1,112	1,038	1,087	456
10	Cardiology Unit	-	-	-	-	-
11	Psychiatric Unit	32	62	75	55	9
12	Physiotherapy Unit	-	-	1	-	-
13	Intensive unit	-	-	-	-	-
Total		**12,837**	**15,909**	**17,607**	**16,617**	**6,741**

3) Healthcare access in the Kyaukse Township

Households in the seven villages namely Kyauk Pone, Kyaung Ywa, Thanmanthar (Downstream), Yeywa, Thayetpin and Kyaung Ywa which are closely located along the proposed dam site in the Kyaukse Township are 118, 140, 180,150,140,118 and 140 respectively (see detailed in ***Table 5.4.5-11***).

TABLE 5.4.5-11

LIST OF VILLAGES LOCATED ALONG THE DAM SITE AREA UNDER THE KYAUKSE TOWNSHIP

No	Village	Township	Total Households	Total Population
1	Kyauk Pone	Kyaukse	118	-
2	Kyaung Ywa	Kyaukse	140	600
3	Thanmanthar (Downstream)	Kyaukse	180	900
4	Yeywa	Kyaukse	150	757
5	Thayetpin	Kyaukse	140	596

(i) The primary healthcare center

Regarding access to healthcare services in the rural communities, the rural residents within the vicinity along the dam site in the Kyaukse Township are largely depending on the Ye R.H.C and three sub centers namely Thanmanthar, Thayetpin and Kyaung Ywa which are directly providing healthcare services to the above-mentioned villages respectively.

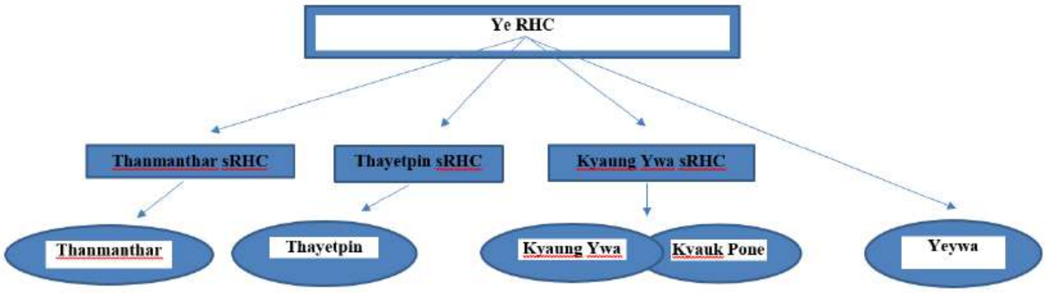


FIGURE 5.4.5-2 : THE PRIMARY HEALTHCARE CENTER FOR THE VILLAGES NEARBY THE PROPOSED DAM SITE IN THE KYAUKSE TOWNSHIP

(ii) The Sub Centers (SC)

a) Tha Man Thar Village (Tha Man Thar sR.H.C)

The health statistics of the Tha Man Thar village is collected from the Tha Man Thar SC (see detailed in ***Table 5.4.5-12***).

The following tables present the health profile of the respective villages in (2014-2018) and the profile is structured around the following variables shown below:

- Number of births
- Number of deaths and causes of death
- Under 5 mortalities
- Neonatal mortality
- Maternal mortality
- Nutrition status
- Man power
- Water usage
- Toilet numbers including
- EPI (Immunization coverage)

PHOTO 5.4.5-3 : THA MAN THAR SUB-RURAL HEALTH CENTER, KYAUKSE TOWNSHIP

TABLE 5.4.5-12

THE HEALTH-RELATED DATA OF THA MAN THAR VILLAGE

Descriptions	2014	2015	2016	2017	May, 2018
Birth	18	20	22	21	8
Mortality	5	2	1	5	-
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	Vit A, Albendazole, FBC	Vit A, Albendazole, FBC	Vit A, Albendazole, FBC	Vit A, Albendazole, FBC	Vit A, Albendazole, FBC
Malnutrition	-	-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1	MW=1
Water Usage	River Water	River Water	Well	Well	Well
Toilet	140	143	162	164	168
EPI	18	20	22	21	8

Cause of Death

Name	Diseases	Ages	Years
Daw Khin Pauk	Liver Cancer	57	2014
U Myint Kyaw	Suicide	87	
U Chut	Liver Cancer	57	
U Tun Hla	Heart Failure	87	
U Mg Khone	Heart Failure	82	
Daw Kyaing	Breast Cancer	79	2015
U Nyunt Oo	Gestro Intestinal Bleeding	40	
Daw Khin Than	Hypertension	71	2016
Mg Khayar	Accident	18	2017
U Aung Khine	Liver Cancer	37	
Daw Win Maw	Head Damage (Accident)	48	
U Tun Kyaing	Heart Failure	88	
U Khin Mg Tint	Liver Cancer	52	

b) Thayet Pin Village (Thayet Pin SR.H.C)

The health statistics of the Thayet Pin village is collected from the *Thayet Pin* SC.

PHOTO 5.4.5-4 : THAYET PIN SUB-RURAL HEALTH CENTER, KYAUKSE TOWNSHIP

TABLE 5.4.5-13
THE HEALTH-RELATED DATA OF THAYET PIN VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	11	9	10	8	8
Mortality	2	1	4	2	1
Maternal Mortality	-	-	-	-	-
Under5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole
Malnutrition	-	-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1	MW=1
Water Usage	River Water and Pipeline System	River Water and Well=2	River Water and Well=2	River Water and Well=11	River Water and Well=16
Toilet	97	99	98	100	102
EPI	11	9	10	8	8

Cause of Death

Name	Diseases	Ages	Years
Phoe Thaw Kyar	Unknown Fever	6	2014
U Nyan Shaine	Heart Disease	69	
U Hla Shwe	Ca Lung	68	2015
U Soe Myint	Accident	47	2016
U Mya Thein	Hypertension	57	
U Nyunt Myaine	Hepatitis	67	
Daw Than	Stoke	76	
Daw Khin	Heart Disease	91	2017
Daw Khin Nyunt	Ca Ear	63	
U Myint Thein	COL	49	

c) Kyaung and Kyauk Pone Villages (Kyaung sR.H.C)

The health statistics of the Kyaung and Kyauk Pone villages are collected from the Kyaung SC.

PHOTO 5.4.5-5 : KYAUNG SUB-RURAL HEALTH CENTER, KYAUKSE TOWNSHIP

TABLE 5.4.5-14

THE HEALTH-RELATED DATA OF KYAUNG AND KYAUK PONE VILLAGES

Descriptions	2014	2015	2016	2017	May, 2018
Birth	11	14	15	10	3
Mortality	3	7	2	4	2
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole	Vit-A, FBC,Alberdazole
Malnutrition	-	-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1	MW=1
Water Usage	River Water	River Water	River Water	River Water	River Water
Toilet	132	137	148	153	157
EPI	11	14	15	10	3

Cause of Death

Name	Diseases	Ages	Years
Daw Aye Thi	HIV	40	2014
Daw Hla Myint	Asthma	62	
Daw Aye Hla	Injury	74	
Daw Nge	H.T	73	2015
Daw Kyan	Ca.S	55	
Daw Aye Mya	Rabies	18	
U Nyi Paing	HIV	36	
U Win Myint	Accident	44	
U Htay	Injury	33	
U Aung Myo Lwin	Ca Liver	78	
U Zaw Min Htwe	Liver Injury	32	2016
U Aung Kyaw Moe	Injury	41	
U Kyaw Thu Lwin	T.B+HIV	33	2017
U Aung Soe	Injury	50	
U Thit	Ca Liver	35	
U Kyaw Khine Win	Injury	33	
U Tun Wai	H.P	75	2018
Daw San San	Heart Case	44	

d) Ye Village (Ye R.H.C)

The health statistics of the Ye villages is collected from the Ye RHC.

PHOTO 5.4.5-6 : YE RURAL HEALTH CENTER, KYAUKSE TOWNSHIP

4) The profile of Kyaukse General Hospital (secondary healthcare center)

The Kyaukse General Hospital is 300 bedded General hospital and is taking care of not only curative services but also public health care services through the rural health centers for the rural communities under its township.

PHOTO 5.4.5-7 : KYAUKSE GENERAL HOSPITAL (300 beds)

TABLE 5.4.5-15

THE HEALTH-RELATED DATA OF YE VILLAGE

Descriptions	2014	2015	2016	2017	May, 2018
Birth	16	7	14	5	6
Mortality	2	4	5	4	2
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	1	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole
Malnutrition	-	-	-	-	-
Staff	MW=5 HA=1 PHS2=1	MW=4 HA=1 PHS2=1	MW=6 HA=1 PHS2=1	MW=6 LHV=1 HA=1 PHS2=1	MW=6 HA=1 PHS2=1
Water Usage	River Water & Well	River Water & Well	River Water & Well	River Water & Well	River Water & Well
Toilet	147	137	122	124	124
EPI	12	10	16	8	5 (up to may)
JE	-	-	-	219	-
Hep.B	-	-	-	-	23

TABLE 5.4.5-15

THE HEALTH-RELATED DATA OF YE VILLAGE (CON'TD)

Death (Cause of Death)			
Name	**Diseases**	**Ages**	**Years**
U Kyaw Myint	Electric Shock	35	2014
U San Hla	Heart Failure	85	2015
U Myint Shwe	Alcohol Abuse	44	
U Zaw Myo Tun	RTA	27	
Daw Tin Shwe	Asthma	75	
Phyo Yati Zaw	Congenital Heart Disease	2	
Daw Mya Lwin	Ca Liver	57	2016
Daw Hla Myine	Heart Disesae	54	
U Thein Ko Min	Stomach Bleeding	28	
U Than Po	Peptic Ulcer	40	
Daw Htar Htar Lwin	Renal Disease	43	
U San Shee	Ca Bladder	68	2017
Daw Hla Tin	DM e HT	70	
Daw Thi Hal	DM e HT	84	
U Kyi Htay	Brain Tumor	42	
U Tun Ngwe	HT	74	2018
Daw Hla Khin	General Weak	100	

a) Hospital Employment Condition

Regarding the current manpower of the Kyaukse hospital, the numbers of healthcare professionals are shown in ***Table 5.4.5-16***.

The hospital health professionals are being hired as government servants. According to the current manpower, there are shortages of human resources in both medical doctors and nurse in the hospital like observed in the Pyin Oo Lwin Hospital.

TABLE 5.4.5-16

HEALTHCARE PROFESSIONALS IN THE KYAUKSE GENERAL HOSPITAL (MANPOWER)

Staffing	Sanction	Appointed	Vacancies
MS	1	1	-
Sr. Consultants	17	9	8
DMS	1	1	-
Jr. Consultants	17	8	9
Medical Officer	68	54	14
Dental Surgeon	2	2	-
Supervisor	6	4	2
Matron	1	1	-
Nursing Staff	297	115	182
Technician	54	31	23
Clerk Staff	13	10	3
Others	117	56	61
Total	**594**	**292**	**308**

b) Outpatient service

According to the Hospital statistics, in 2012-2017, the number of total admissions received by the Kyaukse General hospital are average more than 15,781 per year and minimum (9,239) and maximum (20,9730) were found in 2012 and 2016 respectively.

Looking at the outpatient numbers, average per year is 42,440, minimum (15,528) and maximum (62,728) were in 2013 and 2016 respectively. Regarding average no of admission per day, admissions in (57/day) 2016 is the highest than other years.

TABLE 5.4.5-17

THE RECORDS OF OUTPATIENT DEPARTMENT

Hospital Performances Indicator	2012	2013	2014	2015	2016	2017
Total Admissions	9,239	10,772	14,975	18,681	**20,973**	20,047
Total Out patient	27,575	15,528	42,786	50,302	**62,728**	55,722
Average No of admission per day	25.3	29.5	41	51	**57**	54

c) Hospital Performance Indicators

TABLE 5.4.5-18

HOSPITAL PERFORMANCE INDICATORS

Sr. No	Service	2013	2014	2015	2016	2017
1	**Average No of Out Patients Per Day**	129	176	187	**256**	230
2	**Average No of In Patients Per Day**	137	170	195	212	**222**
3	**Average Duration of Stay**	**4.6**	4	3.8	3.74	4.1
4	**Percentage of Sanction base on average beds**	68.5	8.5	97.5	106	**111**
5	**Percentage of Occupancy base on average beds**	50.7	60	69	**75**	**66.9**
6	**Average turn-over of patient per bed per year**	40	53	66	74	60
7	**Average turn-over of patient individual (in day)**	4.5	2.7	1.7	1.22	2.01
8	**Fatality Rate per-1000 Discharge & Death**	3.7	2.5	3.5	5	8
9	**Live birth per-100 Deliveries**	97	99	99	97	99
10	**Still birth per-100 Deliveries**	3	1	1	3	1
11	**Abortion rate per-100 Deliveries**	22.4	10	9	8	8

d) Leading cases of morbidity and mortality in 2017

The Kyaukse general hospital's common cause-of-death statistics can determine the current public health status of its township including rural communities as well as help focus on the public health actions.

In 2017, the main cause of morbidity was mostly related to accidents and injuries and followed by gastroenteritis diseases.

Regarding mortality, neonatal mortality was majorly leading cause of death and followed by cardiovascular diseases.

TABLE 5.4.5-19

LEADING CASES OF MORBIDITY AND MORTALITY IN 2017

No	Morbidity	Cases	Mortality	Cases
1	RTA	1,181	Birth Asphyxia	25
2	GE	729	Preterm	14
3	AVI	720	Heart diseases	12
4	ARI	720	Poisoning	10
5	Hypertension	458	ARI (Pneumonia)	8

e) The hospital's facilities

TABLE 5.4.5-20

SPECIALIST OPD

No	Specialties	Total Patients
1	MU	10,882
2	SU	2,936
3	PU	2,897
4	O & G	9,852
5	Eye	1,593
6	ENT	2,531
7	Ortho	5,828
8	Dental	2,091
9	Physio	2,258
10	Mental	5,092
11	Skin	1,525
Grand Total		47,485

TABLE 5.4.5-21

ICU

No	Type of service	Numbers
1	GA	590
2	LA	440
3	Spinal	2748
4	Others	574
Total		4352
Major		2412
Minor		1940

f) Others

(i) Funding – 42,136,677 (to 2017)

(ii) Oxygen Plant Activities in 2017

- Running hours - 2036 hrs
- Total no of cylinders -2995 pots
- (Big – 1019 + Small – 1976)

(iii) Hospital Based Activities

- Myanmar Snake Bite Project
- TB Project
- STD
- Deafness

5) Healthcare access in the Sint Gaing Township

Households in the two villages namely Inn Kone and Hpa Lan Pin which are mostly located along the transmission line in the Sint Gaing Township are 178 and 71 respectively (***Table 5.4.5-22***).

TABLE 5.4.5-22

LIST OF VILLAGES LOCATED ALONG THE TRANSMISSION LINE UNDER THE SINT GAING TOWNSHIP

No	Village	Township	Total Households	Total Number of Population
1	Inn Kone (near transmission line route)	Sintgaing	178	976
2	Hpa Lan Pin (near transmission line route)	Sintgaing	71	391

a) The primary healthcare center

Regarding access to healthcare services of the vicinity along the transmission line in the Sintgaing Township, Inn Kone and Hpa Lan Pin villages (see in ***Figure 5.4.5-3***) are largely depending on Ywar Thit sRHC under Daung Kya R.H.C and Nat Yay Kan sRHC under Ywar Bo R.H.C respectively. These heath centers are corresponding with the Palake Station hospital and Sint Gaing Township hospital.

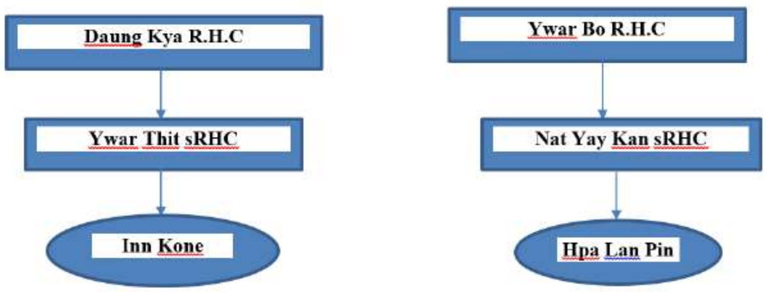


FIGURE 5.4.5-3 : THE PRIMARY HEALTHCARE CENTERS FOR THE VILLAGES ALONG THE TRANSMISSION LINE IN THE SINT GAING TOWNSHIP

b) The Sub Centers (SC)

(i) Inn Kone Village (Ywar Thit sRHC/Daung Kya R.H.C)

The health statistics of the Inn Kone Village is collected from the Ywar Thit sRHC providing direct healthcare services to rural communities under Daung Kya R.H.C.

PHOTO 5.4.5-8 : THE YWAR THIT SUB RHC, SINT GAING TOWNSHIP

TABLE 5.4.5-23

THE HEALTH-RELATED DATA OF INN KONE VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	20	15	18	29	7
Mortality	3	2	3	1	-
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	-	-	-	-
Nutrition	Every 2 months by Donation	Every 2 months by Donation	Every 2 months by Donation	Every 2 months by Donation	Every 2 months by Donation
Malnutrition	-	-	-	-	-
Staff			MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	Well(4)	Well(4)	Well(4)	Well(4)	Well (4)
Toilet	66	70	86	95	102
EPI					

Cause of Death			
Name	**Diseases**	**Ages**	**Years**
U Thein Myint	Stroke	58	2015
U Thein Han	GD	65	
Daw Toke	Asthma	80	
U Pan	Hypertension	67	
Daw Hmat Tin	GD	58	
U Kyaw Oo	Accident	30	2016
U San Maung	Stroke	77	
U Htay Lin	Alcohol	45	
U Kyaw Sein	Accident	65	2017

(ii) Hpa Lan Pin Village (Nat Yay Kan sRHC/ Ywar Bo R.H.C,)

PHOTO 5.4.5-9 : THE NAT YAY KAN SRHC , SINT GAING TOWNSHIP

TABLE 5.4.5-24

THE HEALTH-RELATED DATA OF HPA LAN PIN VILLAGE

Descriptions	2014	2015	2016	2017	May, 2018
Birth	7	16	12	7	5
Mortality	-	1	5	2	2
Maternal Mortality			-	-	-
Under 5 Mortality			-	-	-
Neonatal Mortality			-	-	-
Nutrition	Vit-A, FBC, Albendazole	Vit-A, FBC, Albendazole	Vit-A, FBC, Albendazole	Vit-A, FBC, Albendazole	Vit-A, FBC, Albendazole
Malnutrition	-	-	-	-	-
Staff	MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	Well	Well	Well	Well	Well
Toilet	53	58	69	72	76
EPI	7	16	12	7	5

Cause of Death

Name	Diseases	Ages	Years
U Tun Min	Stomach Disease	36	2015
Daw San Yee	Heart Failure	49	2016
Daw Sein Win	General Weakness	72	
Daw Thay	CVA	65	
U Tun Oo	Ca Liver	46	
Daw Nyunt	General Weakness	95	
U Win Zaw	Ca Liver	37	2017
Daw Cho	Murder Case	31	
U San Min	Rabies	40	2018
Daw Tin Su	General Weakness	70	

c) The profile of the Sint Gaing Township Hospital (secondary healthcare center)

The Sint Gaing Township Hospital is ***50 bedded Township hospital*** and is taking care of not only ***curative services*** but also ***public health care services*** through the rural health centers for the rural communities under its township.

PHOTO 5.4.5-10 : SINT GAING TOWNSHIP HOSPITAL (50 beds)

(i) Hospital Employment Condition

TABLE 5.4.5-25

HEALTHCARE PROFESSIONALS IN THE SINT GAING TOWNSHIP HOSPITAL (MANPOWER)

Position	Sanction	Appointed	Vacancies	Remark
Township Medical Officer	1	1	0	
Medical Doctor In charge	1	0	1	
Assistance Surgeon	6	5	1	
Assistance Surgeon (Dental)	1	1	0	
Nurse (2)	1	1	0	
Staff Nurse	7	7	0	
Nurse (3)	14	5	9	
Lab Technician (3)	1	1	0	
Lab Technician (4)	2	2	0	
Paramedical (X-ray)	1	1	0	
Paramedical (compound)	2	2	0	
Supervisor (4)	2	1	0	
Others	21	3	18	
Driver (5)	2	1	1	
Worker	19	7	12	Labor-5
Total	**81**	**39**	**42**	

(ii) Leading causes of morbidities (In Patients)

The major admissions in patient are Road Traffic Accident (RTA) and followed by birth deliveries and acute viral infection (AVI).

TABLE 5.4.5-26

LEADING CAUSES OF MORBIDITIES (IN PATIENTS)

SN	2017	
	Disease	**No of cases**
1	Injuries (RTA)	561
2	Deliveries	490
3	AVI	449
4	Acute Gastritis	299
5	Chest Infection	225
6	Diabetes	148

(iii) Leading causes of Morbidities (Out Patients)

Looking at the outpatient, RTA is the commonest and followed by Dog bite, skin infection and AVI.

TABLE 5.4.5-27

LEADING CAUSES OF MORBIDITIES (OUT PATIENTS)

SN	2017	
	Disease	**No. of cases**
1	RTA	523
2	Dog bite	354
3	Skin infection	230
4	Acute viral infection	219
5	Gastritis	214
6	Chest infection	176
7	Acute Respiratory Tract infection	135
8	Diabetes Mellitus	128
9	Tuberculosis	122
10	Urinatory Tract infection	61

(iv) Leading causes of Mortalities (In Patients)

The commonest causes of death are non-communicable diseases mainly CVA and heart diseases.

TABLE 5.4.5-28

LEADING CAUSES OF MORTALITIES (IN PATIENTS)

SN	2017	
	Disease	**No. of cases**
1	CVA	2
2	Heart Failure	1
3	Myocardia Infart with DM	1

(v) Hospital Performance Indicator (KPI)

Regarding the KPI, the hospital performance become increased over years and it was highest in 2017.

TABLE 5.4.5-29

HOSPITAL PERFORMANCE INDICATOR

	2012	2013	2014	2015	2016	2017
Total no of Out patients	2069	3469	4563	4730	1329	6339
Total no of In patients	4605	2364	2374	2566	1225	2710
Average no of Out patients per day	8	12	18	19	20	26
Average no of In patients per day	13	18	20	21	22	24
% of bed occupation base on Sancition beds	26	36	40	42	44	48
% of bed occupation base on Available bed	26	36	40	42	44	48
Average duration of Stay (in days)	3	3	3	3	3.6	4
Average turn-over of patients per bed per year	-	-	-	47	21.7	54
Average turn-over intervals (in days)	-	-		4.44	9.01	3
Death Patients	15	22	2	5	-	2
Hospital Death Rate	-	-	-	0.21	0	0.14

6) Healthcare access in the Amarapura Township

Households in the Wae Gyi village which is located very far downstream along the proposed dam site in the Amarapura Township are 330 in numbers.

TABLE 5.4.5-30

LIST OF VILLAGES LOCATED ALONG THE DAM SITE AREA UNDER THE KYAUKSE TOWNSHIP

No	Village	Township	Total Households	Total Population	No of Interview Households
1	Wae Gyi Sin (very far downstream)	Amarapura	330	-	16

a) The primary healthcare center

The village is depending on the Mi Kyaung Tit sRHC under the Salin Kyi R.H.C.

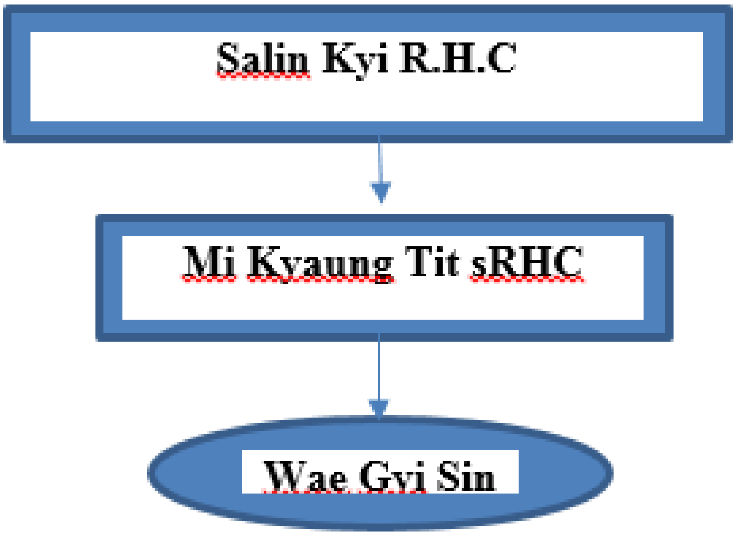


FIGURE 5.4.5-4 : THE PRIMARY HEALTHCARE CENTERS FOR THE VILLAGES ALONG THE DAM SITE IN THE AMARAPURA TOWNSHIP

b) The sub centers

Wae Kyi Sin Village

TABLE 5.4.5-31

THE HEALTH-RELATED DATA OF HPA LAN PIN VILLAGE

Descriptions	2014	2015	2016	2017	2018
Birth	25	28	25	37	11
Mortality	3	1	3	11	-
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	-	-	-
Neonatal Mortality	-	1	1	-	1
Nutrition	Vit-A, FBC	Vit-A, FBC	Vit-A, FBC	Vit-A, FBC	Vit-A, FBC
Malnutrition		-	-	-	-
Staff	MW=1	MW=1	MW=1	MW=1	MW=1
Water Usage	Well 258	Well 260	Well 261	Well 262	Well 264
Toilet	265	273	274	278	134 146
EPI					

TABLE 5.4.5-31

THE HEALTH-RELATED DATA OF HPA LAN PIN VILLAGE (CONT'D)

Cause of Death			
Name	**Diseases**	**Ages**	**Years**
U Nyo Mg	G.D	62	2014
U Sein Hla	G.D	69	
U Naing Win	Alcohol Abuse	38	
Daw Than	G.D	74	2015
Daw Ei Sapal	Accident	28	2016
Daw Sein	G.D	52	
Daw Kyi	G.D	79	
U Thit Tin	G.D	73	2017
U Tin Mg	G.D	84	
U Win	Alcohol Abuse	36	
Daw Aye Bone	G.D	68	
Daw Mya Shwe	G.D	76	
U Aung Myo	Alcohol Abuse	28	
Daw Pyo	G.D	70	
U Sein Mg	Alcohol Abuse	56	
U Win Aung	G.D	61	
U Bo	G.D	73	
U Tun Tun Swe	G.D	43	

c) The profile of Talin Gyi Station Hospital (secondary healthcare center)

The Talin Gyi Station Hospital is one of ***16 bedded Station hospitals*** under the Amarapura Township and it is being mostly dependent by the nearby rural community including Wae Kyi Sin Village **as the secondary healthcare center.**

PHOTO 5.4.5-11 : THALIN GYI STATION HOSPITAL (16 beds)

d) Hospital Employment Condition

TABLE 5.4.5-32

HEALTHCARE PROFESSIONALS IN THE THALIN GYI STATION HOSPITAL (MANPOWER)

Position	Sanction	Appointed	Vacancies	Remark
Medical Doctor In charge	1	1	-	
Assistance Surgeon	1	-	1`	
Staff Nurse	2	2	-	
Nurse (3)	4	2	2	
Health Assistant	1	-	1	
Paramedical (compound)	1	1	-	
Lab Technician	1	-	1	
Paramedical (X-ray)	1	1	-	
Worker (Cleaning)	2	2	-	
Worker (General)	4	4	-	
Worker (Security)	1	1	-	
Total	**19**	**14**	**5**	

TABLE 5.4.5-33

HEALTH SERVICES

Month	NA	EI LSCS EM LSCS	NSVD	Appende ctomy	Hemiotomy	Phimosis	ESC	OPD
2010 Nov	6	1	1	-	-	4	1	307
Dec	40	4	4	3	1	-	4	638
2017 Jan	51	11	10	2	2	-	4	398
Feb	66	7	3	5	4	3	1	491
March	55	9	7	3	1	-	6	425
April	61	6	11	2	2	-	8	520
May	90	16	13	2	4	1	2	502

7) Healthcare access in the Patheingyi Township

Households in the Kywe Na Hpar village which is located very far downstream along the proposed dam site in the Patheingyi Township are 700 in numbers.

TABLE 5.4.5-34

LIST OF VILLAGES LOCATED ALONG THE DAM SITE AREA UNDER THE KYAUKSE TOWNSHIP

No	Village	Township	Total Households	Total Population	No of Interview Households
13	Kywe Na Hpar (further downstream)	Patheingyi	700		13

a) The primary health center

The village is depending on the Kywe Na Hpar sRHC.

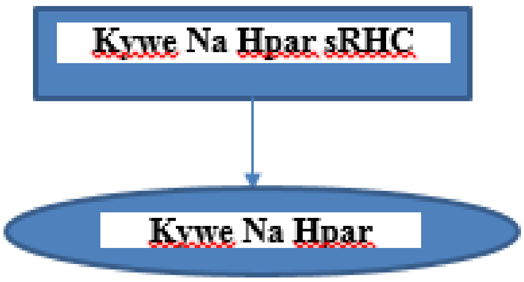


FIGURE 5.4.5-5 : THE PRIMARY HEALTHCARE CENTER FOR THE VILLAGE ALONG THE DAM SITE IN THE PATHEINGYI TOWNSHIP

b) The sub center

Kywe Na Hpar village

PHOTO 5.4.5-12 : THE KYWE NA HPAR SRHC, PATENINGYI TOWNSHIP

TABLE 5.4.5-34

THE HEALTH-RELATED DATA OF KYWE NA HPAR VILLAGE

Descriptions	2014	2015	2016	2017	May, 2018
Birth	54	80	72	78	15
Mortality	26	18	12	20	5
Maternal Mortality	-	-	-	-	-
Under 5 Mortality	-	-	1	2	-
Neonatal Mortality	1	1	-	1	-
Nutrition	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole	Vit-A, FBC, Alberdazole
Malnutrition	-	-	-	-	-
Staff	MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1	MW=1 PHS2=1
Water Usage	River Water & Well	River Water & Well	River Water & Well	River Water & Well	River Water & Well
Toilet	320	332	357	394	394
EPI	54	80	72	78	15
JE	-	-	-	-	-
Hep.B	-	-	-	-	-

Cause of Death		
Years	**2014**	
Diseases	**Ages**	**Total**
Hypertension	65	1
Alcohol Overdose	33/24/47	3
COPD	54/71/96/81/75	5
RVI	36/38	2
Stroke	65/71	2
Accident	23/35/20	3
Heart Failure	70/63/65	3
Severe Asthma	62/63/48	3
General debility	83/78	2
Ca Liver	30	1
Congenital Intestinal Prolapse	5 days	1
Total		**26**
Year	**2015**	
Diseases	**Ages**	**Total**
General Debility	81/97	2
Stroke	57	1
Severe Asthma	68	1
COPD	65/81	2
Accident	46/48/42/16/20	5
Alcohol Overdose	26/55/36	3
Severe Hypertension	63	1
Herat Failure	19	1
Renal Failure	60	1
Low Birth Weight	6 days	1
Total		**18**

TABLE 5.4.5-34

THE HEALTH-RELATED DATA OF KYWE NA HPAR VILLAGE (CONT'D)

Year	**2016**	
Diseases	**Ages**	**Total**
Severe Hypertension	63/56	2
Accident	22/42/20	3
Renal Failure	3	1
Ca stomach	34	1
Liver disease	45	1
Alcohol overdose	38	1
COPD	74	1
Unknown	60/81	2
Total		**12**
Year	**2017**	
Diseases	**Ages**	**Total**
COPD	60/82/78/62	4
Severe	62	1
Accident	39/28/24	3
RVI	45/43	2
Severe Hypertension	55	1
Brain Tumor	49	1
Abnormal	5	1
Septicemia + Severe ARI	4 months	1
General debility	90	1
Low Birth Weight	2 days	1
Heart failure	60	1
Ca-stomach	33	1
Diabetes Mellitus	55	1
Ca Colon	55	1
Total		**20**
Year	**2018**	
Diseases	**Ages**	**Total**
Stroke	72	1
Accident	58	1
Alcohol overdose	50	1
Ca Buccal	57	1
COPD	75	1
Total		**5**

c) The profile of Kyauk Mee Station Hospital (secondary healthcare center)

The Kyauk Mee Station Hospital is one of ***16 bedded Station hospitals*** under the Patheingyi Township and it is being mostly dependent by the nearby rural community including Kywe Na Hpar village not only **as public health care** but also **the secondary healthcare center**.

PHOTO 5.4.5-13 : KYAUK MEE STATION HOSPITAL (16 beds)

d) Hospital Employment Condition

TABLE 5.4.5-35

HEALTHCARE PROFESSIONALS IN THE THALIN GYI STATION HOSPITAL (MANPOWER)

Position	Sanction	Appointed	Vacancies	Remark
Medical Doctor In charge	1	1	-	
Assistance Surgeon	-	-	-	
MW	9	9	-	
PHS2	9	9	-	
Health Assistant	4	4	-	
Paramedical (compound)	-	-	-	
Lab Technician	-	-	-	
Paramedical (X-ray)	-	-	-	
Worker (Cleaning)	-	-		
Worker (General)	-	-	-	
Worker (Security)	1	1	-	
Total	**23**	**23**	-	

TABLE 5.4.5-36

IMPACT INDICATORS

Impact Indicators	2015	2016	2017
Neonatal Mortality Rate (Per 1000 LBs)	5	1.2	2.7
Infant Mortality Rate (Per 1000 LBs)	10.22	3.5	6.5
Under Five Mortality Rate (Per 1000 LBs)	10.2	5.86	7.09
Maternal Mortality Rate (Per 1000 LBs)	1.2	0	0.5

TABLE 5.4.5-37

BASIC HEALTH DATA

RHC	VILLAGE	House	Source of water			Latrine	CHILDREN			Target		15-49 YRS Female	Population			VHW			Remark
			Pump	Well	Stream		<1	<5	<15	<1	AN		Male	Female	Total	CHW	AMW	TTBA	
Kyauk Mee (Main)	Kyauk Mee	486	60	141	-	289	57	267	541	66	70	704	1200	1315	2515	-	-	1	
	Htone Ain	281	108	35	-	162	26	148	282	33	35	353	636	624	1260	1	1	-	
	Tha Le Kone	301	55	97	-	168	39	158	291	41	43	441	806	769	1575	-	-	-	
	Ywa Shi	217	47	77	-	126	24	138	259	28	29	298	529	536	1065	-	-	-	
	Total	1285	270	350	-	745	141	711	1373	168	177	1796	3171	3244	6415	1	1	1	

5.4.5.2 Access to water supply

The villagers have no access to public water supply. They rely on individual household sources and methods of supply. Ground water and river water are the sources of supply. Ground water and river water are still of good quality.

5.4.6 Infrastructure Facilities

5.4.6.1 Water Use and Water Supply

The four villages have no piped water supply system. Ground water and river water are two supply sources which adequately provide water of good quality for domestic consumption. Ground water is accessed through bore wells or dug wells. About 10 to 30 private groundwater wells exist in Ma Gyi Inn and War Net villages while some villagers in Ma Gyi Inn buy drinking water. Few bore wells are equipped with solar power driven pumps.

Bathing and cloth washing in Myitnge River is commonly seen along the river banks, mainly near Hnget Gyi Thaik and Thayet Pin Village. River water is also carried in buckets or plastic containers from the river to houses. The government installed a river water pumping station and piped supply to houses. At present, the system was abandoned due to lack of maintenance and high operating cost. Pictures of river water use and ground water wells in the project area are shown in ***Photo 5.4.6-1***.



PHOTO 5.4.6-1 : WATER SUPPLY IN THE PROJECT AREA

5.4.6.2 Hospital, Medical Clinic

Only Thayet Pin has one health center. The four villages rely on a private clinic in Ong Jor, about 12.17 miles away, a small hospital in Jong Mee, about 17.21 miles away, and Mandalay Hospital, about 36 miles away.

5.4.6.3 School and Religious Facilities

The number of existing schools and religious facilities in the project area are shown in ***Table 5.4.6-1*** and ***Photo 5.4.6-1***. All four villages have kindergarten and primary schools. Secondary school however exist only in May Gyi Inn. All four villages have 1 temple with cemetery.

TABLE 5.4.6-1

SCHOOLS AND RELIGIOUS FACILITIES

Social facilities	Hnget Gyi Thaik	Ma Gyi Inn	War Net	Thayet Pin
Primary School	Kindergarten, Grade 1-4, 5 teachers	Kindergarten, Grade 1-4,	Kindergarten, Grade 1-4, 5 teachers	Kindergarten, Grade 1-4, 3 teachers
Secondary School	None	Grade 5-7	None	None
Cemetery	1 acre	1 acre	1 acre	4 acres
Temple	1 temple	1 temple	1 temple	1 temple

Source : Key Informant Interview by TEAM Consulting Engineering and Management Co., Ltd, April 2015

		
Hnget Gyi Thaik Primary School	Thayet Pin Primary School	Ma Gyi Inn Secondary School
		
Grocery shop in Hnget Gyi Thaik village	Thayet Pin Temple	Ma Gyi Inn Temple

PHOTO 5.4.6-1 : SOCIAL FACILITIES IN THE VILLAGES

5.4.6.4 Road Transportation

(1) Road Condition

Two small roads exist along the river banks from Yeywa Dam. The road on the right bank is a narrow concrete road providing access to Mandalay. The left bank road is mostly unpaved connected with Kyaukse-Mandalay highway at Sintgaing Township. The two roads are in poor conditions (see ***Photo 5.4.6-2***).

	
Road Condition on Right Bank of Myitnge River	**Road Condition on Left Bank of Myitnge River**
	
Traffic Counting Activities at Hnget Gyi Thaik village	**Traffic Counting Activities at Thayet Pin village**

PHOTO 5.4.6-2 : ROAD CONDITION IN THE PROJECT AREA AND TRAFFIC COUNTING ACTIVITIES

(2) Traffic Counting

To establish base line data on traffic conditions, traffic counting was carried out at 2 stations within the project study area from 6.00 am to 6.00 pm during 24-27 April, 2015, covering one working day and one holiday. The two traffic counting (TC) stations were:

- **TC1** - The traffic counting (TC1) station was at Hnget Gyi Thaik village, Pyin Oo Lwin Township, Mandalay Region, Myanmar.
- **TC2** - The traffic counting (TC2) station was at Thayet Pin village, Kyaukse Township, Mandalay Region, Myanmar.

The location of two traffic counting stations is indicated on a map in ***Figure 5.4.6-1***, traffic counting activities and existing condition of road at each station are shown in ***Photo 5.4.6-2***.

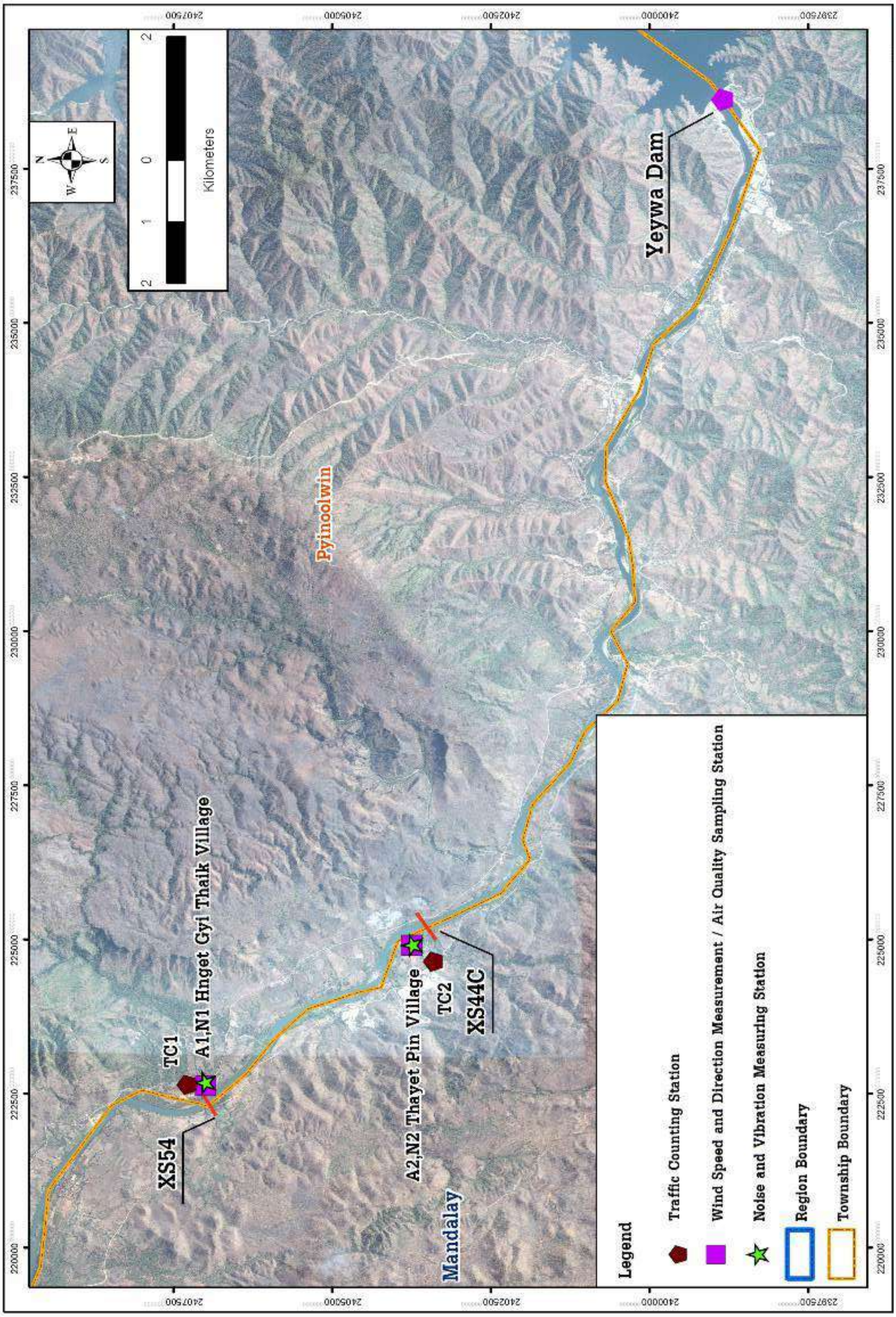


FIGURE 5.4.6-1 : LOCATION OF TRAFFIC COUNTING STATIONS

Traffic counting was done manually by four observers. The number and types of vehicles passing the station were recorded. The traffic counting data were used to calculate the V/C ratios.

Traffic condition is normally assessed in terms of road capacity relative to traffic volume, V/C ratio is commonly used for this purpose. This ratio is considered as a baseline traffic flow condition and will be further utilized to evaluate the consequences of the Project's impact on local traffic.

The calculation of V/C ratios follows the following steps:

1) Convert the number of vehicles from observation to Passenger Car Unit (PCU) by using Passenger Car Equivalents (PCE) factors specified for each type of vehicles as indicated in ***Table 5.4.6-2***. This is used as "Traffic Volume" or "V".

2) Select an applicable carrying capacity or "C" for the road (***Table 5.4.6-3***). The capacity can be estimated following the highway capacity manual (HCM, 2000).

3) Ratio of V/C can be calculated using the following formula;

$$\text{V/C ratio} = \frac{\text{Traffic Volume}}{\text{Carrying Capacity of Respective Road}}$$

V/C ratio can be used to compare with the values defined by the Division of Traffic Engineering (Thailand) as shown in ***Table 5.4.6-4*** for indication of present traffic condition.

TABLE 5.4.6-2

PASSENGER CAR EQUIVALENT FACTOR OF EACH VEHICLE

Types of Vehicles	Passenger Car Equivalents Factor (PCE)
Passenger Car and Taxi	1.00
Light bus	1.50
Medium bus	1.50
Light truck	1.00
Crane and grader	2.10
Medium truck (6 wheeled truck)	2.10
Heavy truck (10 wheeled truck)	2.50
Heavy truck including trailer	2.50
Bicycle, Tricycle	0.33
Motorcycle	0.33

Source: Paopong, 1997 and DOH of Thailand, 2011.

TABLE 5.4.6-3

TRAFFIC CARRYING CAPACITY AND HIGHWAY TYPES

Highway Types	Carrying Capacity of Traffic Volume (PCU/hr.)
2 way road with more than 2 traffic lanes/multi-traffic lanes	2,000 (per 1 traffic lane)
2 way road with 2 traffic lanes	2,000 (for both directions)
2 way road with 3 traffic lanes	4,000 (for both directions)

Source: Paopong, 1997

TABLE 5.4.6-4

RANGE OF V/C RATIO FOR TRAFFIC CONDITION CLASSIFICATION

Range of V/C Ratio	Classification of Traffic Condition
0.88 – 1.00	Severe traffic congestion
0.67 – 0.88	Heavy traffic congestion
0.52 – 0.67	Satisfactorily traffic flow
0.36 – 0.52	Good traffic flow
0.20 – 0.36	Very good traffic flow

Source: Paopong, 1997

(3) Results of the Study

The results of traffic counting are presented in four tables in ***Appendix 5I***. The data show traffic volume of 10 categories of vehicles as follows: (i) passenger car; (ii) light bus; (iii) medium bus; (iv) heavy bus; (v) light truck: (vi) six-wheeled truck; (vii) ten-wheeled truck; (viii) heavy truck including trailer; (ix) bicycle and tricycle; and (x) motorcycle. Tractors, pushcarts and motored tricycles (tuk tuks) were included in the passenger car category.

The traffic volume observed can be summarized as follows.

Station TC1

The number of vehicles passing main road in front of Hnget Gyi Thaik village on Friday 24th and Saturday 25th April 2015 were 577 and 920 unitsday, respectively. The majority of vehicles were motorcycles. For working day (Friday), the traffic volume was highest during evening (during 2.00 pm-5.00 am), between 66-69 units/hour while the highest traffic volume for holiday is about 139 units/hour (during 10.00 am-11.00 am. Results of traffic counting are shown in ***Appendix 5I-1***.

Station TC2

The number of vehicles passing main road in front of Thayet Pin village on Sunday 26th and Monday 27th April 2015 were 57 and 108 units/day, respectively. The majority of vehicles were motorcycles as same as Hnget Gyi Thaik village. For holiday (Sunday), the traffic volume was highest during afternoon (during 2.00 pm - 5.00 am), between 12-18 units/hour while the highest traffic volume for working day (Monday) is about 20 units/hr (during 7.00 am-8.00 am. Number of traffic at this station was too low due to road condition was not smoothly. Most of road condition was dirt road. Results of traffic counting are shown in ***Appendix 5I-2***.

Traffic Conditions

Table 5.4.6-5 shows the V/C ratios calculated for the traffic condition during the field survey. An average V/C ratio of the working day and holiday at Station TC1 was 0.0206 while an average V/C ratio at TC2 was 0.0021. These figures indicated very good traffic flow condition at all traffic counting station within project study area.

TABLE 5.4.6-5

EXISTING TRAFFIC CONDITION WITHIN PROJECT STUDY AREA

Description	TC1			TC2		
	Friday, 24th	Saturday, 25th	Average*	Sunday, 26th	Monday, 27th	Average*
Total Traffic volume (PCU/day)	390.83	595.88	493.36	32.84	66.71	49.78
Traffic volume per12 hrs*(PCU/hr)	32.57	49.66	41.12	2.74	5.56	4.15
Carrying capacity (C) (PCU/hr)	2,000	2,000	2,000	2,000	2,000	2,000
V/C ratio	0.0163	0.0248	0.0206	0.0013	0.0028	0.0021
Traffic Condition	Very good traffic flow			Very good traffic flow		

Remark: * Average of workingday and holiday Values
** Traffic volume per 12 hrs according to traffic counting during field investigation on workingday and holiday at each station.
TC1: Existing road at Hnget Gyi Thaik village (Right bank of Myitnge River)
TC2: Existing road at Thayet Pin village (Left bank of Myitnge River)
Source: Traffic survey by TEAM Consulting Engineering and Management Co., Ltd., April 2015.

5.4.6.5 Navigation

There is no commercial navigation in the river. Some small boats are used for river crossing.

5.4.6.6 Airport

Mandalay International Airport is about 37 km away from the project area.

5.4.6.7 Transmission Lines

There is no transmission line in the project vicinity. The nearest transmission line is about 20 km away.

5.4.6.8 Electricity

About 50 % of households in Hnget Gyi Thaik village and all of households in Ma Gyi Inn village are supplied with electricity from national grid. War Net and Thayet Pin village will soon have electricity supply. Currently, some households in these two villages have small generators and some have solar panel and battery for lighting only during nighttime.

5.4.6.9 Pipelines

No oil or gas pipelines exist in the project area.

5.4.6.10 Energy Sources

Fire wood, oil, and solar energy are energy sources for the villagers.

5.4.6.11 Waste Management

The four villages have no central systems for waste management. Excreta is disposed in cesspits while sullage is disposed of on ground. Garbage from individual households is dumped on open land around the villages. Flies and mosquitoes are abundantly found in every village in the study area.

5.4.7 Unexploded Ordinance (UXO)

The project area has no history of wars. UXO cases have never been reported.

5.4.8 Socio-economic Condition in the Village along Transmission Line

(1) Inn Kone Village

Inn Kone Village is located near the road connecting Shwe Sar Yan to Belin, along the transmission line corridor, and under administration of Sintgaing Township. The village was established 70 years ago and is made up of 78 households. There are no different ethnic groups in the village and all people are Bamar who practice Buddhism. Soonyeiin Lake, which is one of the tourist attractions in the area, is situated very near to Inn Kone village. In this village, fishing is households' main occupation and about 100 households are engaging in fishing activities in Soonyeiin Lake. Most of the households raise pigs and chickens for home consumption and goats for selling. There is a primary school in Inn Kone and the nearest secondary school is located in Soonye village, which is less than 1 km away.

(2) Hpa Lan Pin Village

Hpa Lan Pin Village is located to the north of Inn Kone village and the proposed transmission line will pass near the village area. The current village population number and household number is 400 and 71, respectively. All households living in this village are Bamar and their religion is Buddhist. Bamboo and firewood collection is households' major occupation and there are only about 10 households who own farmland, growing sesame, peas and cotton. Pigs and chickens are raised mostly for consumption, while goats are for selling and oxen for agricultural labor.

While located close to a main road, Hpa Lan Pin village is located far from services. There is no river near the village and water for irrigation is collected from Soonyeiin Lake which is 6.5 km away. While there is one primary school in the village, the nearest secondary school is in Soonyeinn village about 5 km away. The nearest health care center is located in Nat Yae Kan village, about 3 km away.

5.5 CULTURAL COMPONENTS

Area in the Vicinity of Quarry Site

Within the vicinity of quarry site there is a monastery (temple) in Thayet Pin village. The temple is approximately 200 years old. Within the temple there are pagodas, temple assemble hall, and monks' residence. The location of this temple is approximately 500 meters to the East of the project quarry site (see in ***Photo 5.5-1 and Figure 5.5-1***).

Project Dam Site

Within the project study area of dam site, there is a monastery (temple) near Hnget Gyi Thiak village. The temple is approximately 970 years old. Within the temple there are pagodas of King Anawrahta's reign, temple assemble hall, and monks' residence. The location of this temple is approximately 500 meters away to the North of the dam construction site (see in ***Photo 5.5-2 to 5.5-3 and Figure 5.5-1***).

PHOTO 5.5-1 : THAYET PIN TEMPLE

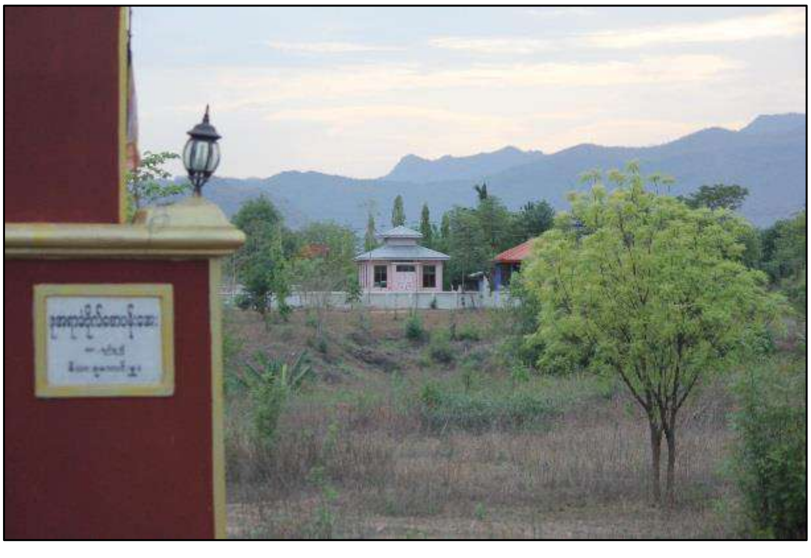


PHOTO 5.5-2 : HNGET GYI THAIK TEMPLE

PHOTO 5.5-3 : PAGODAS IN HNGET GYI THAIK TEMPLE

Besides the temples in Thayet Pin village and Hnget Gyi Thaik village, there is another monastery (temple) namely Ma Gyi In temple in Ma Gyi In village which is located on the right bank of Myitnge river in the section between quarry site and project dam site (***Photo 5.5-4***). This temple is about 100 years old. It is very big temple with wide boundary covering flat plain area and mountain slopes.

PHOTO 5.5-4 : MA GYI IN TEMPLE

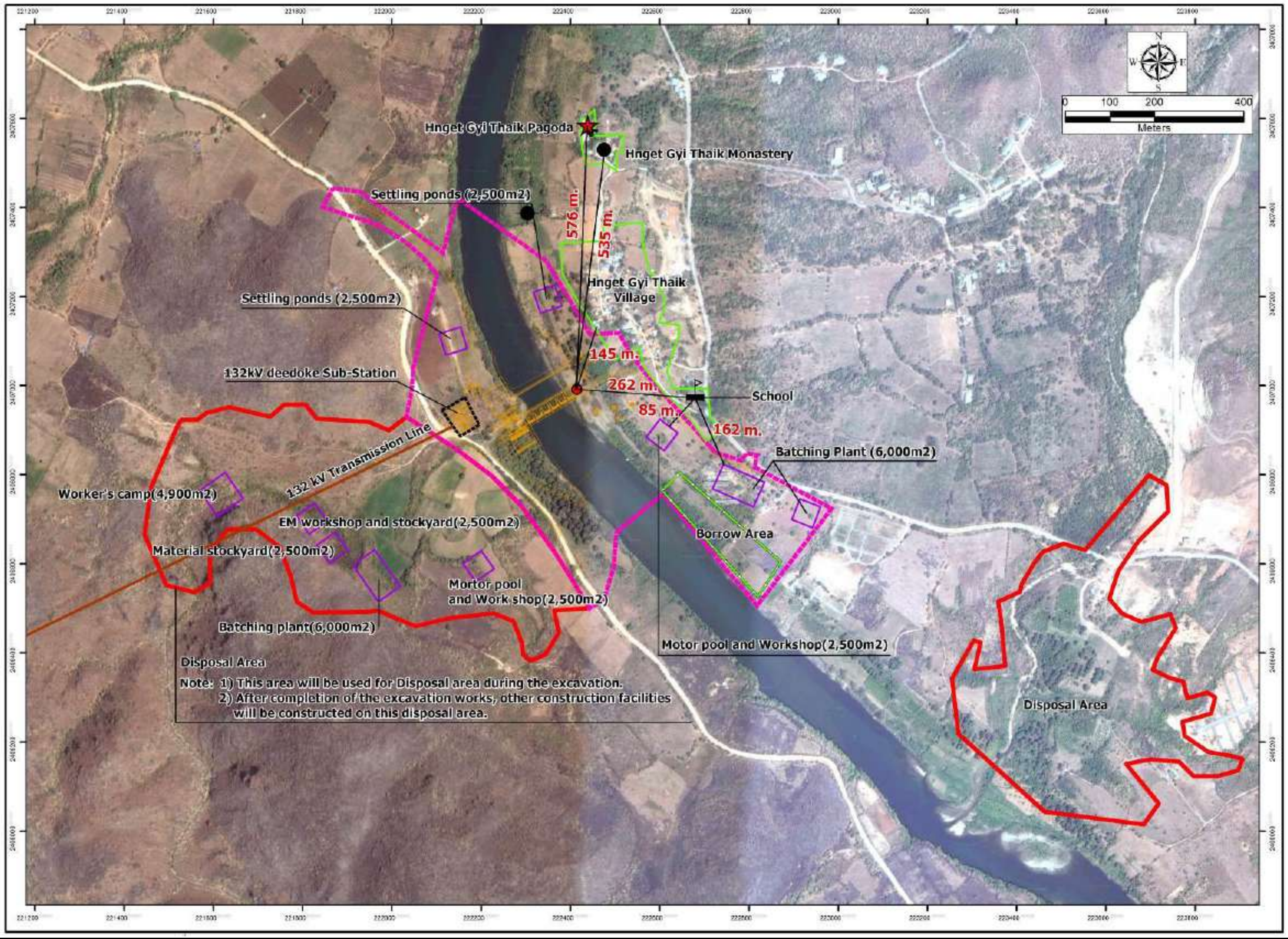


FIGURE 5.5-1 : LOCATION OF 3 HISTORICAL MONUMENTS OF "KING A NAW RAHTAR" NEARBY PROJECT AREA

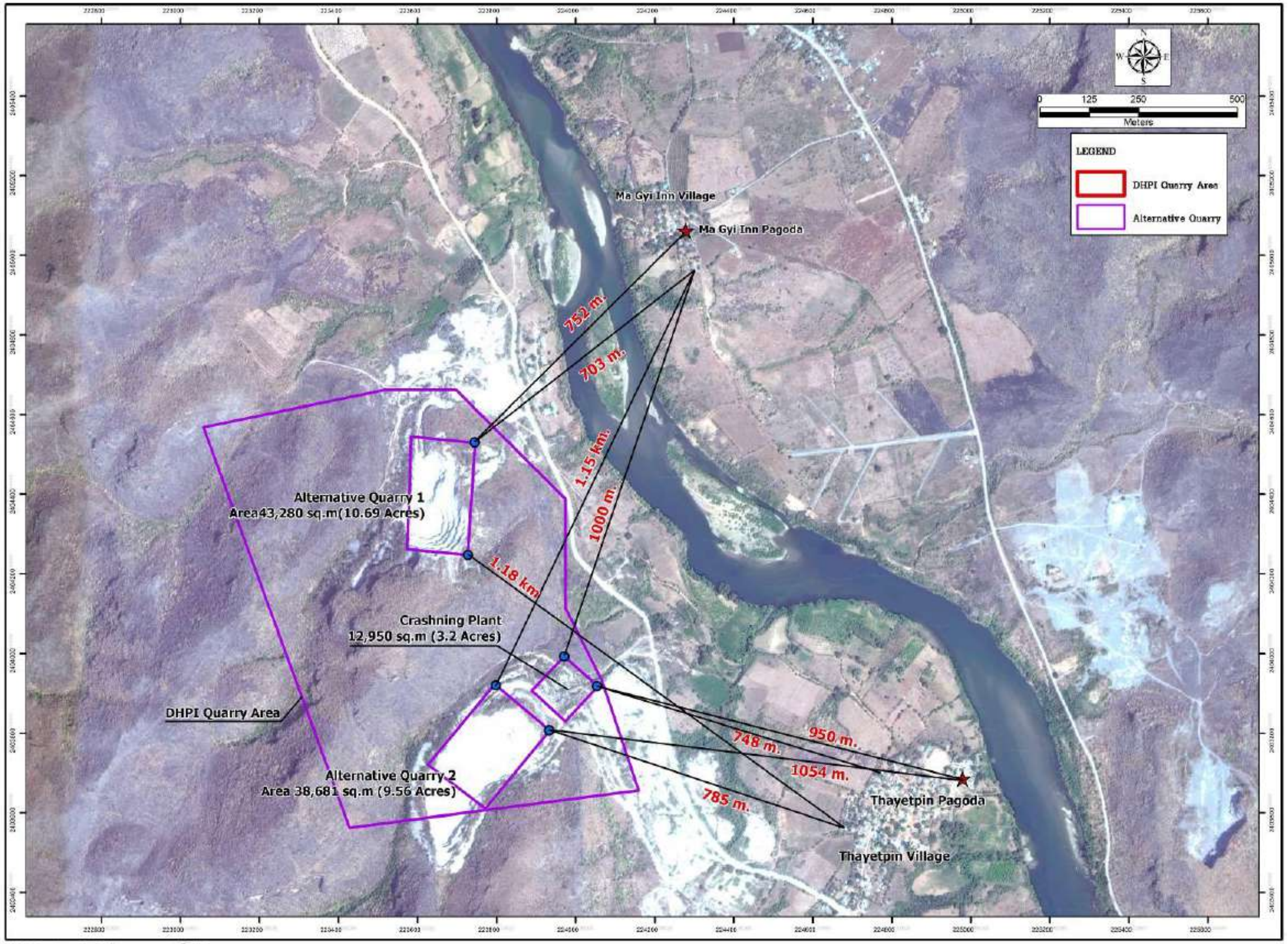


FIGURE 5.5-1 : LOCATION OF 3 HISTORICAL MONUMENTS NEARBY PROJECT AREA (CONT'D)

5.6 VISUAL COMPONENTS

Major visual components of the project area consist of mountains, river, agricultural land, vacant marginal land, and natural vegetation on islets and along the banks of Myitnge River. ***Photo 5.6-1*** shows pictures of these visual components.

5.6.1 Aesthetic

At present, the main aesthetic value of the project area is related to river scene especially the rapids near Section 54 (see ***Photo 5.6-2***). However, the scenery is not strikingly beautiful. The rapids will be submerged after the dam is constructed. Distant mountains also form a scenic background view of the project area.

5.6.2 Point of Interests

No points of interests in the project area that would attract visitors.

5.6.3 Landscape

All the natural visual components of the project area do not form a picturesque landscape. The current landscape quality is considered at a moderate level (***Photo 5.6-3***).







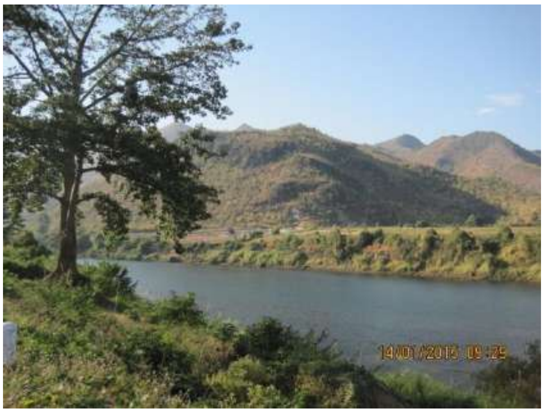



PHOTO 5.6-1 : OVERVIEW VISUAL COMPONENTS IN THE PROJECT AREA

PHOTO 5.6-2 : RIVER SCENE AT THE RAPIDS QUARRY SITE

Landscape of quarry site

Landscape of Project Dam Site

Landscape Upstream of Quarry Site

Landscape Downstream of Project Dam Site

PHOTO 5.6-3 : LANDSCAPE OF PROJECT AREA

CHAPTER 6

IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURES

CHAPTER 6

IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURES

6.1 IMPACT ASSESSMENT METHODOLOGY

6.1.1 Scope of Assessment

Environmental impact assessment (EIA) of a proposed development project is now recognized that it is essentially environmental management planning. In this regard, impact and risk assessment and formulation of mitigation measures are the first stage of environmental management planning. Consequently, the context of EIA reports is now required by MONREC in its EIA Procedure and EIA Guideline to expand beyond the impact assessment and mitigation measures to include a detailed environmental management plan (EMP) covering both the project construction and operation phases. For some types of projects that decommissioning can be clearly planned, for example a mining project, the EMP will also need to cover the decommissioning phase. The EMP will be implemented during project construction and operation to ensure acceptable environmental performance of the project during its construction and operation.

It should be noted that the term "environmental impact" is now generally used to cover not only the natural environment but also social environment or social impacts as well as occupational health and safety. This scope of environmental impact is adopted in the EIA Procedure as shown below:

Environmental Impact means the probable effects or consequence on the natural environment and people of a proposed Project or businesses or activities or undertaking. Impacts can be direct or indirect, cumulative, and positive or adverse or both. For purposes of this Procedure, Environmental Impacts include occupational, social, socio-economical, community health, and safety issues.

6.1.2 Geographical Scope: Study Area Boundaries

The study areas have already been identified and defined in **Section 5.1**. The impact area of each issue is defined in ***Table 6.1.2-1***.

TABLE 6.1.2-1

DEFINITIONS OF THE IMPACT AREAS

ES Issue	Impact Area
Noise	Area from the noise source to a point at which the noise will attenuate to
	an acceptable level
Vibration	Area from the vibration source to a point at which the energy wave will
	attenuate to an acceptable level
Fugitive dust on the construction site	Area around the construction site to a point at which the dust level returns to the level before the construction
Fugitive dust caused by materials transportation	Area along the road to a point at which the dust level returns to the level before the construction
River excavation or dredging	The river reach downstream of the excavation or dredging site to a section where the suspended solid plume is not visible
Quarrying operation Sites for disposal of construction wastes	Area around the quarry site to be determined by noise or vibration, whichever is greater. The area covering the disposal site area and the sensitive receptors
Fish ecosystem	The entire river reach from the Deedoke Dam to Yeywa Dam. The impact assessment may extend to cover areas believed to be ecologically linked to the impact area.
Terrestrial ecosystem	The entire area acquired for project facilities and construction laydown areas. For the hydropower scheme, the area will cover the head works, the hydropower plant, and support facilities. For the transmission line, the area is about 100 m on both sides of center line of the alignment or construction corridor.
Water quality	The entire river reach from the Deedoke Dam to Yeywa Dam.
Background ambient air quality	In the villages near the construction sites
Background ambient noise level	In the villages near the construction sites
Land acquisition	The entire areas of affected land due to project implementation.
River bank agriculture	The planting areas found along the river banks.
Visual quality degradation	The entire river reach and its terraces.
Archeological impacts	The entire river reach and its terraces.
Cultural impacts	In the villages near the construction sites
Environmental management areas	The entire construction site during construction. The entire river reach during operation.

6.1.3 Temporal Scope

The assessment of impacts of each ES issue is based on the temporal scope presented in ***Table 6.1.3-1***.

TABLE 6.1.3-1

TEMPORAL SCOPE

ES Issue	Impact Area
Noise	Over the construction duration, hourly and daily average noise level
Vibration	Over the construction duration, peak particle velocity mm/s
Fugitive dust on the construction site	Over the construction duration, hourly and daily average dust level
Fugitive dust caused by transport of materials	Over the construction duration, hourly and daily average dust level
Turbidity caused by river dredging or excavation	Over the dredging or excavation duration, hourly and daily average turbidity level
Soil contamination	Over the project life
Fish ecosystem	Over the construction and operation periods
Terrestrial ecosystem	Over the construction and operation periods
Water quality	Over the construction and operation periods
Background ambient air quality	Over the construction period, hourly and daily averages of air quality parameters
Land acquisition	During the site preparation period
River bank agriculture	Over the construction and operation periods
Visual quality degradation	Over the construction and operation periods
Archeological impacts	Over the construction and operation periods
Cultural impacts	Over the construction and operation periods
Environmental management areas	Over the construction and operation periods

6.1.4 General Methodology

6.1.4.1 Conceptual Framework

Impact Analysis

The first major step in conducting an EIA is "Impact Analysis" as shown in a diagram in ***Figure 6.1.4-1***. The Impact Analysis is essentially a cause-effect analysis based on the following logics.

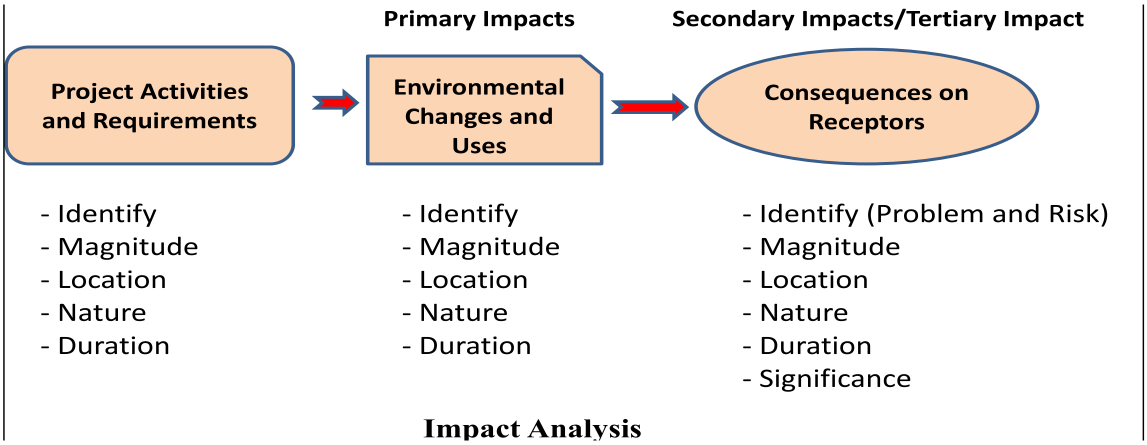


FIGURE 6.1.4-1 : IMPACT ANALYSIS PROCESS

(1) Project construction and operations involve various physical activities and require use of environmental resources as inputs. Examples:

- Construction activity-blasting, dredging and excavation.
- Operational activity-operation of generator and turbines in the power house.

(2) Project activities and requirements consume and emit mass and energy to the environments. They are the sources or root causes of environmental impacts since they will, if not adequately controlled or managed, certainly cause ***significant changes*** or conflicting use of the environmental components. Examples:

- Changes during construction-change in ambient noise level and ambient air quality nearby project construction site caused by blasting, dredging, excavation and percussive piling activities.
- Changes during operation-change in aquatic habitat due to formulation of river pondage area and change in water level on upstream area due to back water effect of the project.

(3) Direct impacts of project activities and requirements on the environment could be considered as ***primary impacts***. Ambient environmental standards are applied to the primary impacts while source or emission standards are applied to project activities.

(4) The magnitude, nature, and duration of the environmental changes or primary impacts will be governed by the location, magnitude, nature, and duration of project activities or requirements. Most primary impacts caused by construction activities and requirements are transient and reversible. Few impacts are permanent and irreversible. Examples'

- Transient environmental changes-increased ambient noise levels and fugitive dust during construction.
- Irreversible and permanent environmental changes-conversion of forest and plantation area into a river pondage area, and conversion of a mountain into a limestone quarry.

(5) The primary impacts caused by project activities and requirements could have consequences on ***receptors*** which could be ecosystems, communities, or workers in geographical areas that the primary impacts occur. The consequences could be considered as ***secondary impacts***. In some cases, the secondary impacts could have consequences on other receptors. For example, degradation of the aquatic ecosystem (secondary impact) caused by blockage of river flow (primary impact) could have impacts on livelihood of local fishermen. The consequences of the secondary impacts could be considered as ***tertiary impacts***.

(6) Secondary and tertiary impacts are ***problems*** that need to be solved by reducing the primary impacts through measures applied to causative project activities or requirement. They are considered problems, since based on existing knowledge and experience, they will certainly occur. Example-fugitive dust from blasting, dredging and excavation activities will certainly pollute the ambient air. If primary or secondary impacts are uncertain, they are considered as ***risks***. Example**-**due to lack of established knowledge, it is not certain whether electromagnetic waves from transmission lines have impacts on human health.

(7) A risk in environmental management could also be an undesirable event which may occur, and if it occurs will render an impact mitigation measure ineffective. An example of risk is dam collapse due to earthquake.

(8) The level of significance of a secondary impact is assessed from its extent and severity in terms of its magnitude and value of loss. The extent and severity of secondary impacts will depend on: (i) nature and magnitude of the primary impacts; and (ii) sensitivity of the receptors which depends on their nature and characteristics.

(9) The environmental problems and risks will have to be evaluated to assess their significance. Measures and resources to be allocated to address the problems and manage the risks should follow their significance. However, impact sources and primary impacts need to be addressed regardless of the significance of secondary impacts due to the legal requirements for projects to comply with applicable source and ambient standards.

Formulation of Measures to Address the Problems

This step is to formulate measures to address the problems. Measures are to be directed at the causes of the problems, i.e. project activities and requirements. Measures could be:

- Engineering measures to be incorporated in the design for implementation by the contractors
- Management measures to be implemented in construction management or operational management of project facilities during the operation phase

It is necessary to design effective implementation arrangements of the measures. Mitigation measures during the construction phase will have to be implemented by the contractors under supervision of construction supervision engineers engaged by the Project Proponent. The Project Proponent will oversee the implementation of mitigation measures through its project manager. Mitigation measures during the operation phase will be implemented as part of the operational management by the operational organization to be set up by the Project Proponent.

It should be noted that the measures will be applied to the project activities and requirements to reduce the primary impacts resulting in reduced secondary impacts. Some measures could be applied directly to the receptors to minimize the impacts on the receptors.

Figure 6.1.4-2 is a diagram showing the mitigation measure concept.

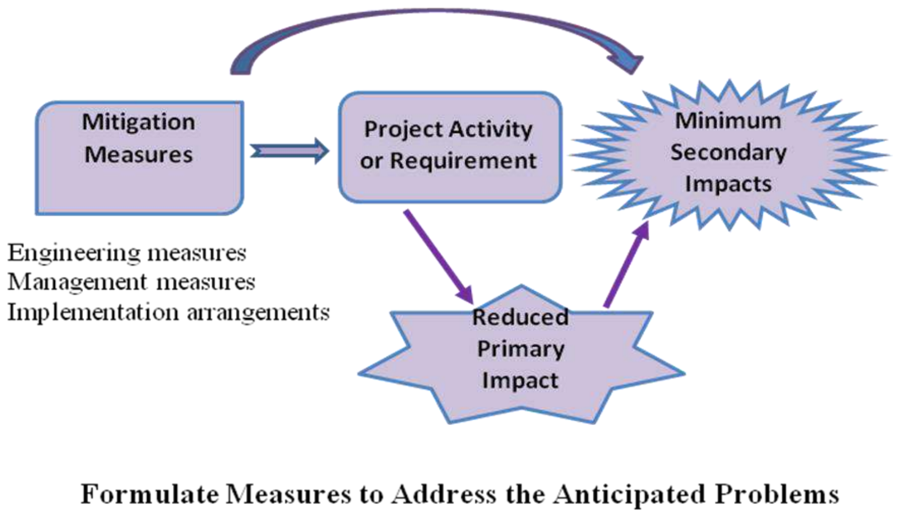


FIGURE 6.1.4-2 : MITIGATION MEASURE CONCEPT

Formulate Risk Management Measures

As pointed out, a secondary impact could create a risk. Measures will have to be formulated to manage the identified risks. ***Figure 6.1.4-3*** is a diagram showing the risk management logic. It involves an undesirable event which may or may not occur, and if it occurs will have adverse impacts on the receptor. In risk analysis, a risk event has to be identified and its likelihood of occurrence and severity of its impact (if it occurs) has to be assessed. Mitigation measures for risk management include measures to minimize the likelihood of occurrence or reduce the impacts. A contingency plan is required to handle the situations if the risk event occurs despite the implementation of risk mitigation measures. Finally, effective implementation arrangements for risk management will need to be designed.

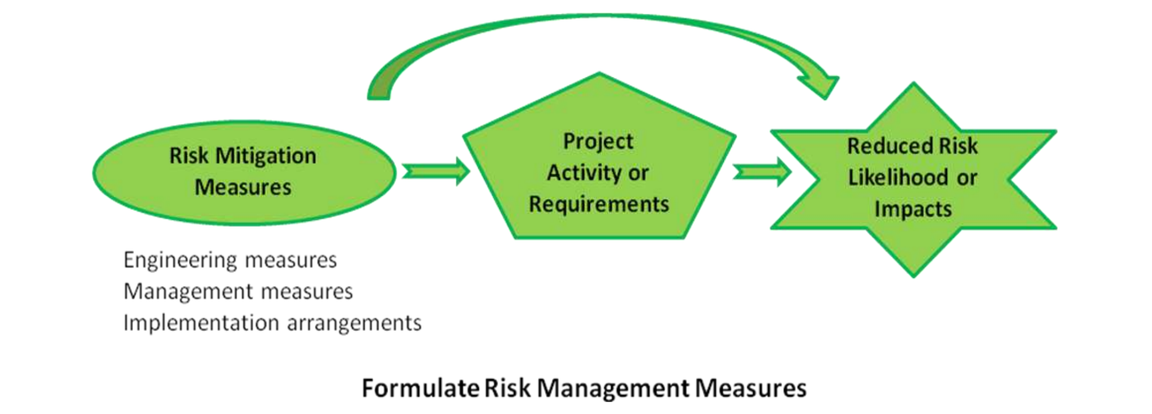


FIGURE 6.1.4-3 : ENVIRONMENTAL RISK MANAGEMENT LOGIC

6.1.4.2 Methodology for the Impact Assessment of Each Environmental Issue

The Conceptual Framework

Compliance with Source Environmental Standards

The assessment of impacts of this Project is premised on a requirement that the design, construction, and operation of Project facilities will adopt or implement best practicable measures to minimize the magnitude of resource consumption and wastes discharged into the natural environment. Examples are: (i) the selected method of percussive piling will have lowest noise levels among the percussive piling alternatives; and (ii) water will be frequently sprayed on uncovered construction site to suppress dust. Therefore, the assessment will be on the severity of the residual impacts to determine the need for additional measures to further reduce the residual impacts. For example, if the residual dust levels will cause health risk and discomfort to people in the villages proximate to the construction site, additional measures will be needed to reduce the dust levels at the receptors.

The above principle indicates that all Project activities must comply with applicable source or emission standards or environmental guidelines.

The assessment of impacts will cover (i) impacts on the ambient environment; and (ii) impacts on the receptors.

Impact on Ambient Environment

The impacts on the relevant ambient environment will be predicted, if possible, using an appropriate mathematical model.

Impacts on Receptors

Each environmental issue will have an impact area. Receptors in the impact area could be people, ecosystem, and properties depending on the nature of the issue. Impacts on the receptors are consequences of the impacts on ambient environment. For example, excessive dust concentration in the ambient air could adversely affect health and daily living of peoples living near the noise sources. The significance of the impact will be determined by severity and extent of the impacts which, in turn, will depend on the magnitude of the issue, and natural and socio-economic characteristics of the impact area.

For example, the impact of fugitive dust during construction will depend on the amount of dust released into the air, wind speed and direction, and land use and population density of the impact area.

Normally, if the ambient air quality is complied with the impacts on receptors should be negligible.

The Methodology

Based on the above conceptual framework, the Consultant has developed a general impact assessment methodology for the impact assessment of each environmental issue. ***Figure 6.1.4-4*** shows a diagram of the methodology. The methodology is explained below:

1. Estimate Magnitude of the Environmental Issue

The first step is to estimate the magnitude of the environmental issue from information on the Project construction and operation presented in ***Chapter 4***. The measurement of the magnitude of an environmental issue depends on the nature of the issue.

Examples: (i) the magnitude of the construction waste disposal issue is the total amount of construction waste that will have to be disposed of; and (ii) the magnitude of the traffic issue is the number of truck loads to be generated during the construction phase.

2. Identify Best Practicable Measures to Minimize the Magnitude of the Issue

Regardless of the level of its impact, the magnitude of the environmental issue must be minimized through best practicable measures to be implemented through design, construction method, or good construction practices.

Examples: (i) a piling method with a low noise level will be used; and (ii) the construction site will be frequently sprayed with water to suppress fugitive dust.

3. Estimate the Remaining Magnitude of the Issue

The remaining magnitude of the issue can be estimated from the efficiency of the mitigation measures reported in various references.

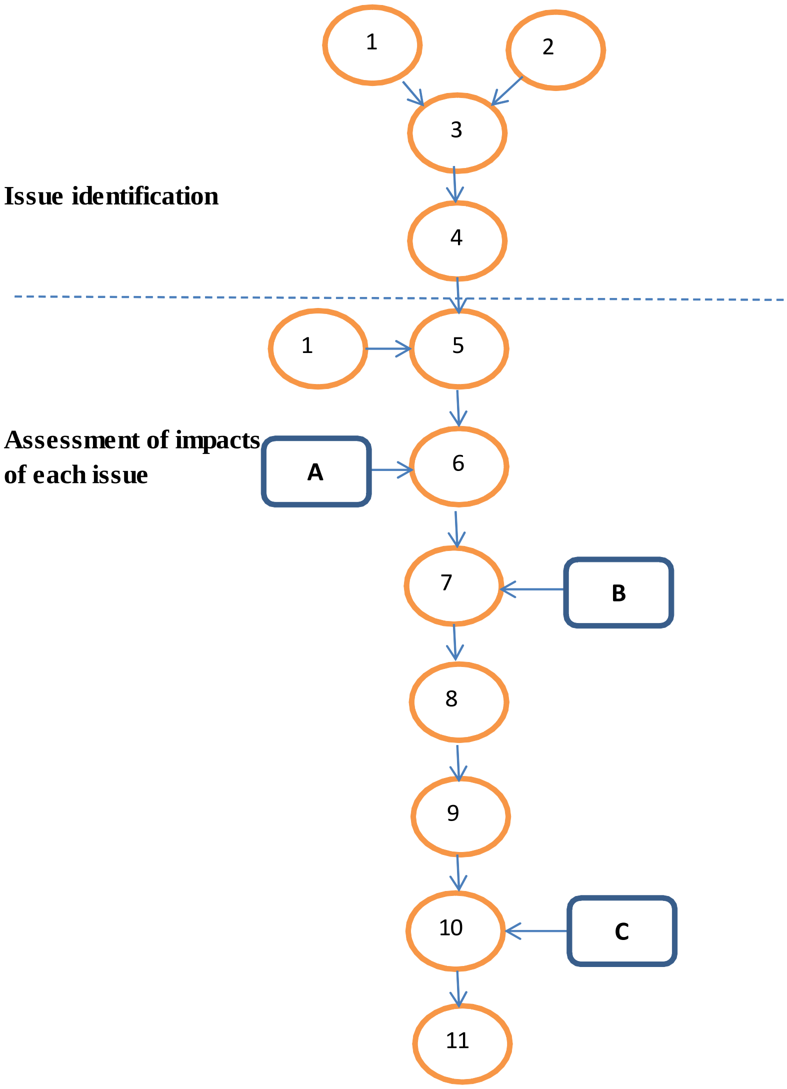
Examples: the remaining amount of fugitive dust after water spraying can be calculated from reported efficiency of water spraying in suppressing fugitive dust.

4. Compare the Remaining Magnitude of the Issue with Applicable Source Standards

Environmental issues related to pollution such as wastewater issues can be referred to applicable source standards, such as effluent quality standard for the wastewater issue.

If the remaining magnitude of the issue does not meet the applicable source standards, additional measures will be required to further reduce the remaining magnitude of the issue.

Some environmental issues, such as fugitive dust and construction wastes, have no source standards. In this case, the assessment can proceed to the next step.



1=Information on Project Nature and Scope
2=Baseline information on physical, environmental, and socio-economic settings of the study area
3=Identify relevant environmental and social issues anticipated during construction and operation
4=Identify sensittive receptors
5=Estimate magnitude of the issue, if possible
6=Identify measures for reducing magnitude of the issue, if possible
7=Compare the remaining magnitude with applicable source standards
8=Calculate impacts of the remaining magnitude of the issue on the receptors
9=Determine duration and nature of the impacts
10= Compare the impacts with the applicable ambient standards, if applicable
11=Assess the significance of the impacts

A=Established knowledge base on impact mitigation measures
B=Applicable source standards or criteria
C=Applicable ambient standards or cirteria

FIGURE 6.1.4-4 : METHODOLOGY FOR THE IMPACT ASSESSMENT OF EACH ENVIRONMENTAL ISSUE

5. Calculate or Estimate the Impact of the Remaining Magnitude of the Issue on Ambient Environmental Quality

A good example is the air pollution issue. This step will calculate the dispersion of the remaining amount of TSP in the ambient air around the project construction site and quarry site. The results will be increases in TSP value in the ambient air at various locations around the project construction site and quarry site.

6. Compare the Resulting Ambient Environmental Quality with the Applicable Ambient Environmental Quality Standard.

An example is the construction noise issue. If the resulting ambient noise levels at the sensitive receptors exceed the maximum permissible noise limits prescribed in the ambient noise standard, it will be necessary to implement measures for noise blocking at the sensitive receptors.

It is also possible that the ambient environment is so severely polluted that the ambient environmental quality standard cannot be met. If this is the case, the project could worsen the pollution problem. Pollution from other sources will need to be reduced or the project moves to other locations.

6.1.5 Methodology for the Determination of Significance

In environmental management, it is necessary to prioritize key environmental issues. Significance in this context is therefore related to priority that the project environmental management will accord to the issue.

The impact of an environmental issue is divided into 5 levels based on six criteria or considerations as shown in ***Table 6.1.5-1***. The criteria will need to be modified to make them specific and relevant to each environmental issue.

TABLE 6.1.5-1

LEVELS OF IMPACT OF THE ISSUE IN ENVIRONMENT MANAGEMENT

Consideration	Level of Impact or Significance of the Issue in Environmental Management				
	Critical	Major	Moderate	Minor	Insignificant
Magnitude of the issue	Very large	Large	Medium	Small	Very small
Nature of the issue	Irreversible	Irreversible	Reversible	Reversible	Reversible
Duration of the issue	Permanent	Long	Relatively short	Short	Very short
After implementing best available measures					
-the remaining magnitude can meet the source standards	No	No	Yes	Yes	Yes
Impacts of the remaining magnitude on ambient env quality					
-resulting ambient env quality can meet the ambient standards	No	Yes	Yes	Yes	Yes
Sensitivity of the impacted area	Very High	High	Medium	Low	Relatively Low

The impact assessment will be made for the impact without control and the impact with control or residual impact. The five impact levels are:

- Level 5-Critical-the impact is irreversible with extensive and severe ecological damages or socio-economic damages.The issue cannot be resolved. The project plan will need to be changed, relocated or abandoned.

- Level 4-Major-the impact will be substantial but it can be effectively reduced using both engineering and management measures.The residual impact will be minor.
- Level 3-Moderate-the impact is moderate in terms of extent and severity and it can be effectively reduced using simple measures. The residual impact will be insignificant.
- Level 2-Minor-the impact is small in magnitude and confined to a small area. It can be easily managed through good construction practices. The residual impact will be negligible.
- Level 1-Insignificant-the impact is very small compared to Level 2 impact and can be easily mitigated through good construction practices. The residual impact will be negligible.

- Mapping

Maps are used in this EIA Report to support narrative description of various subjects. They were obtained from various secondary sources, including: (i) site maps prepared by the technical consultant for using in the Feasibility Study Report; (ii) regional maps presented in various documents; and (iii) Google earth. The available maps are in various scales and they are selectively used to suit the illustration purposes. No attempts were made in this EIA study to prepare its own maps based on field surveys.

- Key Issues and Selection of Valued Environmental Components

Valued Environmental Components (VECs) for the Project are those environmental and social attributes associated with the development of the proposed Project which have been identified to be of concern by the public, government or professional community. The EIA will cover VECs to be identified based on consideration of Government's EIA requirements, nature of the Project, construction activities, existing environmental and socio-economic and cultural settings of the areas impacted by the Project, and ongoing and future developments of hydropower projects in the region. The identified VECs and issues of concern will need to be presented to stakeholders and finalized based on comments from the stakeholders.

The preliminary environmental impact assessment made in the scoping study has identified key issues and VECs to be covered in the ESIA as presented below in ***Table 6.1.5-2***. For each VEC, one or more parameters will be selected to facilitate quantitative or qualitative measurement of potential project impacts and cumulative impacts. Results of the measurement will be used to determine the level or magnitude of incremental change in the VEC. If possible, thresholds or standards will be identified for each measurable parameter. For example, a measure of total suspended solids could be chosen as the measurable parameter for sedimentation effects in watercourses and on fish habitat and condition. The level of change, the applicable standard, and the nature of change (reversible or irreversible) will be the basis for determining the level of significance of the impact.

The EIA will cover direct impacts of the Project on these VECs and also on direct impacts of the Project coupled with future impacts of planned projects on the VECs, or cumulative impacts.

TABLE 6.1.5-2

VECS DURING CONSTRUCTION AND OPERATION PHASES

VEC	Main Concern During Pre-Construction and Construction
Construction Phase	
Air quality	Increases in air pollutants caused by fugitive dust from rock blasting, site excavation, quarrying operation and emissions from operation of trucks and heavy construction equipment.
Noise	Increase ambient noise level at the construction site, quarry site and communities near the material transport routes.
Vibration	Increase vibration at the construction site, quarry site and communities near the material transport routes.
Surface water quality	Increased turbidity of river water due to in-river construction activities and river bed excavation or dredging.
Aquatic ecology and fishery	Loss of benthic organisms and impeding fishing activities due to in-river construction activities and river bed excavation or dredging.
Boat traffic	Impeding boat traffic due to in-river construction activities and river bed excavation or dredging.
Traffic and Road Safety	Increases in traffic load and safety along the material transport routes
Land use	Change in land use and land ownership due to land acquisition for project construction and quarry sites.
Waste	Degradation of the disposal sites due to inappropriate management of construction wastes at disposal site.
Operation Phase	
Livelihoods	Loss of river bank agriculture due to back water effect of project
Fishery	Impacts on fish ecology and fisheries upstream and downstream due to changes in river flow regimes upstream of the dam
Groundwater	Increased groundwater tables in areas along the river banks upstream due to project operation

- **Modeling Requirements**

  - ***Air Quality***

Methodology

As the Project impact on air quality is only fugitive dust generate from site clearance, rock blasting and excavation activities only ground level concentrations of fugitive dust at the construction sites will be calculated using the Box Model. The model is described in the relevant section on the assessment of impacts of fugitive dust during project construction.

Results

The impacts of fugitive dust will be calculated as average concentrations of Total Suspended Particles at the identified sensitive receptors. Concentration contour lines are not necessary.

Mapping

The impacts of fugitive dust will be presented in a table and also on a project site map at scale 1:5,000, if necessary.

- ***Surface Water Quality***

Methodology

An appropriate simple calculation will be applied to predict concentrations of suspended solids over a distance in Myitnge River downstream of the excavation or dredging site. A complicate model will not be applied.

Results

The predicted SS concentrations will be daily average concentrations at various river distances downstream of the excavation site.

Mapping

The predicted suspended solids concentrations will be presented in a table and also on a map of the relevant river section at scale 1:5,000, if necessary.

- ***Groundwater Quality***

Groundwater pollution is not relevant in this Project. Groundwater modeling will not be necessary.

Methodology

Ambient noise levels at the sensitive receptors will be calculated using a simple noise propagation equation to be presented in the relevant section on noise impact assessment.

Results

The calculated noise levels will be expressed as Leq-24 hour in dB(A).

Mapping

The impacts of noise at the sensitive receptors will be presented in a table and also on a project site map at scale 1:5,000, if necessary.

- ***Others***

Modeling is not relevant for other impacts of this Project.

- **Outline of Content**

6.1.5.1 Project Phases Covered in the EIA

The EIA results for each key valued environmental component will be presented for each project phase as follows: pre-construction phase, construction phase, and operational phase.

The decommissioning/closure/post closure phase is not covered in the EIA as explained in the Scoping Report. This terminal project phase is applicable to projects with definite working life such as mining and nuclear power plant projects. For a hydropower project, the working life of the dam will be at least 50 years although most hydropower equipment will need to be replaced during the life of the dam. The chance that the dam will be demolished for ecological reason is extremely unlikely in the context of Myanmar.

6.1.5.2 Subjects Covered in Each Project Phase

For each key valued environmental component the EIA results for each project phase are presented in four subjects: (i) potential impacts; (ii) proposed mitigation measures; (iii) residual impacts; and (iv) proposed monitoring. It should be noted that the proposed monitoring for each key valued environmental component will have to be consolidated and presented in the environmental management plans in ***Chapter 8***.

6.2 IDENTIFICATION OF ENVIRONMENAL AND SOCIAL ISSUES/IMPACTS

6.2.1 Overview of Environmental and Social Context of the Project

The Project is considered to consist of two components; (i) the hydropower component which is the major component; and (ii) the transmission line component which is the associated smaller component. Environmental and social (ES) issues of the two components are different in nature, magnitude and spatial scope. In overall, the hydropower component is much more significant than the transmission line component in ES management of the Project.

6.2.1.1 Construction Phase

The construction of the hydropower component is considered major construction, involving various types of civil works (CW) and the electrical-mechanical/hydraulic-mechnical works (EMHMW), and the transmission line works (TLW). The construction will be carried out within a clearly defined area referred to as the project site. Typically, the construction activities will disturb the physical environment of the project site which may have adverse consequences on the ecosystem and/or people living near the construction sites (sensitive receptors).

In contrast, the construction of the transmission line is considered minor construction, involving construction of a number of foundations for supporting steel towers. TLW will involve installation and erection of steel towers from prefabricated tower elements, and stringing the cables. As the transmission line is a linear structure, the construction will take place at several small areas along the long and narrow corridor, about 50 m wide. The construction will create only minor disturbances to the environment and people living along the transmission line corridor. However, the transmission line will limit land use along the corridor, and may have adverse ecological consequences if the corridor traverses a sensitive terrestrial ecosystem.

6.2.1.2 Operational Phase

During the operation of hydropower plant, the major issue will be the backwater effects. At the design operating level of 80 m a.s.l, the backwater effects will be manifested in: (i) increased water levels in the river section between Yeywa dam and Deedoke dam by about 7 m at the Deedoke dam; and (ii) increased water volume upstream of about 23 million m^3 above the natural volume without Deedoke dam. The backwater effects could create adverse and beneficial consequences. For example, the increased water level could inundate cropping area along the river bank terrace but could increase groundwater table, thus saving time and energy in groundwater extraction.

The operation of the transmission line will not create new adverse consequence. The adverse consequences on land use, if any, created during the construction phase will remain throughout the operational phase. Maintenance of the transmission line and its corridor would create only minor environmental disturbances.

6.2.2 Summary of Identified Issues

Table 6.2.2-1 presents a summary of identification of environmental and social issues anticipated during project construction and operation based on technical information in the final feasibility study report, the Consultant's appreciation of the environmental and social ES settings of the project area, baseline information on existing ES condition in the project area, experience of the Consultant in ES impact assessment, and established knowledge of typical ES issues of run-of-river hydropower projects. These identified issues have also been presented in the Scoping Report.

6.3 BIOPHYSICAL IMPACT ASSESSMENT

This section presents EIA results for the biophysical components covering only biophysical components relevant to this Project. They are: (i) air quality; (ii) noise and vibration; (iii) river water quality; (iv) water level; and (v) fish and fish habitat. The assessment is focused on changes in these biophysical components that will be caused by the Project during its construction and operation phases. It should be noted that the Consultant considers pre-construction activities, such as land acquisition and land clearing, as construction activities. In addition, the decommissioning/closure/post closure phase is not relevant to this hydropower project as pointed out in ***Section 6.1.5.1***. The EIA therefore covers only the construction and operation phases. The subjects discussed in each phase are potential impacts, proposed mitigation measures, residual impacts, and proposed monitoring. Consequently, the structure of this Section follows closely the outline prescribed in *Appendix 3* of the *EIA Guideline 2014*.

6.3.1 Air Quality

6.3.1.1 Construction Phase

Impacts of the Project on air quality will be an issue of concern only during the construction phase. Fugitive dust and gaseous emission are the major air emission during this phase. Fugitive dust will be caused by site clearance, rock blasting and excavation activities. Fugitive dust is expected in the construction of the dam body, the access road, quarrying activities; and in transportation of materials. However, the largest source of fugitive dust would be the excavation activities at the dam site and rock blasting at the quarry site. Gaseous emissions will be caused by combustion of heavy construction equipment and vehicles driven by diesel engines.

TABLE 6.2.2-1

IDENTIFICATION OF ES ISSUES OF THE PROJECT

Project Activities	Disturbances on Physical Environment	Generic Impacts on Receptors	Likely Level of Significance in this Project
Construction of Dam and Hydropower Plant ***On-site Activities*** 1. Rock blasting and site excavation,	- Noise, vibration and dust	- Discomfort and health risks to communities near the construction site	- Medium, 1 community exists near construction site
2. Operation of trucks and heavy construction equipment	- Noise, vibration and dust	- Discomfort and health risks to communities near the construction site	- Medium, 1 community exists near construction site
3. In-river construction, including river bed excavation	- Increased turbidity of river water, loss of benthic organisms - Impeding boat traffic - Impeding fishing activities	- Impacts on fish ecosystem, decreased fish catch - Impacts on water users - Public inconveniences, livelihood of boat operators - Impacts on livelihood	- Insignificant, poor fishery resource - Medium, villagers use river water - Insignificant, no regular boat traffic in the river apart from river crossing - Insignificant, no fishing activities in the river
4. Disposal of construction wastes	- Degradation of the disposal sites	- Soil contamination, impacts on terrestrial ecosystems (depending on characteristics of the disposal sites)	- Low, would not be difficult to find poor land for disposal site.
5. Land acquisition	- Change in land use and land ownership	- Affected communities, loss of properties and livelihood, relocation	- Low, small part of agricultural land would be taken for construction site, no relocation.
Off-site Activities			
1. Quarrying operations	- Noise, vibration and dust	- Discomfort and health risks to community near the quarry site	- Low, 1 community near the planned quarry site
2. Transport of materials into and out of the construction site and the quarry sites	- Noise, vibration, dust, and emissions Increased truck traffic on the roads	- Discomfort and health risks to communities along the transport routes - Traffic safety and community safety	- Significant, communities exist along the access road - Significant, communities exist along the access road

TABLE 6.2.2-1

IDENTIFICATION OF ES ISSUES OF THE PROJECT (CONT'D)

Project Activities	Disturbances on Physical Environment	Generic Impacts on Receptors	Likely Level of Significance in this Project
Construction of Transmission Line Activities Along the Corridor 1. Vegetation clearing along the alignment (50 m corridor)	- Land use change	- Impacts on terrestrial ecology	- Insignificant, deteriorated dry dipterocarp forests exist along the alignment route
2. Disposal of waste vegetation	- Noise and dust	- Discomfort and health risks to communities near the alignment	- Insignificant, only 2 communities near the end of alignment
3. Construction of foundations for towers	- Noise and dust	- Discomfort and health risks to communities near the alignment	- Insignificant, only 2 communities near the end of alignment
Operation of the Hydropower Scheme 1. Maintain water level behind the dam	- Changes in river flow regimes upstream of the dam - Increased groundwater tables in areas along the river banks upstream - Obstruction to boat navigation	- Impacts on fish ecology and fisheries upstream and downstream - Loss of river bank land for cropping, impacts on livelihoods of people - Water logging in cropping areas - Increased time and cost for boats having to use the navigation lock	- Low, poor fishery resource - Low, few small cropping areas - Low, high ground level - Insignificant, no regular boat traffic in the river apart from river crossing
Operation of the Transmission Line 1. Maintenance of transmission line and the corridor	- Noise in cutting vegetation	- Nuisance to people living near the corridor	- Insignificant, only 2 communities near the end of alignment, vegetation under the transmission line would not be dense.

A. Fugitive Dust

(1) Potential Impacts

a. Sources

Potential sources of fugitive dust include site clearance, rock blasting and excavation activities. Fugitive dust is expected in the construction of the dam body, the access road, quarry site and crushing plant; and in transportation of materials. However, the largest source of fugitive dust would be the excavation activities at the dam site, rock blasting at the quarry site, and rock crushing at the crushing plant. Measures for fugitive dust control will be necessary at the construction sites of all facilities, quarry site, and crushing plant to ensure no public complaints.

As the hydropower plant construction site, quarry site, and crushing plant are the major construction areas with the longest construction period, fugitive dust at these sites will require greatest attention compared to the construction sites of the access roads and the transmission line. In addition to the control at the construction sites, efforts will need to be made to minimize fugitive dust generated by construction trucks along the transport routes.

b. Sensitivity of Receptors

The receptors of fugitive dust will be the same receptors of construction noise. They will be workers on site and communities near the project site as follows:-

Activity	Sensitive Receptors	Distances	Number of Household
Dam construction site	Hnget Gyi Thaik village (nearest house)	80 m. from the dam construction site	70
	School in Hnget Gyi Thaik village	85 m. from the dam construction site	-
	Hnget Gyi Thaik Pagoda	576 m. from the dam construction site	-
	Hnget Gyi Thaik Monastery	535 m. from the dam construction site	-
Quarry site 1	Ma Gyi Inn Village (nearest house)	704 m. from the quarry site 1	-
	Ma Gyi Inn Pagoda	752 m. from the quarry site 1	-
Quarry site 2 and crushing plant	Thayet Pin village (nearest house)	784 m. from the quarry site 2	102
		745 m. from the crushing plant	
	Thayet Pin Pagoda	1,052 m. from the quarry site 2	-
		953 m. from the crushing plant	-

c. Magnitude of Fugitive Dust Emission at Sources

The amount of fugitive dust generated in the construction will depend primarily on the nature of construction works, soil characteristics, soil moisture content, types of construction equipment, and wind speeds.

In principle, the magnitude of fugitive dust emission could be calculated for each step of the construction process. However, considering the lack of detailed information on the construction steps, a global estimate has to be adopted using the Emission Factor in construction area established by the US.EPA (AP-42, US EPA 2005). The emission factor is 1.2 tons per acre (about 2.693 metric tons/ha) of the construction area per month during the construction period.

- Based on the above emission factor and the main construction area of the hydropower plant facilities of about 173.2 acres, the total amount of fugitive dust is estimated at 207.84 metric tons/month or about 240.56 grams per sec (g/s).
- For quarry site 1, the main quarrying area is about 10.69 acres; the total amount of fugitive dust is estimated at 12.83 metric tons/month or about 14.85 grams per sec (g/s).
- For quarry site 2, the main quarrying area is about 9.56 acres; the total amount of fugitive dust is estimated at 11.47 metric tons/month or about 3.28 grams per sec (g/s).
- For crushing plant, the plant area is about 3.20 acres; the total amount of fugitive dust is estimated at 3.84 metric tons/month or about 4.44 grams per sec (g/s).

(2) Proposed Mitigation Measures

a. Fugitive Dust Control Targets

The fugitive dust control target will be based on the World Bank's ambient air quality standard. This standard prescribes the concentration of TSP not exceeding 230 $\mu g/m^3$. The TSP level at the receptors will not exceed this limit.

b. Proposed Mitigation Measures at the Construction Sites

At all the construction sites, measures should be implemented to reduce fugitive dust emission. The most common measures are:

- Spray water at and around the construction areas and access roads during site preparation and grading.
- Enforce a speed limit for vehicles and trucks in the construction sites not to exceed 40 km/hr. Construction activities shall be kept as planned so that the disturbed areas will be minimized at any time.
- Restore, resurface, and rehabilitate the disturbed areas as soon as practicable after completion of construction or disturbance.
- Prohibit the open burning of waste in the construction area.
- Dust masks should be provided (where applicable) to all construction workers.

These measures especially water spraying twice a day together with strict implementation of other dust suppression measures should be able to reduce fugitive dust emission as much as 75% (US.EPA (2006), AP 42, chapter 13.2.2).

It should be noted that the dust suppression efficiency of water spraying will depend on the volume of water use per unit area and the frequency of spraying. A 75% efficiency could be expected.

c. Proposed Mitigation Measures Offsite

Fugitive dust along the transport routes should be minimized. Measures to be implemented by the contractorท include:

- Enforce speed limit for trucks not to exceed 40 km/ hr when passing the communities.
- Cover construction materials by tarpaulin sheet during transportation, materials should be dampened, if necessary, before transportation.
- Establish a vehicle washing facilities to minimize the quantity of material deposition on public roads.
- Establish a checkpoint at project gate to ensure the vehicles leaving the project site are following the measures prescribed to reduce dust emissions.

(3) Residual Impacts

a. Predicted TSP Levels at the Receptors from main construction site

The dispersion of fugitive dust can be calculated using the Box Model recommended by Hanna, Briggs and Hosker (Handbook on Atmospheric Diffusion, 1987).

The Box Model is represented by the following formula:

$$C = \frac{Q}{d \times w \times m}$$

Where: C = concentration of dust (mg/m^3)

d = width of the project construction area perpendicular to wind direction (meteorological data period)

= 300 m.

w = average wind speed = 0.26 m/s.

m = average Daytime Mixing Height = 1,500 m

A = area of construction activities

= 10.06 acres

Q = the quantity of dust dispersion into ambient air

The calculations of fugitive dust on the ambient air quality were based on the construction activity at each area, some activity might carried out at nighttime. Although working hours will be separated as 12 or 24 hrs.-shift. However, the air impacts from construction activity were predicted as worst case analysis covering both daytime and nighttime (12 hrs. per shift) for 2 cases as no control and control (Water spraying twice a day).

No Control

- ***Daytime:*** The concentration of TSP is predicted at 130.74 μg/ m^3. Combined with the background ambient TSP of 57.05 μg/ m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 187.79 μg/m^3.
- ***Nighttime:*** The concentration of TSP is predicted at 312.41 μg/ m^3. Combined with the background ambient TSP of 57.05 μg/ m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 369.46 μg/m^3.

Control (Water spraying twice a day)

- ***Daytime:*** The concentration of TSP is predicted at 32.68 μg/ m^3. Combined with the background ambient TSP of 57.05 μg/ m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 89.73 μg/m^3.
- ***Nighttime:*** The concentration of TSP is predicted at 78.10 μg/ m^3. Combined with the background ambient TSP of 57.05 μg/ m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 135.15 μg/m^3.

Details are presented below:

Condition	**TSP Concentration, μg/m^3**	
	Predicted	**Total**
Daytime		
No Control	130.74	187.79
Control (75% suppression)	32.68	89.73
Nighttime		
No Control	312.41	369.46
Control (75% suppression)	78.10	135.15

It can be seen that even without control the total ambient TSP level in daytime will be much lower than the control target of not exceeding 230 μg/ m^3 (*Ambient Air Quality of International Finance Corporation-IFC, 2007*). In case of the total ambient TSP level in nighttime without control will be much more than the control target but the project will conduct with strict implementation of other dust suppression measures which should be able to reduce fugitive dust emission as much as 75%. Therefore, the total ambient TSP level in nighttime will be lower than the control target of not exceeding 230 μg /m^3.

As the receptors in Hnget Gyi Thaik village (nearest house), Hnget Gyi Thaik primary school, Hnget Gyi Thaik Pagoda, and Hnget Gyi Thaik Monastery which are located about 80-576 m. away from the dam construction site, the impact of fugitive dust on the receptors will be smaller than the level at the perimeter of the construction site.

b. Predicted TSP Levels at the receptors from quarry site 1

The Box Model is represented by the following formula:

$$C = \frac{Q}{d \times w \times m}$$

Where: C = concentration of dust (mg/m^3)

d = width of the project construction area perpendicular to wind direction (meteorological data period)

= 160 m.

w = average wind speed = 1.00 m/s.from the least windy month

m = average mixing height
(Daytime =1,840 m, and nighttime = 770 m.)

Q = the quantity of dust dispersion into ambient air

= 14.85 g/s.

The calculations of fugitive dust on the ambient air quality caused by the quarrying activity were predicted as worst case analysis covering both daytime and nighttime (12 hrs. per shift) for 2 cases as no control and control (Water spraying twice a day).

No Control

- ***Daytime:*** The concentration of TSP in the quarry site 1 is predicted at 50.43 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Thayet Pin Primary School, the total concentration is about 111.83 μg/m^3.
- ***Nighttime:*** The concentration of TSP in the quarry site 1 is predicted at 120.51 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 181.91 μg/m^3.

Control (Water spraying twice a day)

- ***Daytime:*** The concentration of TSP is predicted at 12.61 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Thayet Pin Primary School, the total concentration is about 74.01 μg/m^3.
- ***Nighttime:*** The concentration of TSP is predicted at 30.13 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 91.53 μg/m^3.

Details are presented below:

Condition	**TSP Concentration, μg/m³**	
	Predicted	**Total**
Daytime		
No Control	50.43	111.83
Control (75% suppression)	12.61	74.01
Nighttime		
No Control	120.51	181.91
Control (75% suppression)	30.13	91.53

It can be seen that even without control the total ambient TSP level will be much lower than the control target of not exceeding 230 μg /m^3 (*Ambient Air Quality of International Finance Corporation-IFC, 2007*).

As the receptors in Ma Gyi Inn Village and Ma Gyi Inn Pagoda which are located about 704-752 m. away from the quarry site 1, the impact of fugitive dust on the receptors will be smaller than the level at the perimeter of the quarry site.

c. Predicted TSP Levels at the receptors from quarry site 2 and crushing plant

The quarry site 2 is located next to the crushing plant, the impact of fugitive dust on the ambient air quality caused by the quarrying and crushing activities were predicted as worst case analysis covering both daytime and nighttime (12 hrs. per shift) for 2 cases as no control and control (Water spraying twice a day).

The Box Model is represented by the following formula:

$$C = \frac{Q}{d \times w \times m}$$

Where: C = concentration of dust (mg/m^3)

d = width of the project construction area perpendicular to wind direction (meteorological data period)

= 370 m.

w = average wind speed = 1.00 m/s.from the least windy month

m = average mixing height
(Daytime =1,840 m, and nighttime = 770 m.)

Q = the quantity of dust dispersion into ambient air

= 13.28 + 4.44 g/s.

= 17.72 g/s.

The calculations of fugitive dust on the ambient air quality are shown as below;

No Control

- ***Daytime:*** The concentration of TSP is predicted at 26.03 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Thayet Pin Primary School, the total concentration is about 87.43 μg/m^3.
- ***Nighttime:*** The concentration of TSP is predicted at 62.21 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 123.61 μg/m^3.

Control (Water spraying twice a day)

- ***Daytime:*** The concentration of TSP is predicted at 6.51 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Thayet Pin Primary School, the total concentration is about 67.91 μg/m^3.
- ***Nighttime:*** The concentration of TSP is predicted at 15.55 μg/m^3. Combined with the background ambient TSP of 61.40 μg/m^3 from the field measurement at Hnget Gyi Thaik primary school, the total concentration is about 76.95 μg/m^3.

Details are presented below:

Condition	**TSP Concentration, μg/m^3**	
	Predicted	**Total**
Daytime		
No Control	26.03	87.43
Control (75% suppression)	6.51	67.91
Nighttime		
No Control	62.21	123.61
Control (75% suppression)	15.55	76.95

It can be seen that even without control the total ambient TSP level will be much lower than the control target of not exceeding 230 μg /m^3 (*Ambient Air Quality of International Finance Corporation-IFC, 2007*).

As the receptors in Thayet Pin village and Thayet Pin Pagoda which are located about 745-1,052 m. away from the quarry site 2 and crushing plant, the impact of fugitive dust on the receptors will be smaller than the level at the perimeter of the site.

It can be seen that without control the total ambient TSP level will be too much higher than the control target of not exceeding 230 μg /m^3. Therefore, water spraying twice a day at dam construction site, quarry sites and nearby area together with strictly implementation of other dust suppression measures must be conducted.

Some of these maximum values are predicted to occur at Hnget Gyi Thaik village (the nearest settlement to Deedoke Dam construction site) and Thayet Pin village (the nearest settlement to Quarry site). In order to evaluate the significance of the impact of TSP, the calculated concentrations are compared with World Bank's ambient air quality standard due to there is no standard value for TSP in National Environmental Quality (Emission) Guidelines (2015) of Myanmar. As a result of this comparison daily TSP concentration with control 75% suppression measures is under the limit value of the World Bank's ambient air quality standard.

c. Evaluation of the Significance of Fugitive Dust Impact

The impact of fugitive dust impact on the nearby communities is evaluated as follows:

Impact category	Direct impact
Impact duration	Throughout the construction period of about 54 months. More visible during the site preparation duration.
Impact extent	Local air pollution, mainly confined to within the construction site and quarry site
Impact magnitude	Medium magnitude with control at sources
Impact severity	Medium, cause annoyance, insignificant impact on the receptors
Control priority	High

The fugitive dust issue should receive medium control priority.

(4) Proposed Monitoring

Levels of fugitive dust should be monitored daily during the construction at the major construction sites and along the major transport routes. Details are provided in the environmental management plan for the construction phase.

B. Gaseous Emissions

(1) Potential Impacts

a. Sources

Diesel- powered heavy construction equipment, vehicles and generator sets are the major sources of gaseous emissions during the construction. The emissions discharged from the combustion engine will include; carbon dioxide (CO_2), nitrous Oxide (N_2O), and methane (CH_4) which greenhouse gases (GHGs) and potential impact on the climate change.

b. Sensitivity of Receptors

The Contractors will be required to adopt best practices to minimize gaseous emissions at sources through the following management measures:

- Adopt procedures to avoid construction vehicles idling for excessive periods (e.g. more than 5 minutes) if required to queue to enter the construction sites;

- Maintain all construction equipment in proper working conditions according to the manufacturer's specifications. The engines of the construction equipment fleet must be routinely maintained by qualified mechanics to ensure their proper conditions during operations.
- Provide adequate training to the equipment operators in the proper use of equipment.
- Use the proper size of equipment for the job.
- Use the equipment fitted engines with latest low emission technologies (repowered engines, electric drive trains). For example, the diesel generator set to be used must be equipped with modern pollution control equipment.
- Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines).
- Encourage and provide carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes.
- Take measures to manage the movement of construction vehicles entering and leaving the construction sites to avoid, or mitigate and manage the potential for vehicle emissions impacting on adjacent properties, except where such residential or sensitive activities front an arterial road to be used for access to or from the construction site. Measures for construction fleet management are to be provided in the construction vehicle management plan and the construction traffic management plan. Such measures may include avoiding or minimizing queuing on streets approaching the worksites or adjacent to other sensitive activities;
- For stationary plant and equipment powered by diesel motors, take measures to avoid or mitigate and manage the potential impacts of exhaust emissions on adjacent residential or other sensitive activities. For example, ensure all construction vehicles and stationary plant and equipment powered by diesel motors are fitted with emission control measures, and are regularly maintained to manufacturers' specifications.

c. Predicted GHGs Emission

The total quantities of GHGs emissions generated during construction phase have been calculated using a simple mathematical model or equation together with the diesel consumption and emission factors from 2006 IPCC Guideline for National Greenhouse Gas Inventories as shown in ***Table 6.3.1-1***. The equation is shown as the following;

$$\text{GHGs} = \text{E.F.} \times \text{Diesel Consumption}$$

Where;

GHG = Greenhouse gas emissions (kg)

E.F. = Emission factor (kg/MJ)

Diesel Consumption = Diesel consumption (MJ)

TABLE 6.3.1-1

EMISSION FACTOR FOR DIESEL CONSUMPTION

Emission	Emission Factor (kg/MJ)
Carbon dioxide (CO_2)	0.0741
Methane (CH_4) CH_4	0.000003
Nitrous Oxide (N_2O)	0.0000006

The predicted GHGs Emission will be reported as CO_2 equivalent (CO_2e). For CH_4, its quantities are converted to CO_2e by multiplying with the global warming potential (GWP). The Global Warming Potential (GWP) was developed to allow comparison of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 tonne of a gas will absorb over a given period of time, relative to the emissions of 1 tonne of carbon dioxide (CO_2). The larger the GWP, the more that a given gas warms the earth compared to CO_2 over that same period. The time period usually used for GWPs is 100 years. The GWP values are shown in ***Table 6.3.1-2***.

TABLE 6.3.1-2

GLOBAL WARMING POTENTIAL VALUES

GHGs Emission	100-year Global Warming Potential (GWP)
CO_2	1
CH_4	25
N_2O	298

The diesel consumption could be estimated from information on the number, type of diesel engine equipment, and their hours of operation. The total diesel consumption during construction phase is about 5,122,231 liters as shown in ***Table 6.3.1-3***.

TABLE 6.3.1-3

AMOUNT OF DIESEL CONSUMPTION FROM DIESEL ENGINE EQUIPMENT FOR DEEDOKE HPP

Item	Construction Area	Machine		Machine Capability			Number	Operation Time					Disel consumption(L)
		Name	Type	Output (kW)	Fuel consumption rate (L/kWh)	Fuel consumption (L/h)		Working month per machine (Month/machine)	Total working month (Month)	Daily working hour (hr/day)	Monthly working days (day/Month)	Total working hour (hr)	
Excavation	Powerhouse	Ripper bulldozer	32t	171	0.175	30	1	4	4	9	25	900	26,933
		Ripper bulldozer	44t	231	0.175	40	1	4	4	9	25	900	36,383
		Excavator	1.5m3	223	0.175	39	1	4	4	9	25	900	35,123
		Wheel dozer	3.1m3	156	0.153	24	1	4	4	9	25	900	21,481
		Dump truck	32t	347	0.085	29	6	4	24	9	25	5,400	159,273
		Hydraulic crawler drill	150kg class	92	0.175	16	4	4	16	9	25	3,600	57,960
	Sub-Total												***337,152***
	Intake Tailrace	Ripper bulldozer	32t	171	0.175	30	2	1	2	9	25	450	13,466
		Ripper bulldozer	44t	231	0.175	40	2	1	2	9	25	450	18,191
		Excavator	1.5m3	223	0.175	39	2	1	2	9	25	450	17,561
		Wheel dozer	3.1m3	156	0.153	24	2	1	2	9	25	450	10,741
		Dump truck	32t	347	0.085	29	12	1	12	9	25	2,700	79,637
	Sub-Total												***139,596***
	Spillway	Ripper bulldozer	32t	171	0.175	30	2	5	10	9	25	2,250	67,331
		Ripper bulldozer	44t	231	0.175	40	2	5	10	9	25	2,250	90,956
		Excavator	1.5m3	223	0.175	39	2	5	10	9	25	2,250	87,806
		Wheel dozer	3.1m3	156	0.153	24	2	5	10	9	25	2,250	53,703
		Dump truck	32t	347	0.085	29	12	5	60	9	25	13,500	398,183
	Sub-Total												***697,979***
Embankmer	Coffer	Excavator	1.5m3	223	0.175	39	2	8	16	9	25	3,600	140,490
		Dump truck	20t	218	0.085	19	11	8	88	9	25	19,800	366,894
		Bulldozer	21t	152	0.175	27	2	8	16	9	25	3,600	95,760
	Sub-Total												***603,144***
Concrete	Powerhouse	Concrete pumping truck	100m3/h	199	0.078	16	3	21	63	20	3.6	4,500	69,849
		Concrete mixer truck	5.0m3	213	0.059	13	4	21	84	20	3.6	6,000	75,402
		Crawler crane	80t	170	0.089	15	2	21	42	20	3.6	3,000	45,390
		Crane truck	8t	107	0.044	5	2	21	42	20	3.6	3,000	14,124
	Sub-Total												***204,765***
	Spillway	Concrete pumping truck	100m3/h	199	0.078	16	2	12	24	9	5	1,080	16,764
		Concrete mixer truck	5.0m3	213	0.059	13	4	12	48	9	5	2,160	27,145
		Crawler crane	80t	170	0.089	15	2	12	24	9	5	1,080	16,340
		Crane truck	8t	107	0.044	5	3	12	36	9	5	1,620	7,627
	Sub-Total												***67,876***
Excavation	Quarry	Hydraulic crawler drill	150kg class	92	0.175	16	2	46	92	20	25	46,000	740,600
		Ripper bulldozer	44t	231	0.175	40	1	46	46	20	25	23,000	929,775
		Dump truck	20t	218	0.085	19	2	46	92	20	25	46,000	852,380
		Wheel dozer	3.1m3	156	0.153	24	1	46	46	20	25	23,000	548,964
	Sub-Total												***3,071,719***
TOTAL													***5,122,231***

According to the energy densities of diesel from University of Washington (*http://www.ocean.washington.edu/courses/envir215/energynumbers.pdf*) of about 36.4 MJ/liters. The energy consumption of the project is about 186,449,208.4 MJ. Therefore, the quantities of GHGs generated during this phase is shown in ***Table 6.3.1-4***.

TABLE 6.3.1-4

GHGS GENERATED DURING CONSTRUCTION PHASE

Emission	E.F. (kg/MJ)	Diesel Consumption (MJ)	Quantities (kg)	GWP	GHGs Emission (Tonne of CO_2e)
CO_2	0.0741	186,449,208.4	13,815,886.3	1	13,815.9
CH_4	0.000003		559.3	25	14.0
N_2O	0.0000006		111.9	298	33.3
Total					13,863.2

The contribution of the Project to the GHGs emissions during the construction phase, about 13,863.2 Tonne of CO_2e or 0.014 Mt of CO_2e.This amount of GHGs emissions is about 0.01 % of the total GHG emissions of Myanmar in 2013 (201.5 Mt of CO_2e/year, Greenhouse Gas Emissions in Burma (https://www.climatelinks.org, 2018).

d. Evaluation of the Significance of Impacts

In the context of Myanmar, the annual contribution of this Project to the GHGs emissions of the country during the project construction could be considered as insignificant. Evaluation of the impact is shown below.

Impact category	Indirect impact
Impact duration	Short
Impact extent	Regional
Impact magnitude	Insignificant
Impact severity	Insignificant
Control priority	Low

6.3.1.2 Operational Phase

The Project will have no air pollution during its operations.

6.3.2 Noise

6.3.2.1 Construction Phase

Excessive noise from the project activities will be an issue of concern during construction phase. Noise could be associated with vibration such as noise from rock blasting and piling activities. Other activities or sources such as drilling, site-clearing, and equipment and material transportation activities is normally not high enough to create vibration.

(1) Potential Impacts

a. Sources

Considering the nature and magnitude of construction of this Project, noise will be mostly generated during the rock blasting, crushing, and piling activities.

Noise will be managed at all construction sites but priority should be given to the main construction site as noisy construction activities will be most intensive and concentrated at this site over a long period. A smaller noise issue will be generated along the construction corridors of the access roads and the transmission line.

Based on the tentative construction schedule presented in ***Figure 4.3-14***, noise problems could be expected to be most intensive during the period from Months 4-8, 12-13 and 28-30 where the foundations of the dam and the power house will be constructed.

b. Sensitivity of Receptors

Excessive noise from the construction activity will affect both construction workers and the nearby sensitive receptors as follows:

Sensitive Receptors	Distances	Number of Household
Hnget Gyi Thaik village (nearest house)	80 m. from the Dam Construction Site	70
Thayet Pin village (nearest house)	784 m. from the Quarry Site 2	102
	745 m. from the Crushing Plant	
	1,100 m. from the Deedoke Camp	
Hnget Gyi Thaik Primary School	85 m. from the Dam Construction Site	-
Hnget Gyi Thaik Pagoda	576 m. from the Dam Construction Site	-
Hnget Gyi Thaik Monastery	535 m. from the Dam Construction Site	-
Ma Gyi Inn Village (nearest house)	704 m. from the Quarry Site 1	-
Ma Gyi Inn Pagoda	752 m. from the Quarry Site 1	-
Thayet Pin Pagoda	1,052 m. from the Quarry Site 2	-
	953 m. from the Crushing Plant	
	1,300 m. from the Deedoke Camp	

c. Magnitude of Noise Levels at Sources

Table 6.3.2-1 shows the construction noise data from The Central Artery/Tunnel (CA/T) project in Boston, Massachusetts, which began in the early 1990s, is the largest urban construction project ever conducted in the United States which complied by Federal Highway Administration's (FHWA). Moreover, FHWA also developed an "Acoustical Usage Factor" to estimate the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation.

Dam Construction Site: Piling activity which used impact pile-driver or vibratory pile driver generates the highest noise at 101 dBA. Therefore, piling activities will be the most significant source of noise and will be used as the representative activity for noise emission during construction phase of dam.

Quarry Site: Blasting activity generates the highest noise at 94 dBA, will be used as the representative activity during this phase.

Crushing Plant: The noise data from crushing activity is adopted from Noise Exposure and Hearing Capabilities of Quarry Workers in Ghana: A Cross-Sectional Study (Charles K.R. at el, 2016) which collected the noise level generated by the crusher machine from the various companies. The highest noise level from crusher machine is about 102.7 dBA, will be used as the representative activity during this phase.

Deedoke Camp: Electric generating by the Generator which generates the highest noise at 82 dBA will be used as the representative activity during this phase.

In the transmission line construction corridor, piling for construction of the tower foundations will be the major noise source. However, as the towers will be located at about 400 m intervals, the piling noise will move along the corridor, thus reducing the extent of the problem.

(2) Proposed Mitigation Measures

a. Noise Control Targets

The noise control targets within the construction site and at the receptors are dictated by the adopted both Myanmar and international Guidelines and Standards. For the Project, the construction noise control will be designed to achieve three conditions:

- The maximum noise level within the construction site expressed in Leq-8 hr. not exceed 85 dBA as in limit set by OSHA standard
- The maximum noise level expressed in Leq-1 hr. not exceed the limit set by Myanmar National Environmental Quality (Emission) Guidelines and the IFC Standard of 55 dBA during daytime and 45 dBA during nighttime.
- The increase in the ambient noise is not more than 3 dBA as the limit set by Myanmar National Environmental Quality (Emission) Guidelines and the IFC Standard.

TABLE 6.3.2-1

NOISE LEVELS OF CONSTRUCTION EQUIPMENT RELATED TO THE PROJECT

Equipment Description	Impact Device	Acoustical Usage Factor	Lmax at 50 ft., dBA	
			Spec.	Actual
Other Equipment > 5 HP	No	50	85	N/A
Auger Drill Rig	No	20	85	84
Backhoe	No	40	80	78
Blasting	Yes	N/A	94	N/A
Boring Jack Power Unit	No	50	80	83
Chain Saw	No	20	85	84
Clam Shovel (dropping)	Yes	20	93	87
Compactor (ground)	No	20	80	83
Compressor (air)	No	40	80	78
Concrete Batch Plant	No	15	83	N/A
Concrete Mixer Truck	No	40	85	79
Concrete Pump Truck	No	20	82	81
Concrete Saw	No	20	90	90
Crane	No	16	85	81
Dozer	No	40	85	82
Drill Rig Truck	No	20	84	79
Drum Mixer	No	50	80	80
Dump Truck	No	40	84	76
Excavator	No	40	85	81
Flat Bed Truck	No	40	84	74
Front End Loader	No	40	80	79
Generator	No	50	82	81
Generator (<25KVA, VMS signs)	No	50	70	73
Gradall	No	40	85	83
Grader	No	40	85	N/A
Horizontal Boring Hydraulic. Jack	No	25	80	82
Hydra Break Ram	Yes	10	90	N/A
Impact Pile Driver	***Yes***	***20***	***95***	***101***
Jackhammer	Yes	20	85	89
Man Lift	No	20	85	75
Mounted Impact Hammer (hoe ram)	Yes	20	90	90
Pavement Scarafier	No	20	85	90
Paver	No	50	85	77
Pickup Truck	No	40	55	75
Pumps	No	50	77	81
Rock Drill	No	20	85	81
Roller	No	20	85	80
Sand Blasting	No	20	85	96
Scraper	No	40	85	84
Shears (on backhoe)	No	40	85	96
Slurry Plant	No	100	78	78
Slurry Trenching Machine	No	50	82	80
Soil Mix Drill Rig	No	50	80	N/A
Tractor	No	40	84	N/A
Vibratory Concrete Mixer	No	20	80	80
Vibratory Pile Driver	***No***	***20***	***95***	***101***
Warning Horn	No	5	85	83
Welder / Torch	No	40	73	74

Remark: Adopted from the Roadway Construction Noise Model (RCNM) User's Guide, 2006

However, according to the field investigation during April 22-29, 2014 and July 15-22, 2015, the maximum Leq 1-hr. daytime and nighttime at both station N1 (Hnget Gyi Thaik Primary School) and N2 (Thayet Pin Primary School) exceeded the limit set by EQEG and IFC standards. Therefore, the control target for the residential area which used these stations as the representative will adopted only increasing of noise level in background or baseline condition during construction phases should not exceed 3 dBA. The control targets for noise level are summarized in ***Table 6.3.2-2***.

TABLE 6.3.2-2

NOISE CONTROL TARGET DURING CONSTRUCTION ACTIVITIES

Noise Sensitive Receptors	Leq 1-hr. (dBA)				
	Base-line[1/]	Myanmar Standard[2/]	IFC Standard[3/]	OSHA Standard[4/]	Adopted Control Target
Whole day					
The main construction and quarry sites/ Construction worker	-	-	-	85 for 8 hr.	85 for 8 hr.
Daytime					
N1: Hnget Gyi Thaik Primary School	68.7	55.0 and increase in ambient noise not greater than 3 dBA		-	71.7
N2: Thayet Pin Primary School	67.2			-	70.2
Hnget Gyi Thaik village/ Residential area	68.7[5/]			-	71.7
Hnget Gyi Thaik Pagoda	68.7[5/]			-	71.7
Hnget Gyi Thaik Monastery	67.2[6/]			-	70.2
Ma Gyi Inn village	67.2[6/]			-	70.2
Ma Gyi Inn Pagoda	67.2[6/]			-	70.2
Thayet Pin Pagoda	67.2[6/]			-	70.2
Nighttime					
N1: Hnget Gyi Thaik Primary School	62.3	45.0 and increase in ambient noise not greater than 3 dBA		-	65.3
N2: Thayet Pin Primary School	66.5			-	69.5
Hnget Gyi Thaik village/ Residential area	62.3[5/]			-	65.3
Hnget Gyi Thaik Pagoda	62.3[5/]			-	65.3
Hnget Gyi Thaik Monastery	66.5[6/]			-	69.5
Ma Gyi Inn village	66.5[6/]			-	69.5
Ma Gyi Inn Pagoda	66.5[6/]			-	69.5
Thayet Pin Pagoda	66.5[6/]			-	69.5

Source: 1/ Field survey by TEAM Consulting Engineering and Management Co., Ltd. during April 22-29, 2014 and July 15-22, 2015.

2/ Myanmar National Environmental Quality (Emission) Guidelines (2015)

3/ Occupational Noise Exposure standard: 29 CFR 1910.95

4/ Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental Noise Management of IFC (2007)

4/ Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental Noise Management of IFC (2007)

5/ Adopted the baseline data from N1: Hnget Gyi Thaik Primary School

6/ Adopted the baseline data from N2: Thayet Pin Primary School

b. Proposed Measures

Physical Measures

Possibilities are limited for reduction of noise levels of construction equipment. The Contractors and the subcontractors may rent construction equipment from suppliers and would not be at liberty to improve them. It is difficult to design practicable noise retrofit kits to endure the environment of the construction sites. Therefore, the Contractors and his subcontractors should be required to use equipment that has best noise performance.

In addition, the noise reduction at the perimeter could be achieved using an acoustic wall or a sound barrier at least 3 m high with adequate length to block the noise emanating to the receptor. Workers will need to be provided with ear plugs or ear muffs operating in the excessive noise areas.

Management Measures

The following management measures should be implemented to complement the physical measures.

- Major construction activities which generate loud noise should be limited to only during the day time. Activities that are necessary to be carried out at night time will need approval of the site engineers, and will need to have adequate noise control equipment or measures.
- Speeds of vehicles in the construction site will not be more than 40 km/hr.
- Noise performance requirements of construction equipment will need to be clearly stated in contract specifications.
- Temporary sound barriers or shielding should be installed for non-mobile equipment.
- The Contractors will be required to regularly monitor ambient noise levels at the receptors, particularly during the noise generation period such as piling.
- The construction environmental management plan will need to include an efficient complaints redress procedure and an efficient corrective action procedure to address the non-compliance of noise performance.

c. Proposed Monitoring

A proposed noise monitoring program is proposed in the construction phase EMP.

(3) Residual Impacts

a. Predicted Noise Levels at the Receptors

The prediction of noise impact on the receptors has been conducted utilizing the Roadway Construction Noise Model (RCNM) version 1.1 (Latest version, updated on February 15, 2006). RCNM is the Federal Highway Administration's (FHWA) National Model for the prediction of construction noise. This model developed by FHWA, which is based on the noise prediction calculations and equipment database used in the Central Artery/Tunnel (CA/T) project in Boston, Massachusetts, which began in the early 1990s, is the largest urban construction project ever conducted in the United States.

The RCNM provides a construction noise screening tool to easily predict construction noise levels and determine compliance with noise limits for a variety of construction noise projects of varying complexity. This Model allows the estimation of three key metrics of interest: Lmax, Leq-1 hr., and L10 at the concerned sensitive receptor for a construction operation. Moreover, RCNM allows to defined construction equipment, noise limit criteria, and effects of shielding due to noise mitigation measures/devices.

The primary equation used in the RCNM for predicting construction-induced Leq noise levels at receptor locations, when summed overall operating equipment, is as follows:

$$L_{maxCalc} = L_{max@50ft} - 20\text{Log}(D/50) - IL_{bar} \quad \text{...........................(1)}$$

$$Leq = L_{maxCalc.} + 10\text{Log}(UF/100) \quad \text{...................................(2)}$$

Where:

$L_{maxCalc}$ = the emission level at the selected receptor (dBA),

$L_{max@50ft}$ = the emission level for the equipment at 50 ft. (dBA),

D = the distance between the equipment and receptor (ft.),

ILbar = the insertion loss of intervening barriers (dBA), and

UF = a time-averaging equipment usage factor (%).

However, the resulting emission level from RCNM model will be the net effect of construction equipment. The total noise level (Predicted result and ambient measurement) can be calculated using the following equation:

$$Lp_{total} = 10\log\left(\sum_{i=1}^{n} 10^{Lpi/10}\right) \quad \text{...(3)}$$

Where:

Lp_{total} = the total noise level (dBA),

Lp_i = noise level (dBA),

n = number of noise level

The calculations of construction noise on the ambient noise levels were based on the construction activity at each area, some activity might be carried out at night time as presented in ***Table 6.3.2-3***. Although working hours will be separated as 12 or 24 hrs shift. However, the noise impacts from construction activity were predicted as worst case analysis covering both daytime and nighttime (12 hrs per shift) for 2 cases as no control and control (Installation of temporary noise barrier) are;

- ***No Control Case (Without temporary noise barrier installation)***

1) Dam Construction Site/Piling Activity

N1: Hnget Gyi Thaik Primary School

Daytime: The Leq 1 hr. from the piling activity, predicted from 1RCNM is about 84.4 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 84.5 dBA exceeding the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activity, predicted from RCNM is about 84.4 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 84.4 dBA exceeding the control target adopted from EQEG and IFC standards.

Hnget Gyi Thaik village

Daytime: The Leq 1 hr. from the piling activity, predicted from 1RCNM is about 83.9 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 84.0 dBA exceeding the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activity, predicted from RCNM is about 83.9 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 83.9 dBA exceeding the control target adopted from EQEG and IFC standards.

Hnget Gyi Thaik Pagoda

Daytime: The Leq 1 hr. from the piling activity, predicted from 1RCNM is about 67.3 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 71.1 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activity, predicted from RCNM is about 67.3 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 68.5 dBA exceeding the control target adopted from EQEG and IFC standards.

Hnget Gyi Thaik Monastery

Daytime: The Leq 1 hr. from the piling activity, predicted from 1RCNM is about 67.9 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 71.3 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activity, predicted from RCNM is about 67.9 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 69.0 dBA exceeding the control target adopted from EQEG and IFC standards.

2) Quarry Site 1/Blasting Activity

Ma Gyi Inn Village

Daytime: The Leq 1 hr. from the blasting activity, predicted from 1RCNM is about 47.7 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 67.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the blasting activity, predicted from RCNM is about 47.7 dBA, combined with 66.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 66.6 dBA in accordance with the control target adopted from EQEG and IFC standards.

Ma Gyi Inn Pagoda

Daytime: The Leq 1 hr. from the blasting activity, predicted from 1RCNM is about 47.1 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 67.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the blasting activity, predicted from RCNM is about 47.1 dBA, combined with 66.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 66.5 dBA in accordance with the control target adopted from EQEG and IFC standards.

3) Quarry Site 2/Blasting Activity

N2:Thayet Pin Primary School

Daytime: The Leq 1 hr. from the blasting activity, predicted from 1RCNM is about 46.8 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 67.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the blasting activity, predicted from RCNM is about 46.8 dBA, combined with 66.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 66.5 dBA in accordance with the control target adopted from EQEG and IFC standards.

Thayet Pin Pagoda

Daytime: The Leq 1 hr. from the blasting activity, predicted from 1RCNM is about 44.2 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 67.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the blasting activity, predicted from RCNM is about 44.2 dBA, combined with 62.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 66.5 dBA in accordance with the control target adopted from EQEG and IFC standards.

4) Crushing Plant/Crushing Activity

N2:Thayet Pin Primary School

Daytime: The Leq 1 hr. from the crushing activity, predicted from 1RCNM is about 65.9 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 69.6 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the crushing activity, predicted from RCNM is about 65.9 dBA, combined with 66.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 69.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Thayet Pin Pagoda

Daytime: The Leq 1 hr. from the crushing activities, predicted from 1RCNM is about 63.8 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 68.8 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the crushing activity, predicted from RCNM is about 63.8 dBA, combined with 62.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 68.4 dBA in accordance with the control target adopted from EQEG and IFC standards.

5) Deedoke Camp/ Electricity Generating Activity

N2:Thayet Pin Primary School

Daytime: The Leq 1 hr. from the electric generating activity, predicted from 1RCNM is about 41.8 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 67.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the electric generating activity, predicted from RCNM is about 41.8 dBA, combined with 66.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 66.5 dBA in accordance with the control target adopted from EQEG and IFC standards.

Thayet Pin Pagoda

Daytime: The Leq 1 hr. from the electric generating activity, predicted from 1RCNM is about 40.4 dBA, combined with 67.2 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 67.2 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the electric generating activity, predicted from RCNM is about 40.4 dBA, combined with 62.5 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 66.5 dBA in accordance with the control target adopted from EQEG and IFC standards.

- ***Control Case (With temporary noise barrier installation)***

The results of the total noise level at the Hnget Gyi Thaik Village, School in Hnget Gyi Thaik Village, Hnget Gyi Thaik Pagoda, and Hnget Gyi Thaik Monastery caused by the piling activities of dam construction exceeded the control target with adopted from EQEG and IFC standards. Therefore, the project provides the specific mitigation measures to control the noise level to meet the project control target by installation of temporary noise barrier made of steel (1.27 mm thickness), at least 3 m high with adequate length to block the noise emanating to the receptor or other material with the transmission loss (TL) about 25 dBA or equivalent.

6) Dam Construction Site/Piling Activity

N1: Hnget Gyi Thaik Primary School

Daytime: The Leq 1 hr. from the piling activities, predicted from 1RCNM is about 59.4 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 69.2 dBA exceeding the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activities, predicted from RCNM is about 59.4 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 64.1 dBA exceeding the control target adopted from EQEG and IFC standards.

Hnget Gyi Thaik village

Daytime: The Leq 1 hr. from the piling activities, predicted from 1RCNM is about 58.9 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 69.1 dBA exceeding the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activities, predicted from RCNM is about 58.9 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 63.9 dBA exceeding the control target adopted from EQEG and IFC standards.

Hnget Gyi Thaik Pagoda

Daytime: The Leq 1 hr. from the piling activities, predicted from 1RCNM is about 42.3 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 68.7 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activities, predicted from RCNM is about 42.3 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 62.3 dBA exceeding the control target adopted from EQEG and IFC standards.

Hnget Gyi Thaik Monastery

Daytime: The Leq 1 hr. from the piling activities, predicted from 1RCNM is about 42.9 dBA, combined with 68.7 dBA, the maximum Leq 1 hr. during daytime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 68.7 dBA in accordance with the control target adopted from EQEG and IFC standards.

Nighttime: The Leq 1 hr. from the piling activities, predicted from RCNM is about 42.9 dBA, combined with 62.3 dBA, the maximum Leq 1 hr. during nighttime from the field measurement during April 22-29, 2014 and July 15-22, 2015, the total Leq 1 hr. is about 62.3 dBA exceeding the control target adopted from EQEG and IFC standards.

7) Quarry Site 1-2 ,Crushing Plant, and Deedoke Camp

No specific mitigation measure requires.

TABLE 6.3.2-3

CALCULATIONS OF NOISE LEVELS AT THE SENSITIVE RECEPTOR

Items	Unit	Sensitive Receptor /Noise Emission Source															
		N1: Hnget Gyi Thaik Primary School		N2:Thayet Pin Primary School			Hnget Gyi Thaik village		Hnget Gyi Thaik Pagoda		Hnget Gyi Thaik Monastery		Ma Gyi Inn Village	Ma Gyi Inn Pagoda	Thayet Pin Pagoda		
		Dam Construction Site		Quarry Site 2	Crushing Plant	Deedoke Camp	Dam Construction Site		Dam Construction Site		Dam Construction Site		Quarry Site 1	Quarry Site 1	Quarry Site 2	Crushing Plant	Deedoke Camp
		No Control	Control	No Control	No Control	No Control	No Control	Control	No Control	Control	No Control	Control	No Control	No Control	No Control	No Control	No Control
Distance	**m.**	**80**	**80**	**784**	**745**	**1,100**	**85**	**85**	**576**	**576**	**535**	**535**	**704**	**752**	**1,052**	**953**	**1,300**
	ft.	**262**	**262**	**2,572**	**2,444**	**3,609**	**279**	**279**	**1,890**	**1,890**	**1,755**	**1,755**	**2,310**	**2,467**	**3,451**	**3,127**	**4,265**
Representative Device	-	Pile Driver[1/]		Blasting	Crusher Machine	Generator	Pile Driver[1/]		Pile Driver[1/]		Pile Driver[1/]		Blasting	Blasting	Blasting	Crusher Machine	Generator
Lmax@50 ft.	dBA	105.8	105.8	94	102.7	82	105.8	105.8	105.8	105.8	105.8	105.8	94	94	94	102.7	82
ILBar		-	25	-	-	-	-	25	-	25	-	25	-	-	-	-	-
UF	%	20	20	5	50	50	20	20	20	20	20	20	5	5	5	50	50
Daytime																	
Leq-Ambient	dBA	68.7	68.7	67.2	67.2	67.2	68.7	68.7	68.7	68.7	68.7	68.7	67.2	67.2	67.2	67.2	67.2
Leq-Effect of Source	dBA	84.4	59.4	46.8	65.9	41.8	83.9	58.9	67.3	42.3	67.9	42.9	47.7	47.1	44.2	63.8	40.4
LeqT-Total Noise Level	dBA	84.5	69.2	67.2	69.6	67.2	84.0	69.1	71.1	68.7	71.3	68.7	67.2	67.2	67.2	68.8	67.2
Control Target[2/]	**dBA**	**71.7**	**71.7**	**70.2**	**70.2**	**70.2**	**71.7**	**71.7**	**71.7**	**71.7**	**71.7**	**71.7**	**70.2**	**70.2**	**70.2**	**70.2**	**70.2**
Nighttime																	
Leq-Ambient	dBA	62.3	62.3	66.5	66.5	66.5	62.3	62.3	62.3	62.3	62.3	62.3	66.5	66.5	66.5	66.5	66.5
Leq-Effect of Source	dBA	84.4	59.4	46.8	65.9	41.8	83.9	58.9	67.3	42.3	67.9	42.9	47.7	47.1	44.2	63.8	40.4
LeqT-Total Noise Level	dBA	84.4	64.1	66.5	69.2	66.5	83.9	63.9	68.5	62.3	69.0	62.3	66.6	66.5	66.5	68.4	66.5
Control Target[2/]	**dBA**	**65.3**	**65.3**	**69.5**	**69.5**	**69.5**	**65.3**	**65.3**	**65.3**	**65.3**	**65.3**	**65.3**	**69.5**	**69.5**	**69.5**	**69.5**	**69.5**

Remark: [1/] Assumed 3 simultaneous operations for Pile Driver

(4) Evaluation of the Significance of Noise Impact

The impact of construction noise on the nearby communities is evaluated as follows:

Impact category	Direct impact
Impact duration	Throughout the construction period of about 54 months. More significant during the site preparation and piling
Impact extent	Local confined to areas around the construction sites
If no control – **Impact magnitude**	Resulting ambient noise levels at Hnget Gyi Thaik Village will exceed the control target adopted from EQEG and IFC standards.
– **Severity**	Moderate
Control priority	**High**

The construction noise issue deserves high control priority.

6.3.2.2 Operation Phase

Excessive noise during operation is not an issue for a hydropower project like this Project. During the operation phase, noise will be mainly generated by generators and turbines located in the power house. The noise levels would not exceed the control target.

There will be constant humming sound from loaded transformer and cracking sounds from transmission line but the noise level is acceptable to human ear and it does not pose any health hazard.

Mitigation Measure

No mitigation measures will be required. Operators may need ear protection device when working in the turbine house.

6.3.3 Vibration

6.3.3.1 Construction Phase

Impacts of the Project on vibration will be an issue of concern only during the construction phase. Major cause of vibration is blasting activities for preparation of the dam foundation.

(1) Potential Impacts

a. Sources

Potential sources of vibration in this Project include; excavation works, quarrying operations, blasting activities at construction site, handling and transportation of excavated materials, and movement of heavy vehicles on unpaved roads and surfaces. However, the largest source of vibration would be at the dam site construction area. Nevertheless, measures for vibration control will also be necessary at the construction sites of all facilities and quarry site to ensure no public complaints.

b. Sensitivity of Receptors

The receptors of vibration will be the same sensitive receptors of noise as shown in ***Figure 6.3.3-1***.

c. Vibration Control Targets

The vibration control target at the sensitive receptor are dictated by the adopted vibration standards are;

1) The vibration from the project activities in term of Peak Particle Velocity (PPV) at the historical monuments should not be greater than the limit for the structure that particular sensitivity of vibration set by DIN 4150-3 of 3.0 mm./sec (0.12 inches/sec.)

2) The PPV at the nearest communities should not be greater than the limit for dwelling and buildings of similar design and/or occupancy set by DIN 4150-3 of 5.0 mm./sec (0.2 inches/sec.)

3) The PPV at the nearest sensitive receptors should not be greater than the limit set by US Bureau of Mines (USBM), 1971 as shown in ***Table 6.3.3-1***.

TABLE 6.3.3-1

MAXIMUM PERMITTED PEAK PARTICLE VELOCITIES

Distance from blasting site (ft.)	Maximum allowed peak particle velocity (inch/sec.)
0 to 300	1.25
301 to 5000	1.00
5001 and beyond	0.75

Source: USBM (1971).

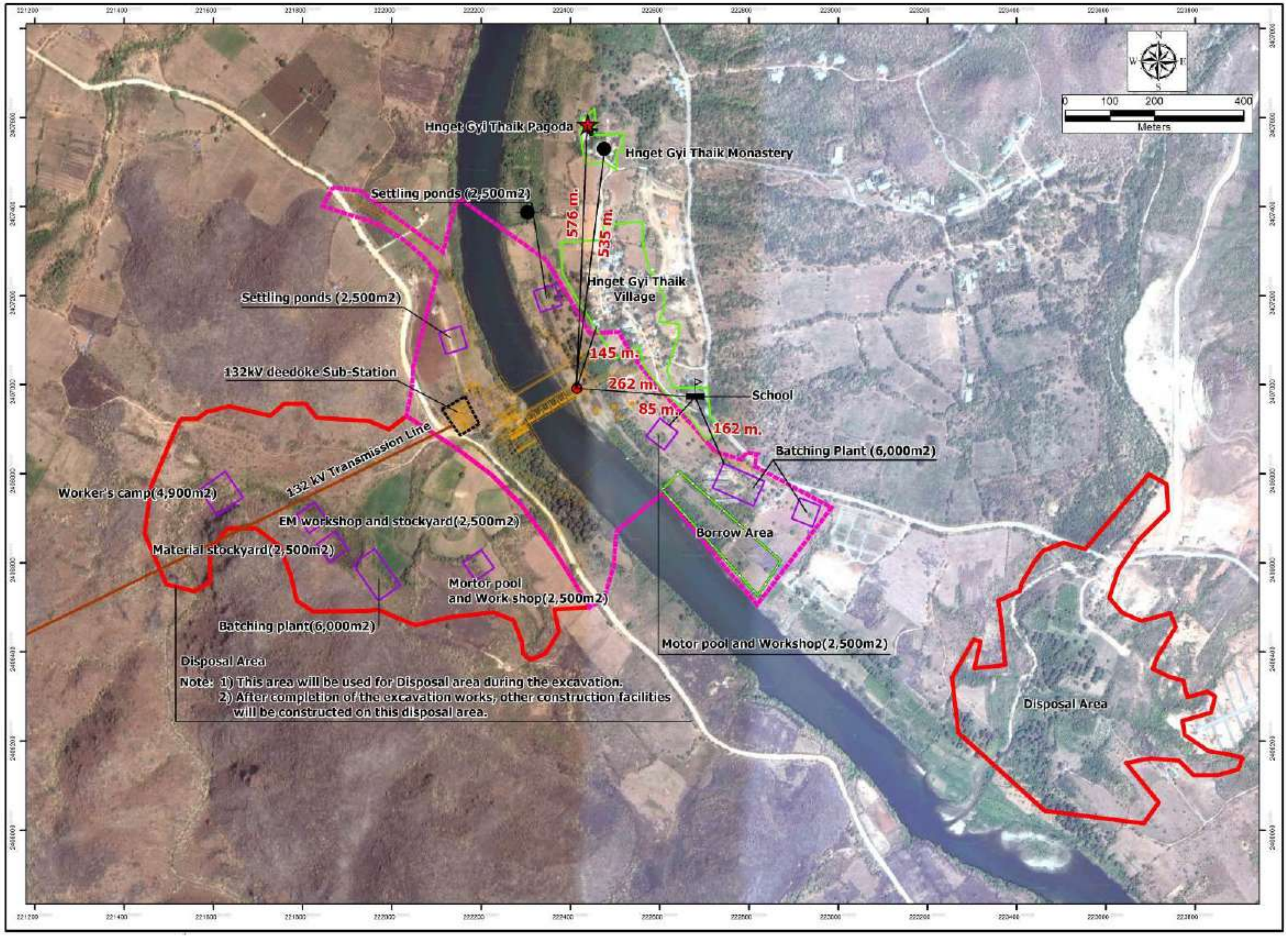


FIGURE 6.3.3-1 : LOCATION OF 3 HISTORICAL MONUMENTS OF "KING A NAW RAHTAR" NEARBY PROJECT AREA

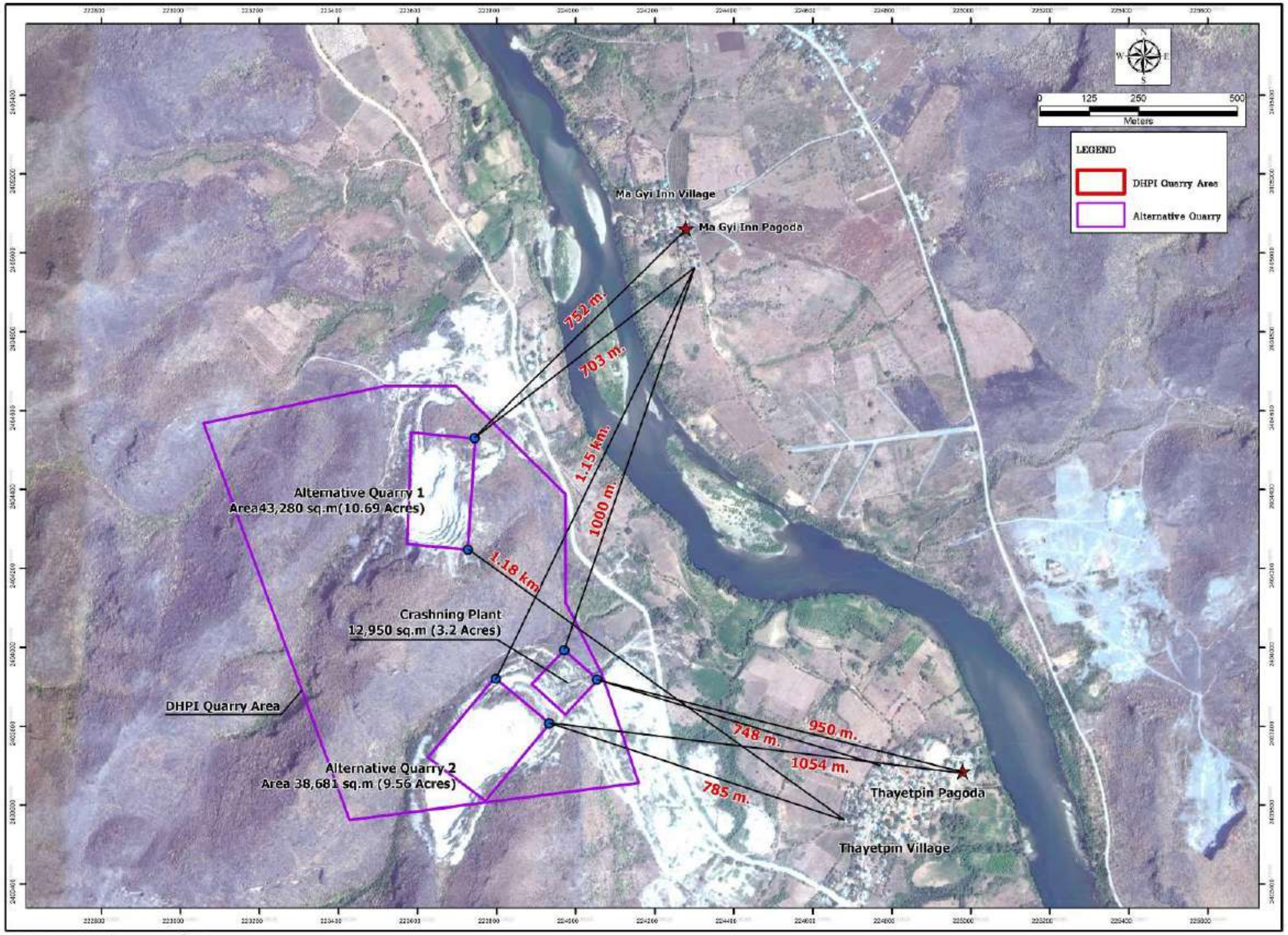


FIGURE 6.3.3-1 : LOCATION OF 3 HISTORICAL MONUMENTS NEARBY PROJECT AREA (CONT'D)

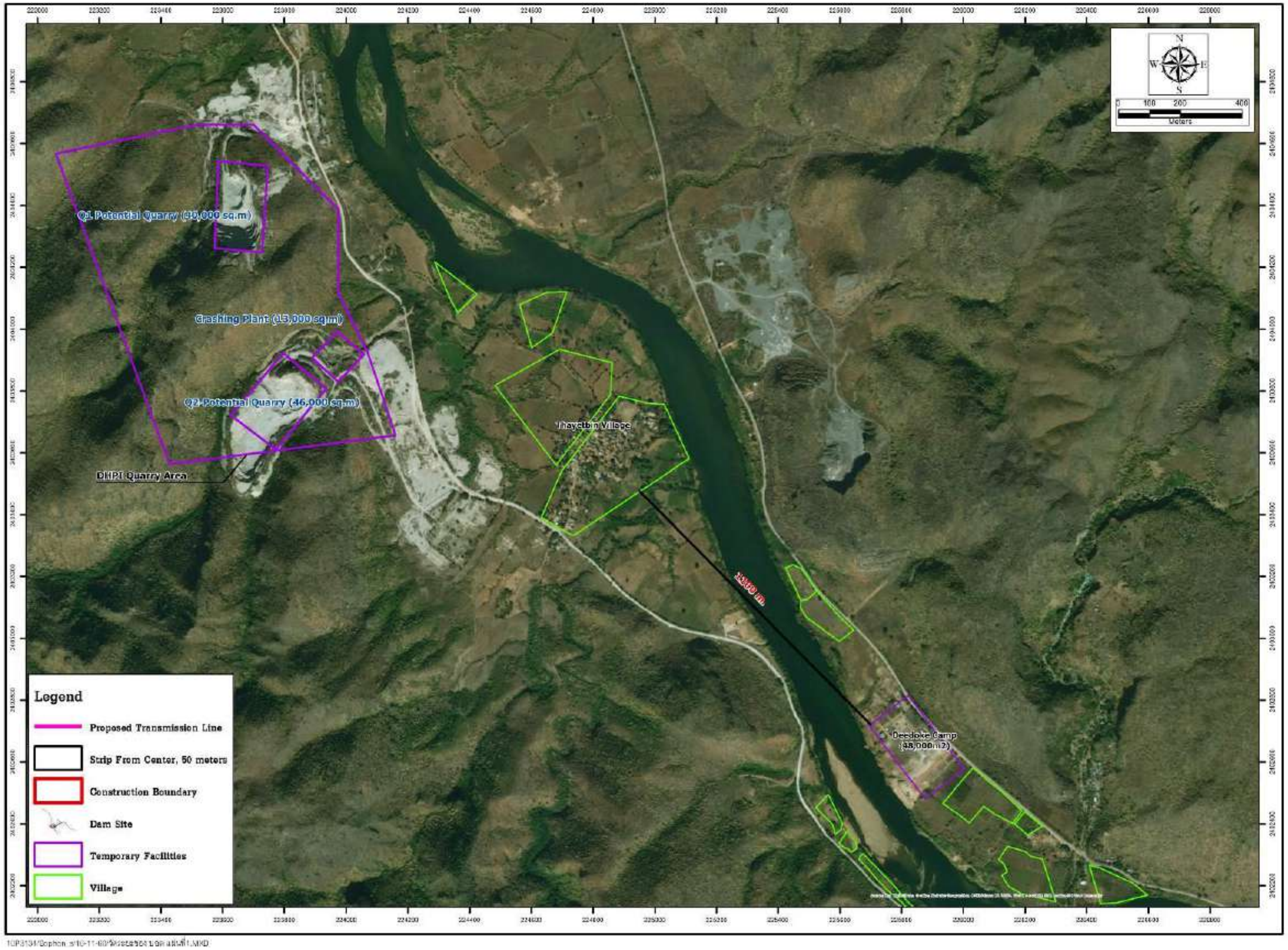


FIGURE 6.3.3-1 LOCATION OF 3 HISTORICAL MONUMENTS NEARBY PROJECT AREA (CONT'D)

d. Predicted of Vibration Levels at the Receptors

1) Dam Construction Activity

According to Construction Noise Handbook (FHWA, 2006), data set of vibration level generated by various types of construction equipment have been measured under a wide variety of construction activities with an average of source levels reported in terms of PPV at 25 ft. from the source. The most significant source of vibration is the impact pile-driver with the typical PPV value about 0.644 inches/sec. Therefore, this equipment will be applied as the representative equipment for vibration assessment for dam construction of the Project.

The vibration level from other activities at the identified receptors can be predicted in terms of Peak Particle Velocity (PPV) and can be calculated using the following equation:

$$PPV_{equip} = PPV_{ref} \times [25/D]^{1.5}$$

Where, PPV_{equip} = Peak Particle Velocity at receiver, in/sec.

PPV_{ref} = Peak Particle Velocity at reference, in/sec.

D = Distance from the source to the receiver, ft.

Using above equation, the predicted PPV are;

I. PPV at the Hnget Gyi Thaik Primary School which is located about 80 m. away from the dam construction site is about 0.019 inch/sec. or 0.481 mm/sec. below the maximum PPV limit for dwelling and buildings of similar design and/or occupancy set by DIN 4150-3 of 5.0 mm./sec (0.2 inches/sec.)

II. PPV at Hnget Gyi Thaik Village which is located about 85 m. away from the dam construction site is about 0.017 inch/sec. or 0.439 mm/sec. below the maximum PPV limit for dwelling and buildings of similar design and/or occupancy set by DIN 4150-3 of 5.0 mm./sec (0.2 inches/sec.)

III. PPV at the Hnget Gyi Thaik Pagoda which is located about 576 m. away from the dam construction site is about 0.001 inch/sec. or 0.025 mm/sec. below the maximum PPV limit for the structure that particular sensitivity of vibration set by DIN 4150-3 of 3.0 mm./sec (0.12 inches/sec.)

IV. PPV at the Hnget Gyi Thaik Pagoda which locate about 535 m. away from the dam construction site is about 0.001 inch/sec. or 0.028 mm/sec. below the maximum PPV limit for the structure that particular sensitivity of vibration set by DIN 4150-3 of 3.0 mm./sec (0.12 inches/sec.)

Detail is presented in ***Table 6.3.3-2***.

2) Quarry Site

The vibration level from blasting activities at the identified receptors can be predicted in terms of Peak Particle Velocity (PPV) and can be calculated using the following equation:

$$V = K\,[R/(Q^{0.5})]^{m}$$

Where, V = Peak Particle Velocity, PPV (inch/sec)

K = Site and rock factor constant

= 160 (Blasting and Explosives Quick Reference Guide, 2010)

Q = Maximum instantaneous charge (lb.)

R = Distance from charge (ft.)

m = Constant related to the rock and site

= -1.6 (Blasting and Explosives Quick Reference Guide, 2010)

Using above equation, the predicted PPV are;

I. **PPV at the Ma Gyi Inn Village** which is located about 704 m. away from the quarry site 1 is about 0.05 inch/sec. or 1.26 mm/sec. below the maximum PPV limit for dwelling and buildings of similar design and/or occupancy set by DIN 4150-3 of 5.0 mm./sec (0.2 inches/sec.) and US Bureau of Mines (USBM), 1971 (1.00 inch/sec.)

II. **PPV at the Ma Gyi In Pagoda** which is located about 752 m. away from the quarry site 1 is about 0.04 inch/sec. or 1.14 mm/sec. below the maximum PPV limit for the structure that particular sensitivity of vibration set by DIN 4150-3 of 3.0 mm./sec (0.12 inches/sec.) and US Bureau of Mines (USBM), 1971 (1.00 inch/sec.)

III. **PPV at the Thayet Pin Primary School** which is located about 784 m. away from the quarry site 2 is about 0.04 inch/sec. or 1.06 mm/sec. below the maximum PPV limit for dwelling and buildings of similar design and/or occupancy set by DIN 4150-3 of 5.0 mm./sec (0.2 inches/sec.) and US Bureau of Mines (USBM), 1971 (1.00 inch/sec.)

IV. **PPV at the Thayet Pin Pagoda** which is located about 1,052 m. away from the quarry site 2 is about 0.03 inch/sec. or 0.66 mm/sec. below the maximum PPV limit for the structure that particular sensitivity of vibration set by DIN 4150-3 of 3.0 mm./sec (0.12 inches/sec.) and US Bureau of Mines (USBM), 1971 (1.00 inch/sec.). Details are shown in ***Table 6.3.3-2***.

TABLE 6.3.3-2

PREDICTED PPV RESULTS FROM BLASTING ACTIVITIES AT THE NEAREST SENSITIVE RECEPTOR

Activity	Location	Sensitive Receptors	Distance		Peak Particle Velocity, PPV		Standard	
			m.	Ft.	inches/sec.	mm/sec.	USBM*	DIN4150-3**
Piling	Dam Construction Site	Hnget Gyi Thaik Primary School	80	262	0.019	0.481	-	0.2 inches/sec[2/] (5.0 mm/sec)
		Hnget Gyi Thaik Village	85	279	0.017	0.439		0.2 inches/sec[2/] (5.0 mm/sec)
		Hnget Gyi Thaik Pagoda	576	1,890	0.001	0.025		0.12 inches/sec[3/] (3.0 mm/sec)
		Hnget Gyi Thaik Pagoda	535	1,755	0.001	0.028		0.12 inches/sec[3/] (3.0 mm/sec)
Blasting	Quarry Site 1	Ma Gyi Inn Village	704	2,310	0.05	1.26	1.00 inches/sec[1/] (25.4 mm/sec)	0.2 inches/sec[2/] (3.0 mm/sec)
		Ma Gyi Inn Pagoda	752	2,467	0.04	1.14		0.12 inches/sec[3/] (3.0 mm/sec)
	Quarry Site 2	Thayet Pin Primary School	784	2,572	0.04	1.06		0.2 inches/sec[2/] (3.0 mm/sec)
		Thayet Pin Pagoda	1052	3,451	0.03	0.66		0.12 inches/sec[3/] (3.0 mm/sec)

Source: *USBM (1971).
**DIN4150-3

Remark 1/Maximum PPV from blasting for sensitive receptor within 301 to 5,000 ft.
2/Maximum PPV for dwelling and building (Residential)
3/Maximum PPV for historical or vibration sensitivity area.

(2) Proposed Mitigation Measures

a. Proposed Measures

Based on the geological conditions of the blasting sites and the control targets, the Contractor will prepare a blasting plan to reduce ground vibration and air pressure to the acceptable levels. The blasting plan will be reviewed for approval by the supervision engineers of the Project Proponent.

The Contractor's blasting plan should consider various measures to select the most effective measures. The Contractor may consider the following measures recommended in a technical document[1],

Blast design

- Use a blast design that produces the maximum relief practical in the given situation. Explosions in blastholes which have good relief-i.e. those having nearby free faces-produce less ground vibration. The use of delay blasting techniques establishes internal free faces from which compressional waves produced later in the blast can delay patterns, maximum relief can be retained.
- In general, when blasting multiple row patterns, greater relief can be obtained by using a longer delay between rows than between the holes within a single row. A delay of at least 2–3 ms/m of burden between the holes within a row is recommended for the necessary relief and best fragmentation.
- Use a spacing/burden ratio greater than one. The presence of weak seams or irregular back break may dictate the local use of a spacing/ burden ratio close to one.

Hole straightness

- Control drilling of blast holes as closely as possible. Establish bench marks for use in setting out the hole locations for the next blast before each blast in order to help avoid possible errors due to irregular back break.

Sub-drilling

- Restrict the amount of sub drilling to the level required to maintain good floor conditions.
- Typical sub drilling for holes inclined 3:1 is 30% of the burden at floor level. Tape each drill hole and match it to the face height. If hole depth is greater than intended, backfill with drill cuttings or crushed stone. Excessive sub drilling can increase vibration because of the lack of a nearby free face to create reflection waves.

Charge per delay

- Use the following techniques to reduce charge weight per delay and, therefore, peak particle velocity.

---

[1] Mostafa Mohamed (2010). Vibration Control, Vibration Control, MickaÃƒÂ«l Lallart (Ed.), ISBN: 978-953-307-117-6, InTech, Available from: http://www.intechopen.com/books/vibration-control/vibration-control

- reduce hole depths with lower bench heights and increase specific drilling,
- use smaller diameter holes,
- subdivide explosive charges in holes by using inert decks and fire each explosive deck with initiators using different delays,
- use electronic or mechanical timers to increase the available number of periods of delay electric blasting caps and to increase timing flexibility. Non electric delays coupled with surface delay connectors can provide similar flexibility.

Explosives

- Eliminate or reduce hole-to-hole propagation between charges intended to detonate at different delay periods. Use explosive, such as water gels, which are much less sensitive than dynamite to hole -to-hole propagation. Hole-to-hole propagation occurs when the explosive charges or blast holes are only a few feet apart, as in trenching, decked holes, or underwater excavations, or at greater distances when blasting inter bedded soft and hard layer rock, such as coral or mud-seamed rock, that is saturated with water.

Using NONEL blasting system

- Use NONEL blasting system can reduce the wave superposition by increasing delay time among shots. In addition to reduce the air vibration by using NONEL shock tube instead of detonating cord.

The following measures should be considered in planning the blasting to reduce air vibrations:

- Detonating cord should be used as sparingly as possible, and any exposed lengths covered with as much material as possible. Stemming release can be controlled by detonation technique, together with an adequate amount of good stemming material. It should be noted however that detonation cord and stemming release have been virtually eliminated with the use of in hole initiation techniques.
- Gas venting results from overcharging with respect to burdens and spacing or, perhaps, a local weakness within the rock, and is also typified by the occurrence of fly rock. Its control is essential for economic and safe blasting, and is considerably aided by accurate drilling and placement of charges, together with regular face surveys.

6.3.3.2 Operation Phase

Vibration effect during operation is not an issue for a hydropower project like this Project. During the operation phase, vibration will mainly be generated by inbound-outbound traffic. The vibration levels would not exceed the control target.

6.3.4 Lighting

6.3.4.1 Construction Phase

(1) Potential Impacts

a. Sources

The potential lighting impacts during construction phase are;

- Overhead lighting within the dam construction site, quarry site , and Deedoke camp site,
- Vehicle or equipment-mounted light (e.g. haul truck, concrete truck, etc.)

b. Sensitivity of Receptors

The sensitive receptors of lighting impact will be the adjacent communities similar to the noise and vibration sensitive receptors.

c. Magnitude of Lighting at Sources

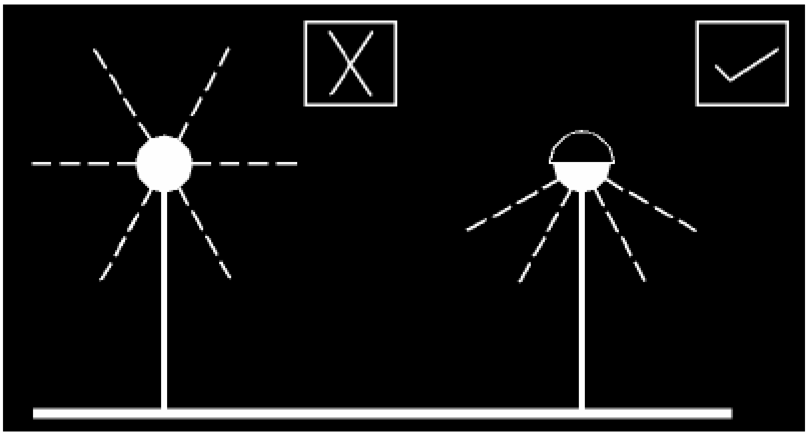
The lighting impact on the surrounding project boundary would vary. It would be influenced by the relative level of construction site and presence of barrier such as vegetation, building, and topographic, etc.

(2) Proposed Mitigation Measures

The following management measures should be implemented to complement the physical measures.

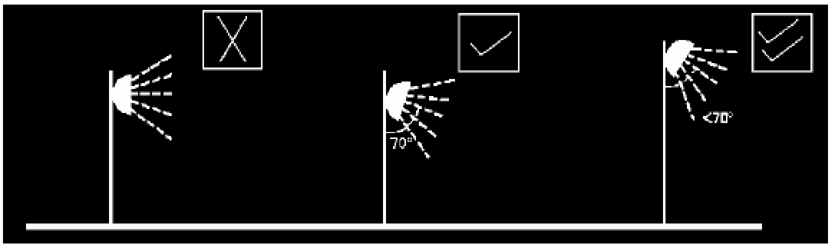
- Installation and arrangement of construction's lighting in accordance with the international standard or best practice such's Guidance Notes for the Reduction of Obtrusive Light GN01:2005, etc. Examples of typical mitigation methods recommended in GN01:2005 are set out as below;

  - ➢ Use specifically designed lighting equipment that minimizes the upward spread of light near to and above the horizontal.



(**Source:** Guidance Notes for the Reduction of Obtrusive Light GN01:2005)

➢ Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°.



(**Source:** Guidance Notes for the Reduction of Obtrusive Light GN01:2005)

- Restriction of night-lighting to the minimum required for operations and safety requirement
- Use of light shields to limit the spill of lighting

(3) Residual Impacts

The residual negative impacts of lighting would be insignificant and limited within the dam construction site, quarry site, and Deedoke camp.

(4) Evaluation of the Significance of Lighting Impact

The impact of construction light on the nearby communities is evaluated as follows:

Impact category	Direct impact
Impact duration	Throughout the construction period of about 54 months. More significant during the site preparation and piling
Impact extent	Local confined to areas around the construction sites
If no control – **Impact magnitude**	 Low
– **Severity**	Moderate
Control priority	**Moderate**

The lighting issue deserves moderate control priority.

6.3.4.2 Operation Phase

(1) Potential Impacts

a. Sources

The potential lighting impacts during this phase are the overhead lighting and building lighting within the project site.

b. Sensitivity of Receptors

The sensitive receptors of lighting impact will be Hnget Gyi Thaik Village, the nearest sensitive receptors of about 80 m. to the dam site.

c. Magnitude of Lighting Levels at Sources

Similar to the construction phase, the lighting impact on the surrounding project boundary would vary. It would be influenced by the relative level of construction site and presence of barrier such as vegetation, building, and topographic, etc.

(2) Proposed Mitigation Measures

The mitigation measure should be implemented to minimize the lighting impacts on the surrounding project site is similar to those mitigation measures during construction phase.

(3) Residual Impacts

The residual negative impacts of lighting would be insignificant and limited within the dam site.

(4) Evaluation of the Significance of Lighting Impact

The impact of construction light on the nearby communities is evaluated as follows:

Impact category	Direct impact
Impact duration	Throughout the operation period.
Impact extent	Local confined to areas around the dam sites
If no control - **Impact magnitude**	 Low
- **Severity**	Low
Control priority	**Low**

The lighting issue deserves low control priority.

6.3.5 River Water Quality

6.3.5.1 Construction Phase

(1) Potential Impacts

a. Sources

In-river construction, particularly river bed excavation and coffer dam construction and removal, will increase water turbidity visible as a sediment plume downstream from the construction. The plume will be diluted as it extends downstream. Finally, the plume will disappear and water turbidity will return to the natural level. Water users within the plume reach will be adversely affected by increased water turbidity.

Increases in river water turbidity could also be caused by surface runoff from the exposed construction site during rainfalls.

In addition to turbidity increases, the river water could be polluted by wastes discharged into the river from the following sources:

- Domestic wastewater from worker camps;
- Solid wastes from worker camps; and
- Wastewater from construction activities, particularly waste water from various washing activities.

However, these waste sources would not have significant effects on water quality. The daily water requirements for domestic and construction purposes are estimated at 51 and 31 m^3, respectively. As the normal river flow is about 400 m^3/sec (or 34.56 million m^3), these wastewaters will be diluted more than 1 million times. The impacts of these wastewater on river water quality, such as dissolved oxygen, will be negligible. Nevertheless, the wastewater will need to be treated before disposal to comply with the environmental regulations.

It should be noted that rainfalls will also generate turbid surface runoff in other areas. Therefore, the turbid surface runoff from the construction site would not be a significant source of sediment as its area is small compared to the catchment area of Deedoke Dam.

b. Increases in Turbidity Caused by River Excavation

River excavation will be the most significant source of turbidity compared with the construction and removal of coffer dams. At this stage of project preparation, no information on the river excavation method and characteristics of the river sediment have not yet been worked out. Therefore, it is not possible to calculate the dispersion of sediments during the river excavation. The extent of river turbidity increases will have to be gauged using results of a study of the subject on river dredging in the U.S.A. (Ref: Factors Governing The Distribution of Dredge-Resuspended Sediments, W. Frank Bohlen, Marine Sciences Institute and The Department of Geology and Geophysics, University of Connecticut, Avery Point Groton, Connecticut, U.S.A. 1977). The major findings are summarized below:

Sediment plumes caused by dredging can be considered to consist of three contiguous zones: an initial mixing zone, a secondary zone and a final mixing zone. The initial mixing zone immediately adjacent to the dredge has dimensions governed by bucket induced mixing and suspended material concentrations determined by dredge efficiency. In this zone, the water will be most turbid by the introduction of 2-4% of the sediment mass contained in each bucket load. The suspended solid concentrations in this initial zone could be as high as 200-400 mg/l. The plume will expand in width due to lateral dispersion as it progresses downstream into the secondary mixing zone. The suspended solids concentrations will decrease rapidly due primarily to gravitational settling. At the downstream limit of this zone distributions become essentially exponential in character and remain so through the final mixing zone. In this area concentrations progressively approach the upstream background levels and variations are governed primarily by diffusion. The plume could be as long as 700 m.

Based on the above reported experience, it could be safely assumed that the plume in the Myitnge River during the river-bed excavation could increase water turbidity as far as 700 m. As the water in the dry season is very clear with very low suspended solids concentrations, less than 5 mg/l, the impacts will be significant.

c. Sensitivity of Receptors

The expected changes in river water turbidity will affect river water users downstream of the construction site, and the aquatic ecosystem. The number of water users will depend on the length of the river section in which water turbidity increases above the normal level without the Project.

(2) Proposed Mitigation Measures

a. River Excavation and Coffer Dam Construction and Removal

The Contractors will be required to implement best management practices in reducing the impacts on water turbidity caused by river excavation, coffer dam construction, and coffer dam removal.

Mitigation measures will consist of operational controls and engineered controls. Examples of operational controls for re-suspension in river dredging include:

- Reducing the dredging rate;
- Changing dredging operations based on site conditions such as currents and wind;
- Using a sequence of dredging such as moving upstream to downstream; and
- Changing the number of vertical cuts (passes) to increase sediment capture.

Silt screens and silt curtains should be the main engineered controls.

The Contractors should be required to prepare a sediment management plan covering all in-river construction activities which could cause turbidity increase.

b. Surface Runoff and Waste Water Management

The Contractors will be required to prepare detailed design of a wastewater management system for the power plant construction site. The wastewater management system will consist of a collection system and a simple treatment system. The proposed design concept is based on the principle of wastewater segregation, treatment and reuse as briefly described below:

Surface Runoff

- The site preparation activities, including land clearing and site filling and compaction, should be carried out during the dry season to avoid the problem of surface runoff with high turbidity discharging into the surrounding paddy field or nearby drainage channels, if exist.
- The power plant construction site should be surrounded by temporary fences to limit the amount of sediment that could be washed from the construction area during the raining time into the surrounding paddy field.
- To prevent contamination of the surface runoff, potential contamination sources will be covered with roof. The surface runoff would contain only suspended solids washed out from the open area.
- Construct a temporary drainage system to collect the surfaced runoff from the construction area to avoid the discharge of surface runoff into the surrounding paddy field.
- The collected storm water will be drained into a retention pond for removal of suspended solids before discharging into the river or a nearby drainage channel, if exist. After the construction, the retention pond will be retained and used for wastewater management during the operational phase.

Domestic Wastewater

- Toilet wastes will be separated from grey water or salvage.
- Kitchen and canteen waste water will be discharged into oil and grease trap tank before draining into a retention pond.
- Toilet wastes will be discharged into a septic tank (or more than one septic tank) with a hydraulic retention time of about 5 days. The volume of toilet wastes is estimated at about 20% of the total volume of domestic wastewater, or about 7.6 m^3/d. The septic tank effluent (seepage) will be discharged into the retention pond. Alternatively, toilet wastes and grey water could be treated in a package sewage treatment plant.
- Grey water will be discharged into the retention pond.
- The retention pond will be designed as an oxidation pond with a hydraulic retention time of about 7 days.

Wash Waters

- The concrete wash water and the wheel wash water will be discharged into a concrete settling basin. The effluent will be treated to adjust the pH, if necessary, and reused. The remaining effluent will be discharged into the retention pond.
- Water in the retention pond will be used for dust suppression on unpaved areas in the construction site, watering of the green area, concrete washing, and wheel washing.

(3) Residual Impacts

If the proposed mitigation measures are strictly implemented, the turbidity increase in the river would be reduced and would not affect river water users downstream. The water would still be of acceptable quality for domestic consumption except drinking with no boiling or other treatments.

(4) Proposed Monitoring

River water quality will need to be monitored during the construction period particularly in the dry season. A water quality monitoring program is proposed in the construction phase EMP.

(5) Evaluation of the Significance of Noise Impact

The impact of increased water turbidity on the nearby communities is evaluated as follows:

Impact category	Direct impact
Impact duration	More significant during the river excavation, coffer dam construction and removal period of 14 months.
Impact extent	Local confined to areas around the construction sites and water users downstream.
If no control – **Impact magnitude**	Increased water turbidity downstream within about 700 m from the construction site.
– **Severity**	Moderate
Control priority	Medium

The water quality issue deserves medium control priority.

6.3.5.2 Operation Phase

Water released from the dam could be polluted only by wastewater from industries or large communities located upstream or decaying submerged vegetation.

Considering the nature and design of the Project, it is extremely unlikely that industries and large communities will be established upstream of the dam in the distant future. The backwater effect of the dam will not flood vegetated areas beyond the river banks apart from vegetation along the river banks. Therefore, the upstream reach would have insignificant quantities of submerged and decayed vegetation after the dam is completed. It can be concluded that the likelihood will be low for the water discharged from the dam to have poorer quality than the existing condition.

Impacts of water quality from decaying of submerged vegetation

Results from surface water quality survey during the study period in 2016, indicated that water of Yeywa river near proposed dam site of Deedoke HPP indicates very good water quality with high DO (6.1 – 8.0 mg/L in Apr. 2015 and 5.9 – 7.8 mg/L in Jul. 2015), low BOD and very low heavy metal concentrations. The water quality in pondage area will be altered, particularly during early stage of operation period due to decomposition of submerged vegetation and remaining biomass. Typically, this process would consume a huge amount of oxygen which will depend upon the remaining amount of carbon substances. Furthermore, excessive oxygen consumption may lead to anoxic conditions in such area.

The primary issue is related to the inundation of about 102 ha (*See* **Article 6.4.3.2** in **ESIA Report**) of the vegetation covered area. The biomass present in the area can be divided into two categories included (i) soft biomass, i.e. leaves, twig, herb, bush and grasses etc., and (ii) solid biomass, i.e. stems and large branches of trees. The decomposition of the solid parts is a very slow process and most of them will be removed from the project area therefore this portion can be neglected in the calculations. Biomass in tropical and equatorial regions is estimated between 200 and 400 tons/ha of dry materials (Ogawa, 1965[2]). In anticipated inundation area of Deedoke HPP, the lower estimate average case of 200 tons/ha biomass will be assumed because only portions of the vegetation remain in the reservoir. Soft biomass will be about 5% of total dry weight. Then soft biomass adopted for this calculation will be 10 t/ha. The calculation of oxygen demand for biomass decomposition in pondage area of Deedoke HPP is shown in ***Table 6U***. The percentage of soft biomass left in the reservoir is assumed at 2 levels, 50% and 20% of the vegetation covered area.

The calculations showed that the amount of oxygen available in the pondage at the first filling is 75.53 tons, which will not be sufficient by far for decomposing all soft biomass. To decompose all biomass in the reservoir, 545.7 tons of oxygen will be required (in case all 50% of soft biomass are left and coarse biomass are removed). In this case, decomposing the biomass would roughly require the amount of oxygen contained in 0.01 years of flow into Deedoke HPP. Therefore, the oxygen depletion can be alleviated in less than 1 week after operation.

[2] Ogawa, H., K. Yoda, K. Ogino and T. Kira. 1965. Comparative Ecological Studies on Three Main Type of Forest Vegetation in Thailand. II. Plant Biomass. Ibid. 4: 49-80.

TABLE 6.3.5-1

OXYGEN REQUIREMENTS FOR BIOMASS DECOMPOSITION IN PONDAGE AREA OF DEEDOKE HPP

Parameter	Unit	Pondage Area of Deedoke HPP		
Percent soft biomass left and decomposed in the reservoir	%	100	50	20
Pondage area with vegetation covered (soft biomass remain)	ha	102.0	51.0	20.4
Biomass average	t/ha	10	10	10
Biomass total (soft only)	t	1,020.0	510.0	200.4
Oxygen in inflow water (from this study)	mg/l	5.81	5.81	5.81
Total volume of gross water storage in reservoir[1/]	MCM	13.5	13.5	13.5
Mean annual flow[2/]	MCM	10,000.0	10,000.0	10,000.0
Total oxygen at first filling	T	75.53	75.53	75.53
Total oxygen in annual inflow	t	58,100.0	58,100.0	58,100.0
Oxygen required per ton biomass	t	1.07	1.07	1.07
Total oxygen required for biomass decomposition	t	1,091.4	545.7	218.28
Oxygen balance	T	57,008.6	57,554.3	57881.72
Time for all soft biomass decomposition	year	0.02	0.01	0.005

Remark [1/] Article 14.2 in Deedoke HPP Feasibility Study Report, Nov.4, 2015

[2/] Article 6.1 in Deedoke HPP Feasibility Study Report, Nov.4, 2015

6.3.6 River Water Level

6.3.6.1 Construction Phase

During the construction of the dam and the adjoining power house, the river flow will be diverted passing the construction site. The water level upstream of the construction site will increase to compensate for head losses in the diversion channels. However, the increased water level would be too small to be noticeable.

6.3.6.2 Operation Phase

(1) Potential Impacts

The dam will maintain water at 80 m a.s.l at the design flow rate of 600 m^3/s. At this flow rate and without the dam, the water level at the proposed dam site is about 80 m m.s.l. ***Figure 6.3-2*** taken from the Feasibility Study Report shows the calculated water level profiles of the river at various flow rates with and without the dam. The profiles indicate the backwater effect will be experienced at river flows below 700 m^3/s up to Yeywa dam, about 20 km from the project dam. The most upstream limit of the backwater effect will recede with increasing river flows. At a return period of 10,000 year flood, no backwater effect will be experienced.

The calculated water level at site 54 is presented in ***Figure 6.3.6-1***. It should be noted that for a probable maximum flood (PMF) discharge of 12,500 m^3/s the water level will reach an elevation above 85 m a.s.l and will cause large inundations of the valley. However, this PMF appears to be extremely high. For a return period of 10,000 years, the flood discharge at Deedoke dam site was estimated in the final feasibility study report at 7,300 m^3/s.

The water level behind the dam would normally be at 80 m. m.s.l. This could cause inundation of river bank areas with lower elevation. ***Figure 6.3.6-2*** shows contours of river bank areas from Deedoke dam to Yeywa dam. Most locations along the river banks are higher than 81 m a.s.l. Only some small areas will be inundated at this raised water level. ***Figure 6.3.6-3*** shows the site plan with clearly marked areas that will be flooded.

The raised water level will increase water depth upstream of the dam, thus increasing the water volume in the river compared to the normal volume without the dam. The increase in water volume at 80 m a.s.l was estimated at about 23 million m^3.

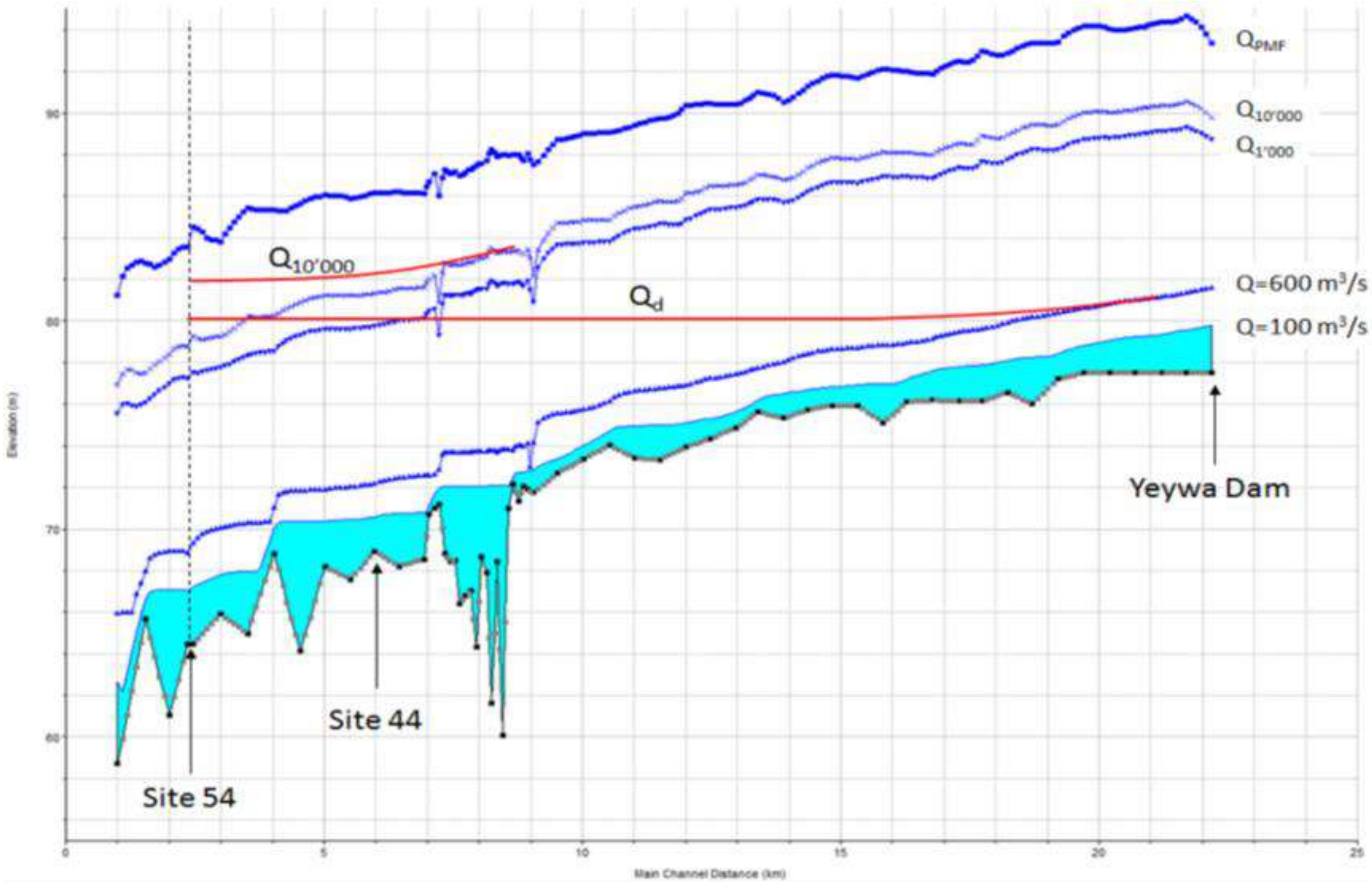


FIGURE 6.3.6-1 : CALCULATED WATER LEVEL PROFILES-WITH AND WITHOUT THE DAM
(Red Line with Deedoke Dam)

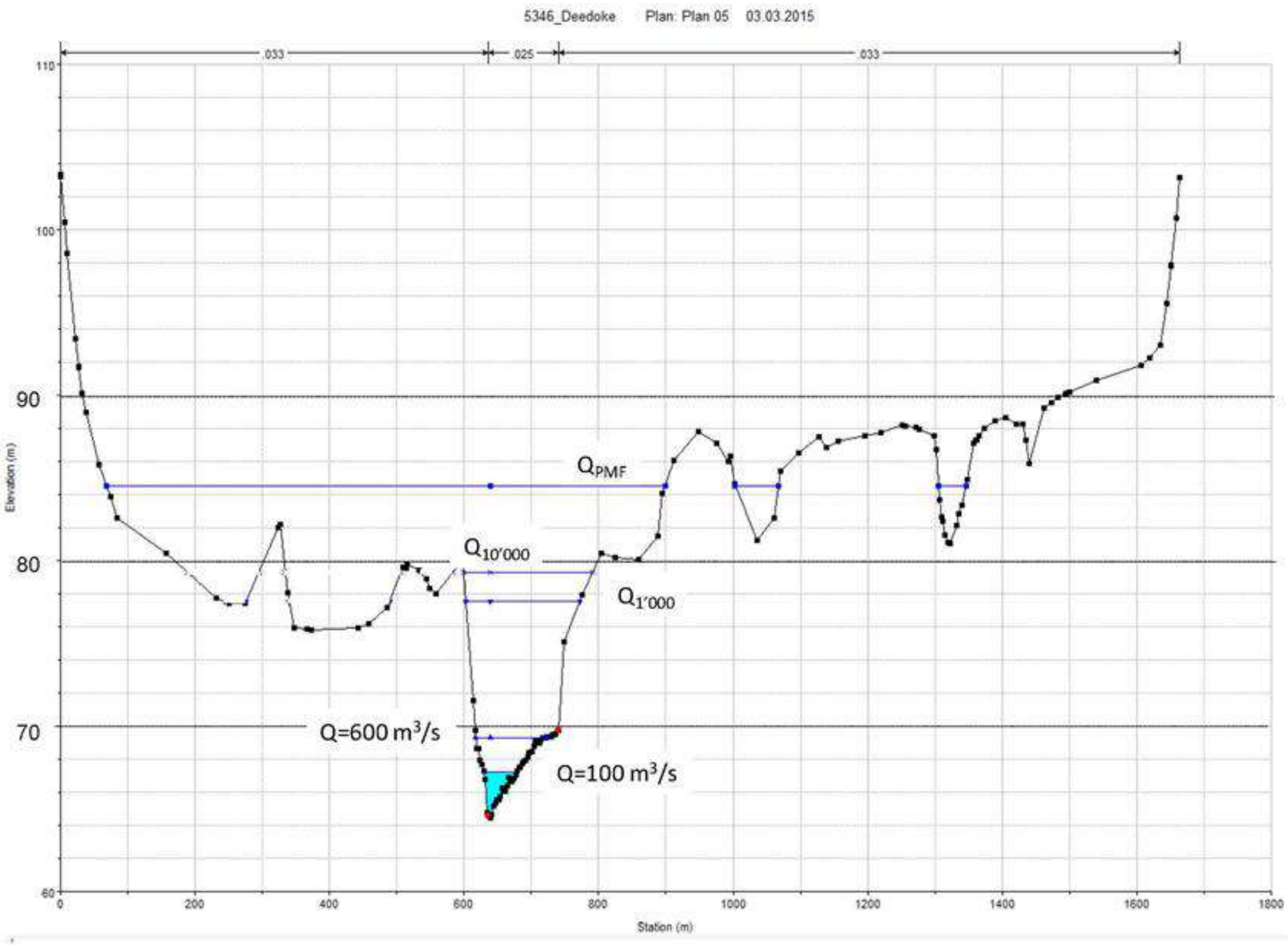


FIGURE 6.3.6-2 : CALCULATED WATER LEVEL AT SITE 54 FOR VARIOUS RIVER DISCHARGES

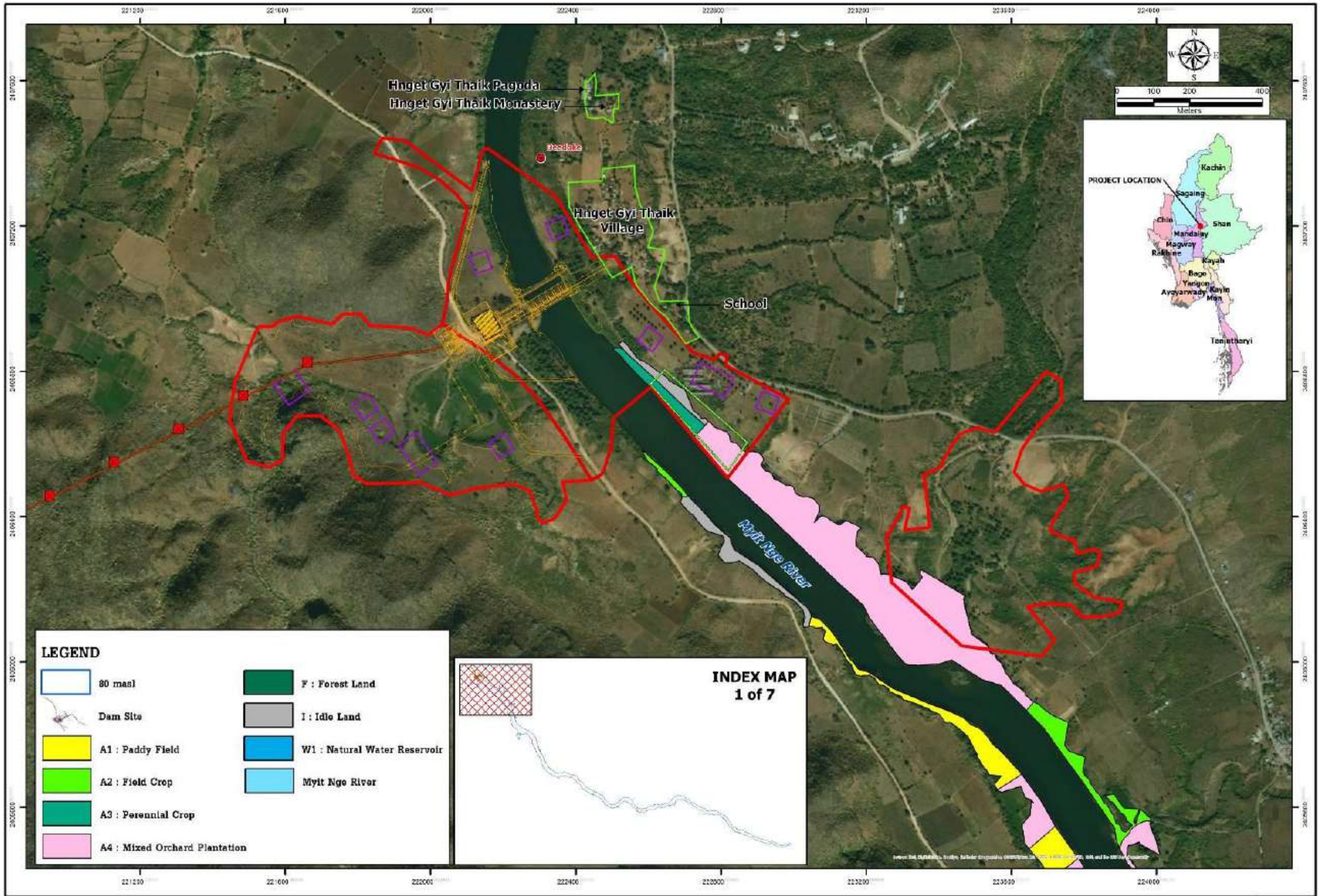


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l

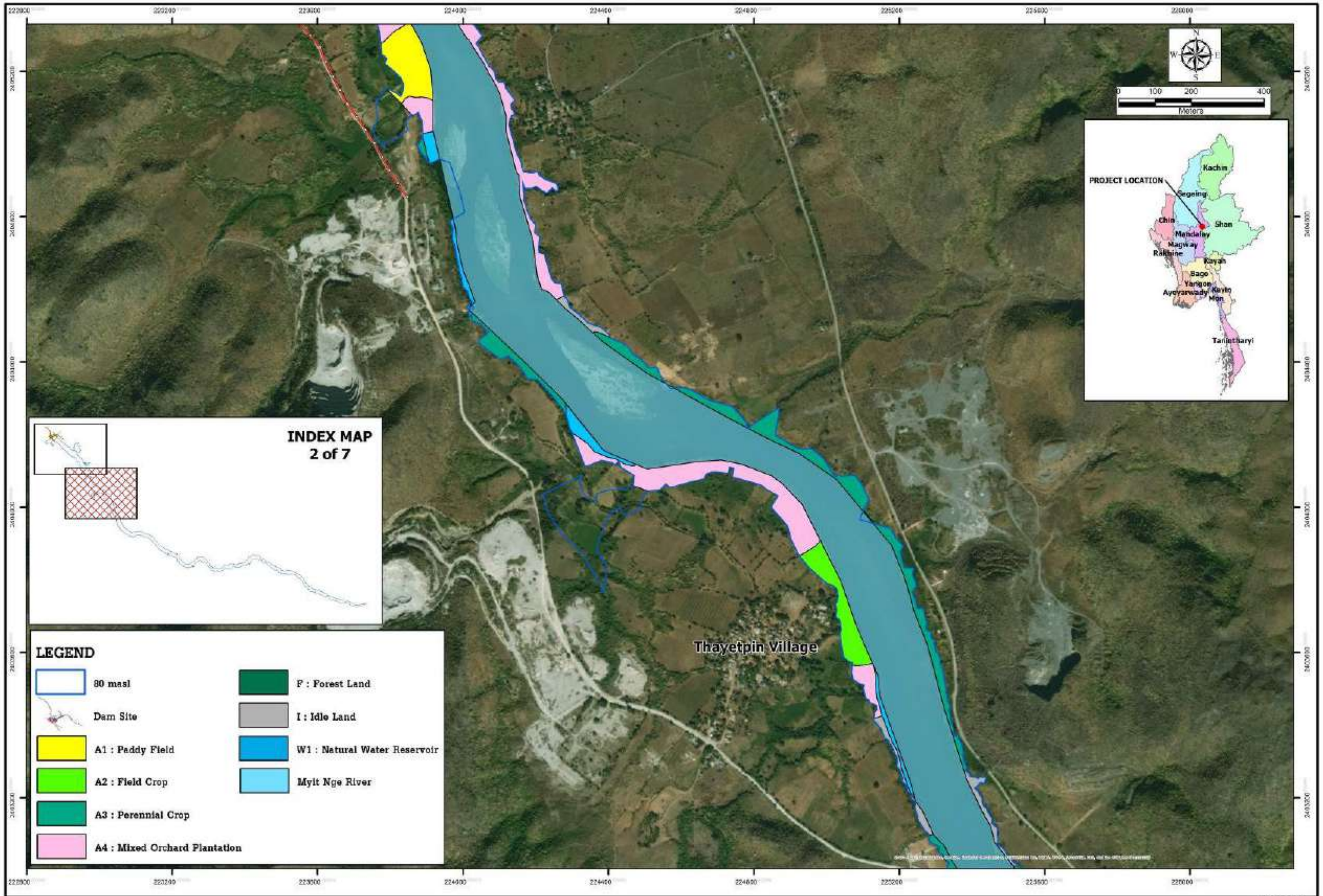


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l (CONT'D)

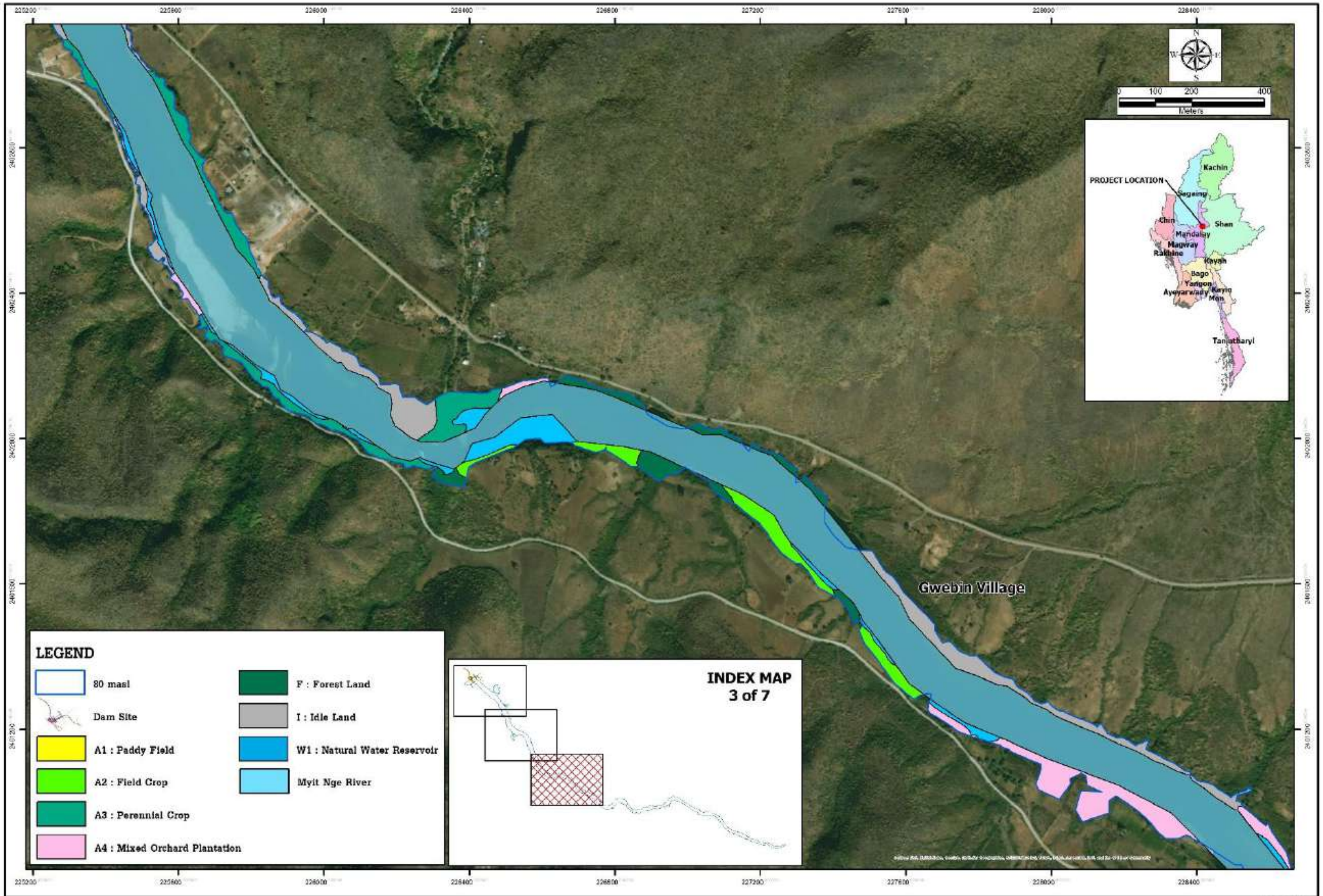


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l (CONT'D)

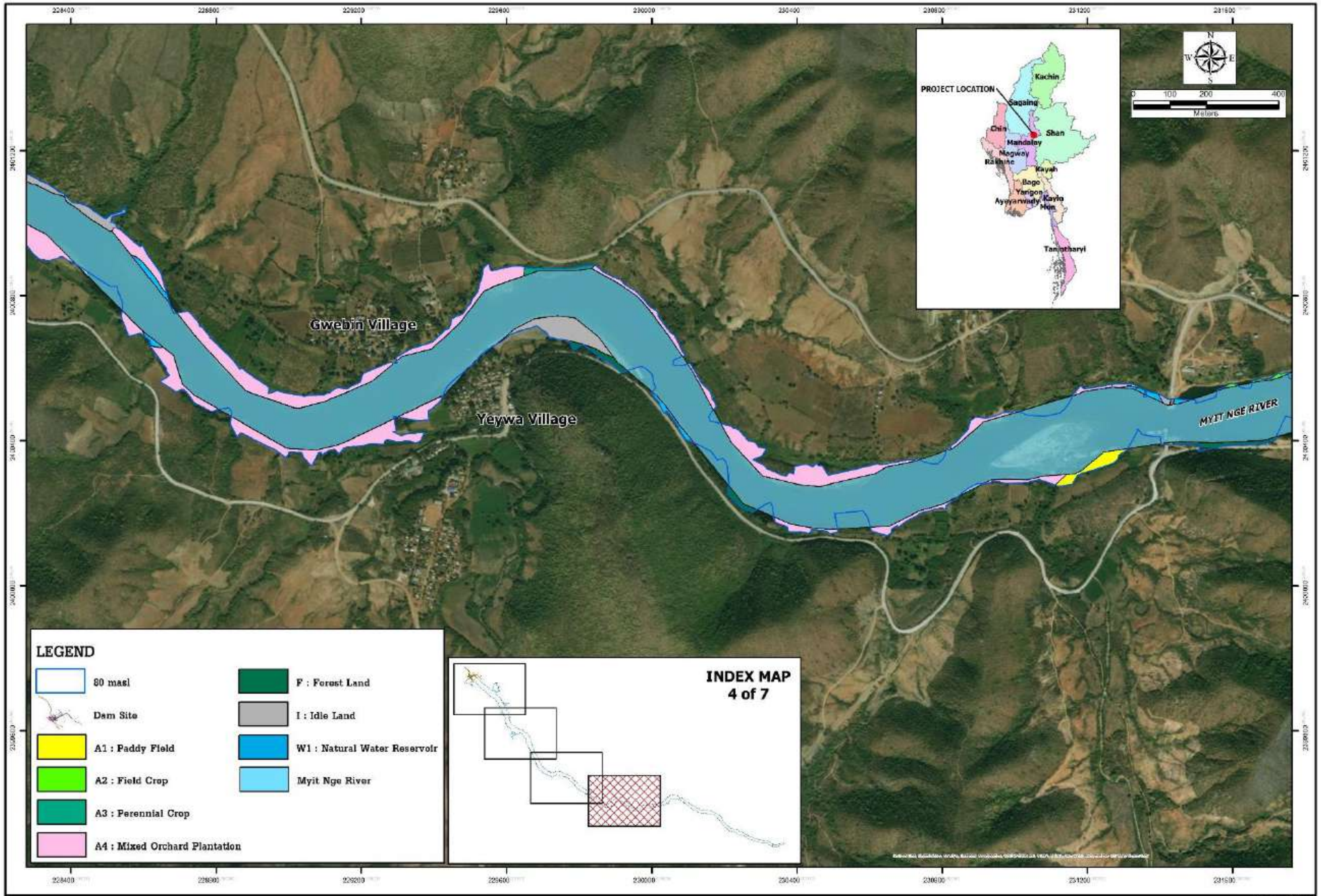


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l (CONT'D)

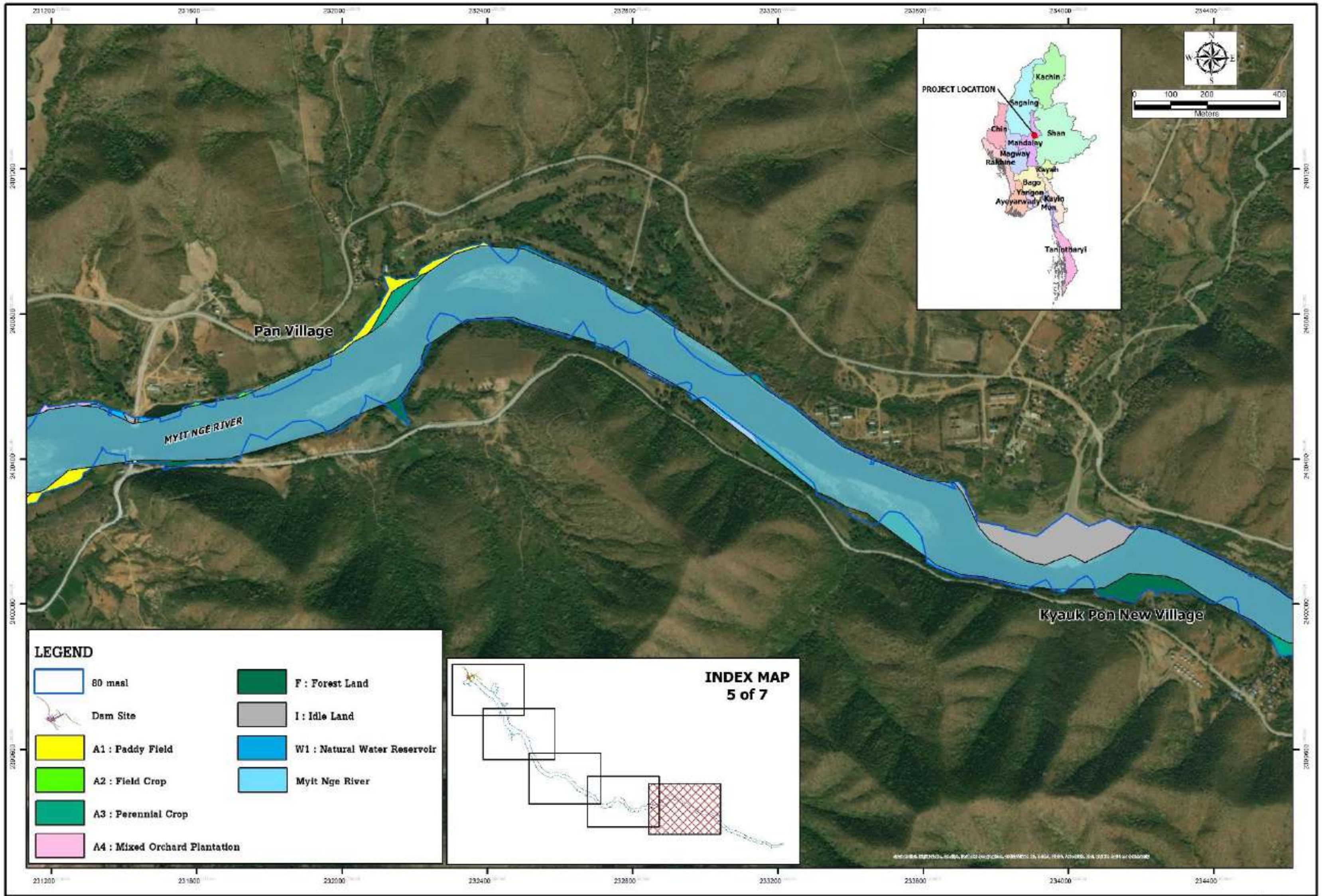


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l (CONT'D)

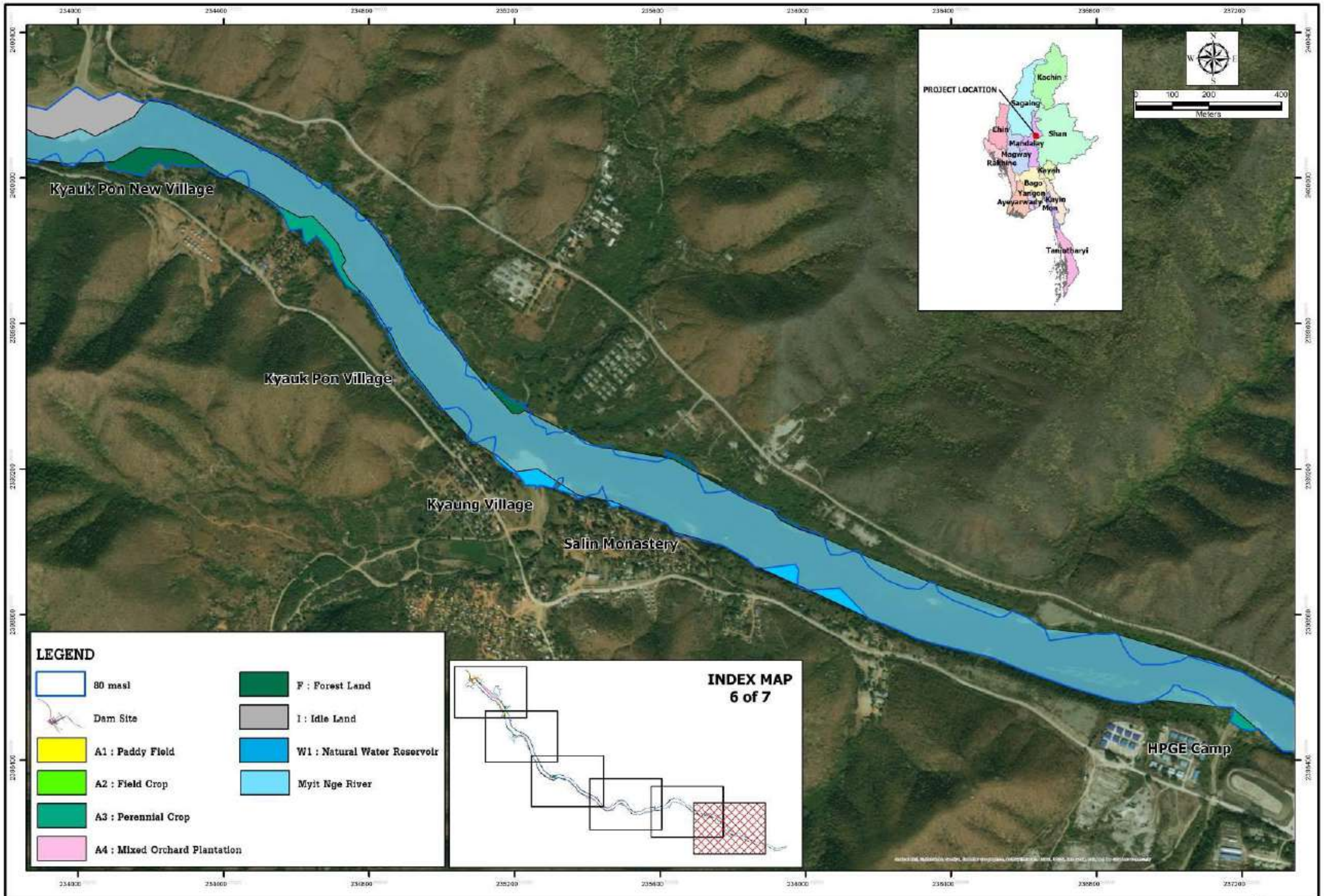


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l (CONT'D)

TEAM

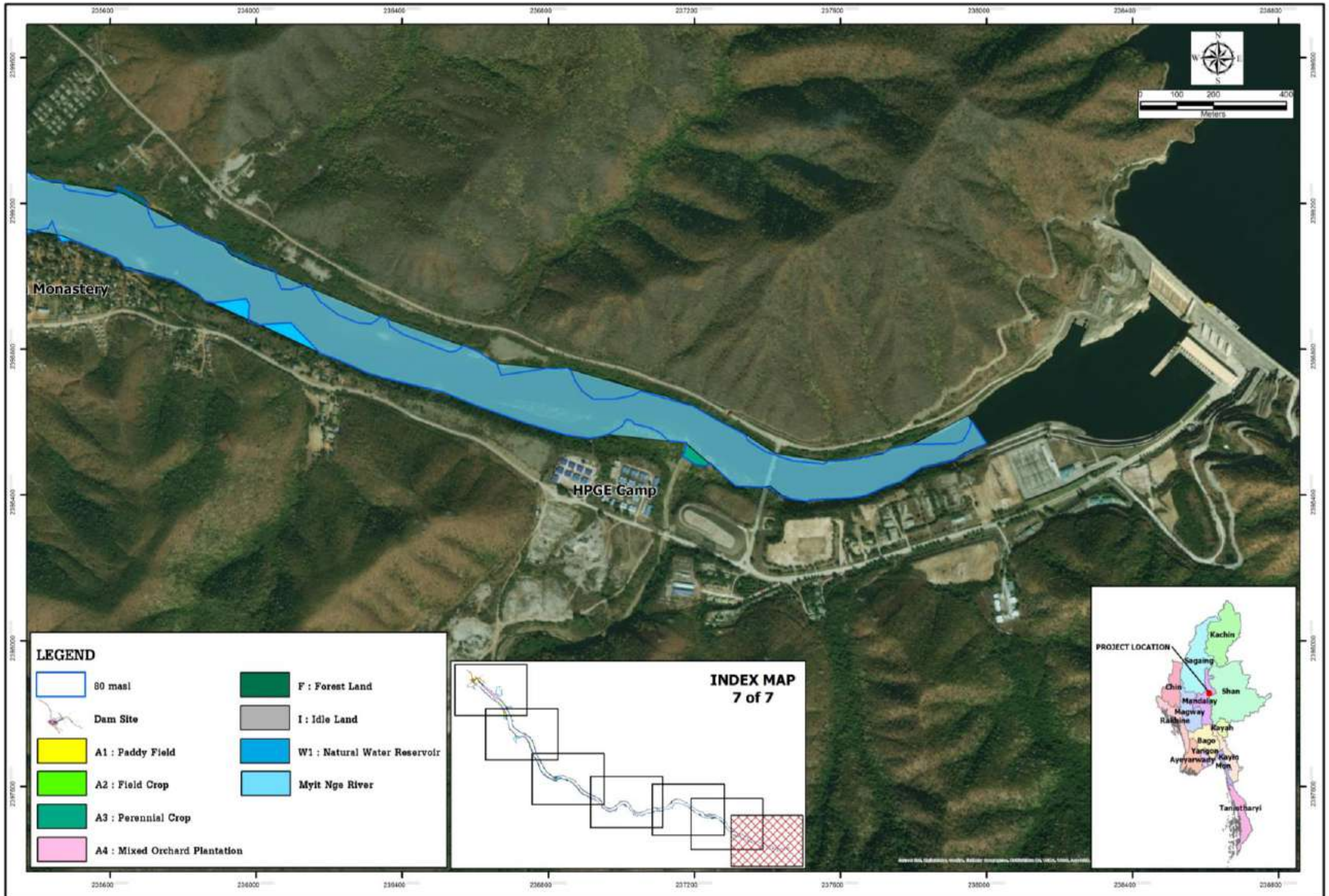


FIGURE 6.3.6-3 : MAP SHOWING AREA UNDER 80 m a.s.l (CONT'D)

The backwater effect will have both negative and positive effects. The negative impacts will include:

- Some of the flooded river bank areas are currently used for agriculture. No houses are found in these affected areas.) Therefore, the riverine cropping area will be permanently lost with adverse effect on livelihood of the villagers using the land.
- Increased water depth would pose dangers to river water users who cannot swim.

The positive impacts would include:

- Groundwater table would rise in the dry season, thus saving time and energy in water abstraction and increasing groundwater yield.
- Opportunities for fisheries will be created by the increased water depth and volume.

(2) Proposed Mitigation Measures

If the negative impacts outweigh the positive impacts, the operating water level could be reduced to below 80 m a.s.l. Alternatively, dikes or embankments could be constructed to protect the low lying areas.

If it is not technically feasible to protect the low lying areas, the current land users will need to be compensated in accordance with government regulations.

(3) Residual Impacts

a. Predicted Level of Residual Impacts

Subject to a detailed ground survey, the areas which could be inundated is tentatively estimated at about 276.92 acres. Riverine agriculture is not widely practiced in this region compared to that along Mekong River. Steep slope of the river banks would be the factor.

Therefore, the residual impacts should be acceptable to the affected households.

b. Evaluation of the Significance of Backwater Impact

The impact of backwater on the riverine communities is evaluated as follows:

Impact category	Direct impact
Impact duration	Throughout the dam life
Impact extent	Local confined to low lying areas along the river banks upstream of the dam
If no control – **Impact magnitude**	About 276.92 acres of land along the river banks could be flooded
– **Severity**	Medium
Control priority	**Medium**

The backwater issue deserves medium control priority.

(4) Proposed Monitoring

River flows and levels at the dam will be daily measured and recorded as part of the hydropower plant operations.

The flood protection dikes will be periodically inspected and maintained to ensure their stability.

6.3.7 Fish and Fish Habitat

Results of the fishery surveys, presented in ***Chapter 5-Description of the Environment***, established that the river reach from Yeywa dam to near its confluence with Irrawaddy River was poor in fishery resources compared with those of Irrawaddy River. The rarity of local fishing activities in the river corroborated this scientific finding. It should be noted that the existing ecological conditions of the river are the impacts of Yeywa Dam. One of the impacts is the infestation of submerged aquatic weeds on the river bed with consequences on fish diversity and propagation.

Impacts of the Project on fish and fish habitat in the river will have to be assessed against this backdrop of existing river ecological conditions.

6.3.7.1 Construction Phase

(1) Potential Impacts

As already discussed in ***Section 6.3.4***, the construction will have some effects on river water quality at and downstream of the dam site. A major issue will be increases in water turbidity during the coffer dam construction and removal which, according to the tentative construction schedule, would last for a duration of about 14 months. The increase in turbidity and subsequent sedimentation downstream will affect all aquatic organisms such as plankton, benthic organisms and fish in the following manners:

- High level of turbidity would result in the population decline of plankton and benthic flora as turbidity reduces light intensity-critical factor for photosynthesis. However, as the duration of high turbidity would be only about 7 months in the first year, 4 months in the third year and 3 months in the fifth year, the population decline of photosynthesis organisms would not be so significant. Moreover, the population of these organisms would recover to their natural condition in a short period since this kind of organisms have a short life span.
- Siltation of fine soil particles from highly turbid water will affect respiratory process of gill respiration organisms such as aquatic insects, crustacean, snail, mussel and fishes impaired. Massive death of these organisms could result. Highly motile fauna such as fish can avoid this situation by swimming away from the concentration poison source while the small and less motile such as polychaete, aquatic insect larvae would be the most suffering group. However, as the coffer dam construction and removal period would be only about 14 months, the turbidity impact would not be significant. .

In addition to the turbidity issue, eutrophication in the downstream aquatic ecosystem could be another issue of the impact of construction.

Results of the field surveys revealed that the ecosystem of Myitnge River could be classified as *mesotrophic* ecosystem based on its medium rich of nutrients. Its species diversity and density of plankton, benthos and also fish were comparably lower than the stations at the dam site and in the Irrawaddy River. Furthermore, the most dominant phytoplankton group is the blue-green algae and the Dinoflagellate which prefer high nutrients environment. Under suitable environmental conditions, blooming of these two groups of microalgae would easily occur. Such algal blooming would be harmful to the environment not only by rapid depletion of dissolve oxygen but also by some toxins, such as microcystin, that the algae secrete to the environment. If the cumulative amount of this harmful toxin is over the lethal dose, the water will become too toxic for safe drinking by fish, waterfowl, amphibians and also human.

Other evidence for eutrophication in Myitnge River was found in the dominant group of benthic fauna-oligochaete worms (Family Naiadidae), and the true midge larva (Family Chironomidae). It has long been known that these 2 groups of benthos are a good indicator of eutrophication as their most preferable living condition is high organic content sediment. This type of area would later easily change into polluted area. The presence of these 2 groups of benthos was also good indications that the discharge from Yeywa dam contains high organic nutrients that would gradually deposit onto the river bottom.

In conclusion, although the project construction has potential to create adverse impacts on fish and the aquatic ecosystem, the actual impacts would not be significant considering: (i) short duration of high turbidity during coffer dam construction and removal; and (ii) existing poor status of fishery resource in the river. However, the increase in water turbidity during the construction will have to be controlled to protect water user downstream. This aspect is already discussed in ***Section 6.3.4***.

(2) Proposed Mitigation Measures

Proposed mitigation measures for controlling the water turbidity are already presented in ***Section 6.3.4***.

(3) Residual Impacts

The significance of fish and fish habitat issue during the construction phase is evaluated as follows:

Impact category	Indirect impact
Impact duration	Temporary, during coffer dam construction and removal period
Impact extent	A river section downstream of the construction site. The length and magnitude of impacts will depend on river flows.
If no control – **Impact magnitude**	 Small due to poor fishery resource in the river
– **Severity**	Low
Control priority	Low

The issue deserves low priority.

6.3.7.2 Operation Phase

(1) Potential Impacts

In the operation phase, the dam will block fish movement upstream passing the dam, increase water depth upstream of the dam, and increase water volume between the dam and Yeywa dam. These features will change the upstream area from being a running ecosystem (lotic condition) into a still reservoir ecosystem (lentic condition). This change would have both negative and positive effects on the Myitnge River ecosystem.

a. Positive Impacts

The noticeable positive effects would be: (i) increase the overall capacity of natural fish production in the Myitnge River; (ii) provide adequate water supply for both agriculture and aquaculture activities to the surrounding communities; and (iii) provide a water recreational site.

The survey results clearly indicated low fish production in the river upstream of the construction site as inferred from less species diversity of fish. Based on the information on water quality and abundance of existing aquatic organisms, the total fish biomass would significantly increase within the first year of impoundment. According to the geographical characteristics of the river banks, several artificial wetlands would be developed beyond the extent of impoundment. These artificial wetlands would support local fish species such as carps and minnow as spawning and nursing ground. Furthermore, the artificial wetlands would become excellent habitats for several fish species such as snakehead, eels and carps. Eventually, the fish resource in the river upstream of the dam would increase, thus providing fishing opportunities for local fishermen.

Based on the fish species found around the project area, most of them could thrive and propagate in the river barrage condition and modified habitats. Therefore, the created river pondage behind the dam, with water supplied from Yeywa dam, would create opportunities for aquaculture for the surrounding communities. The aquaculture could use floating cages or hapas to culture economically important species such as the Nile Tilapia (*Oreochromis niloticus*), the Rohu (*Labeo rohita*), or the Myanmar Pangasiid catfish (*Pangasius mayanmar*). However, in river aquaculture will need effective water quality management.

b. Negative Impacts

Negative impacts could be experienced in the river pondage as flow velocities will be significantly reduced due to increased depth and cross-sectional area of the channel. The potential impacts could be:

- Blooming of unwanted flora species such as blue-green algae, or pond weed (*Potamogenton* sp.) Sedimentation in the river pondage could result in accumulated nutrients. Under some favorable conditions, the high nutrient environment could result in excessive growth (blooming) of some undesirable phytoplankton species, such as *Microcystis*, or *Oscillatoria*, and/or floating aquatic plants such as the pond weed. Blooming of these plankton or plant species could cause the collapse of the whole aquatic ecosystem, which would eventually lead to the pollution stage. This phenomenon has been experienced in several dam reservoirs over the world.

- Occurrence of some epidemic diseases caused by some parasitic worms that use fish or aquatic organisms as their temporary hosts. Stagnant water is the most preferable environment for several benthic invertebrates such as shrimps, freshwater crab, snail and even some fish species. These species are usually the intermediate hosts of severe parasitic species such as digenea fluke worms. These organisms are usually consumed by human, thence the parasite would finally become human parasite. In some countries such as Thailand, Laos, and Cambodia, many people like to eat raw aquatic invertebrate. Hence, the epidemic of these kinds of parasitic organisms have been frequently reported.

However, the river pondage of the Project will have a maximum depth of only about 15 m at the dam site and the depth will decrease upstream toward Yeywa dam. It will therefore be much shallower than most storage dam reservoirs. Therefore, the chance of algal bloom and infestation of parasitic hosts will be less

Furthermore, Myitnge River particularly downstream side from dam structure would experience highly fluctuated in the daily change of water current. During electric generating hours, water in main channel would clear, cold with swiftly current while non-operating period water become stagnant with shallowing depth. This situation would not suitable for living of small species such as the minnows, spiny eels and also young of predator species such as snakehead (*Channa* spp.). The species that encounter this fluctuation would be the larger species such as Nga phe aung (*Osteobrama belengeri*) and the Nile tilapia (*Oreochromis niloticus*) while the smaller species such as Nga lay doun (*Osteobrama cunma*), Nga maw tawt (*Esomus* spp.) and probably other small species such as Snakehead and Croaking gourami cannot stand for strong current and move to live in tributaries.

In conclusion, construction of the Dee Doke dam which is small compared to existed Yeywa Dam, would gave less effect to diversity of freshwater fish in project area. Seeming that the diversity of fish was threatened prior construction of this dam. The consultant still to keep on an idea of constructing of artificial wetland within dam area of enhancing fish production and diversity in new dam's reservoir.

(2) Proposed Mitigation Measures

The potential negative impacts will have to be controlled through reservoir operational management to flush out aquatic plants, if necessary.

(3) Residual Impacts

The residual negative impacts on fish and fish habitat would be insignificant.

The significance of fish and fish habitat issue during the operation phase is evaluated as follows:

Impact category	Indirect impact
Impact duration	Permanent
Impact extent	The entire river reach from the project dam to Yeywa dam
If no control – **Impact magnitude**	 Small due to poor fishery resource in the river
– **Severity**	Low
Control priority	Low

The issue deserves low priority.

6.3.8 Erosion and Sedimentation

Soil erosion occurs naturally depending on many factors among erosivity of the rain, erodibility of the soil, slope length and steepness, crop practice and conservation practice. Prior to construction, the factor (crop practice) on which soil erosion depends is increased, because the clearing of the construction would remove protective vegetative cover. It is anticipated that until the construction site is covered by all project's facilities or re-vegetation, soil loss would be greater than existing condition.

6.3.8.1 Construction Phase

(1) Potential Impacts

According to the approval FS, the volume of the coffer dam was 300,000m^3.

Basically, the surface of the coffer dam would be protected with rocks (riprap) or gabion so as to prevent erosion from occurring (see in ***Figure 6.3.8-1***).

In spite of the mitigation, the volume of the sediment which might be transported due to erosion would be assumed to be 10% of the coffer dam volume during the construction period of 5 years. 10% is the same assumption of the wash load and suspended load in the "Yeywa HPP-Inception Report, 2001".

Based on the assumption, the volume is calculated to be 30,000 [m^3/s]. The thickness of the accumulated sediment to the downstream in the Myitnge River is:

30,000 m^3 / (80,000m x 100m) = around 4mm

Furthermore, the concentration of the sediment would be:

30,000[m^3] / 2.0[t/m^3] (Unit weight of soil) / (15 Billion m^3 (Annual inflow) x 5 years) = 0.0008[g/l] << 0.005[g/l] (Minimum value of the records of the Myitnge River in the "Yeywa HPP-Inception Report, 2001)

Those results has revealed that the possible erosion of the coffer dam would be negligible considering the large volume of inflows of the Myitnge River., even though the surface protection would basically be taken as the mitigation.

A

B

FIGURE 6.3.8-1 : RIPRAP (A) AND GABION (B)

(2) Proposed Mitigation Measures

- Plan construction activities that may accelerate soil erosion rate during dry season, where possible.
- Minimize area of land clearance and carefully monitor stripped soil from erosion.
- Carefully monitor land clearance activities throughout the pre-construction phase to ensure that vegetation is not cleared beyond pre-defined project boundaries;
- Install drainage control structures at suitable locations to divert clean runoff away from disturbed area;
- Install erosion and sediment control structures such as silt fences and sediment ponds at suitable locations to filter and collect eroded sediments from turbid runoff before as soon as site clearance is finished, where necessary;
- Once a borrow area is no longer required, its slopes should be reduced and rehabilitated with stockpiled topsoil;
- Progressively do re-vegetation of disturbed area as soon as practicable, to facilitate long term stabilization;
- Regularly monitor suspended sediments and sedimentation rates at key locations upstream and downstream of project facilities, during construction, to confirm the extent of impacts and implement suitable management responses; and
- Strictly implement the mitigation measures for solid waste management and surface water quality.

Erosion

According to the approved FS, in order to prevent erosion at the downstream of the spillway from occurring, the stilling basin was designed to be 50m long in consideration of the river hydraulics. Therefore, it is noted that the erosion which would give significant impacts on the downstream could not occur.

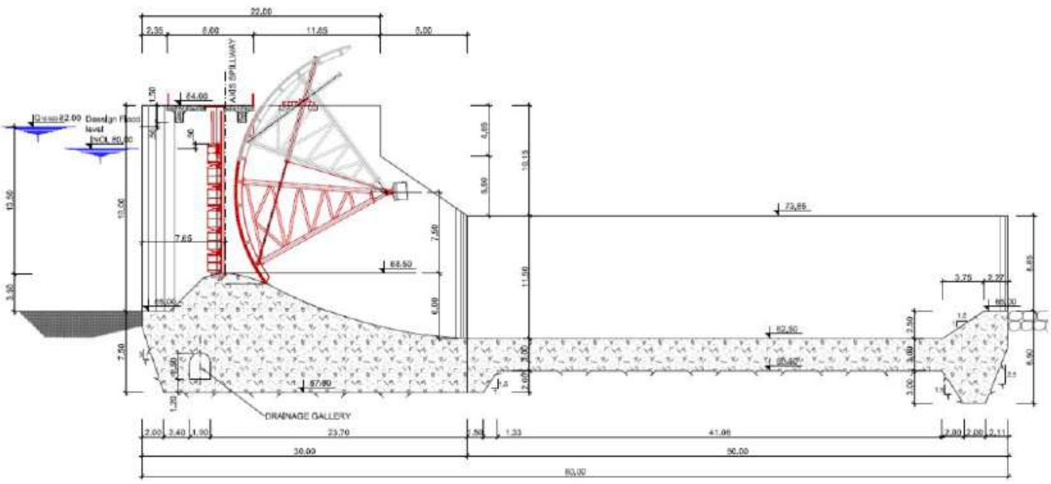


FIGURE 6.3.8-2 : STILLING BASIN

6.3.9 Hydrology in Myitnge River

6.3.9.1 Construction Phase

During construction of the spillway for about 24 - 30 months, the river flow would be diverted through a diversion channel. The hydrology of the Myitnge river would not be significantly changed. A impact on hydrology during construction phase would be only temporary and limited at this diversion channel. The diversion channel is operated during the spillway construction and finally coffer dams will be removed from the river.

6.3.9.2 Operation Phase

(1) Normal flow period

The Deedoke Hydropower Project is planned to be developed as a run of river type hydropower station and has only a small pond. The pond is too small to regulate river inflow and operation of Deedoke will not alter the present river flow, basically. This means that inflow and outflow at Deedoke are always same through year.

(2) Flood flow period

The spillway is designed with the capacity to spill out a design flood discharge of 7,300 m^3/s (return period of 10,000 years) at the pond water level 82 m. However, in the flood flow period, all spillway gates will be fully opened in order to return the flow condition to the original river because the original river has the maximum discharge capacity.

According to the past record at Shwezayan Gauging Station, floods of 1,000 to 1,500 m3/s occur every year. In such flood period, power generation will be continued with the spillway gate partially opened. In this case, we must consider of the minimum backwater effect to the upstream regions.

For appropriate flood treatment, further hydraulic study introducing a numerical river flow model should be carried out in the next detailed design stage.

(3) Residual Impacts

a. Predicted Level of Residual Impacts

In the normal flow period, generally, a run-of-river plant will keep the pond water level at a normal water level (NWL) through year. However, in the flood period, spillway gate operation will be required for safety in the upstream regions as well as continuous power generation. Monitoring of inflow from Yeywa Power Station and water level at the Deedoke site will be routinely performed for rational and effective gate operation. Fortunately, outflow from Yeywa needs several hours to arrive in Deedoke. Therefore, Deedoke operators can have enough time to prepare for flood treatment by the gate operation so as to minimize the impacts to upstream and downstream regions. The impacts should be acceptable to the affected households.

b. Evaluation of the Significance of impact from alteration of hydrology

The impact from alteration of hydrology in the flood period, especially on the upstream communities is evaluated as follows:

Impact category	Direct impact
Impact duration	Flood period
Impact extent	The section of Myitnge River between Yeywa and Deedoke
If no control – **Impact magnitude**	Alteration of flow elevation in Myitnge River especially upstream area from Deedoke site
– **Severity**	Low to medium
Control priority	Medium

(4) Monitoring and Inspection

River flows and levels at the dam will be daily measured and recorded as part of the hydropower plant operations.

The spillway gates will be periodically inspected and maintained to ensure their function.

6.4 SOCIAL IMPACT ASSESSMENT

6.4.1 The Assessment Framework

6.4.1.1 Scope of the SIA

Appendix 3 of the EIA Guideline 2014 indicates 19 socio-economic components in the section on Social Impact Assessment of the EIA report (see ***Table 6.4.1-1***). The EIA Guideline 2014 does not elaborate on each individual component. ***Section 5.4*** presents information on these socio-economic components.

It should be noted that for a proposed project some components will not be relevant depending on the context of the project. For this Project, ten components will not be relevant as they do not exist in the project area (see Section 5.4) or the magnitudes of related project activities or inputs will be too small to induce significant changes in the socio-economic components. For example, the tourism component is not relevant because the study area has no established tourism activities. The irrelevant components are highlighted in yellow in ***Table 6.4.1-1***. Therefore, the social impact assessment of this Project will cover only 9 socio-economic components.

TABLE 6.4.1-1

SOCIO-ECONOMIC COMPONENTS INDICATED IN THE EIA GUIDELINE

6.3.1 Communities and Services	6.3.11 Public Health and Safety
6.3.2 Population and Communities	6.3.12 Occupational Health and Safety
6.3.3 Economic Activities	6.3.13 Agriculture
6.3.4 Vulnerable Groups	6.3.14 Forestry
6.3.5 Land Use	6.3.15 Fisheries/Aquaculture
6.3.6 Infrastructure Facilities	6.3.16 Industries
6.3.7 Water Use and Water Supply	6.3.17 Mineral Development
6.3.8 Energy Sources	6.3.18 Tourism
6.3.9 Transportation	6.3.19 Vulnerability to Natural Hazards and Climate Change
6.3.10 Navigation	
	6.3.20 Others

Note: Those highlighted in yellow are considered irrelevant to this Project.

6.4.1.2 Concept of Social Impacts

Social impacts are consequences of changes in socio-economic components or changes in biological components which will be caused by project activities, project requirements, project employment and spending, and people needed for project construction/operation. Therefore, social impacts are secondary impacts, some of which could have further consequences (tertiary impacts). For examples: (i) excessive construction noise (change of physical environment) could affect quality of life of people living near the project site (social impact); (ii) land acquisition (project requirement-primary impact) could result in loss of livelihood and properties (social impact) with likely consequences on poverty and degrading quality of life (tertiary impact; and (iii) competing use of community infrastructure and services (project requirements-primary impact) could cause public inconveniences (social impact) with consequences on quality of life (tertiary impact). ***Figure 6.4.1-1*** shows a generic SIA concept which can be also applied for this project.

It should be noted that there are several categories of social impacts. The categories relevant to this Project are: (i) quality of life; (ii) livelihood; (iii) safety risk; (iv) health risk; (v) inconveniences or nuisance; (vi) family and community fabric; and (vii) cultural conflicts.

It should be noted that social impacts could occur at three levels- individual person level, community or village level, and higher level. The SIA for this Project will be limited to only the individual person and the village levels.

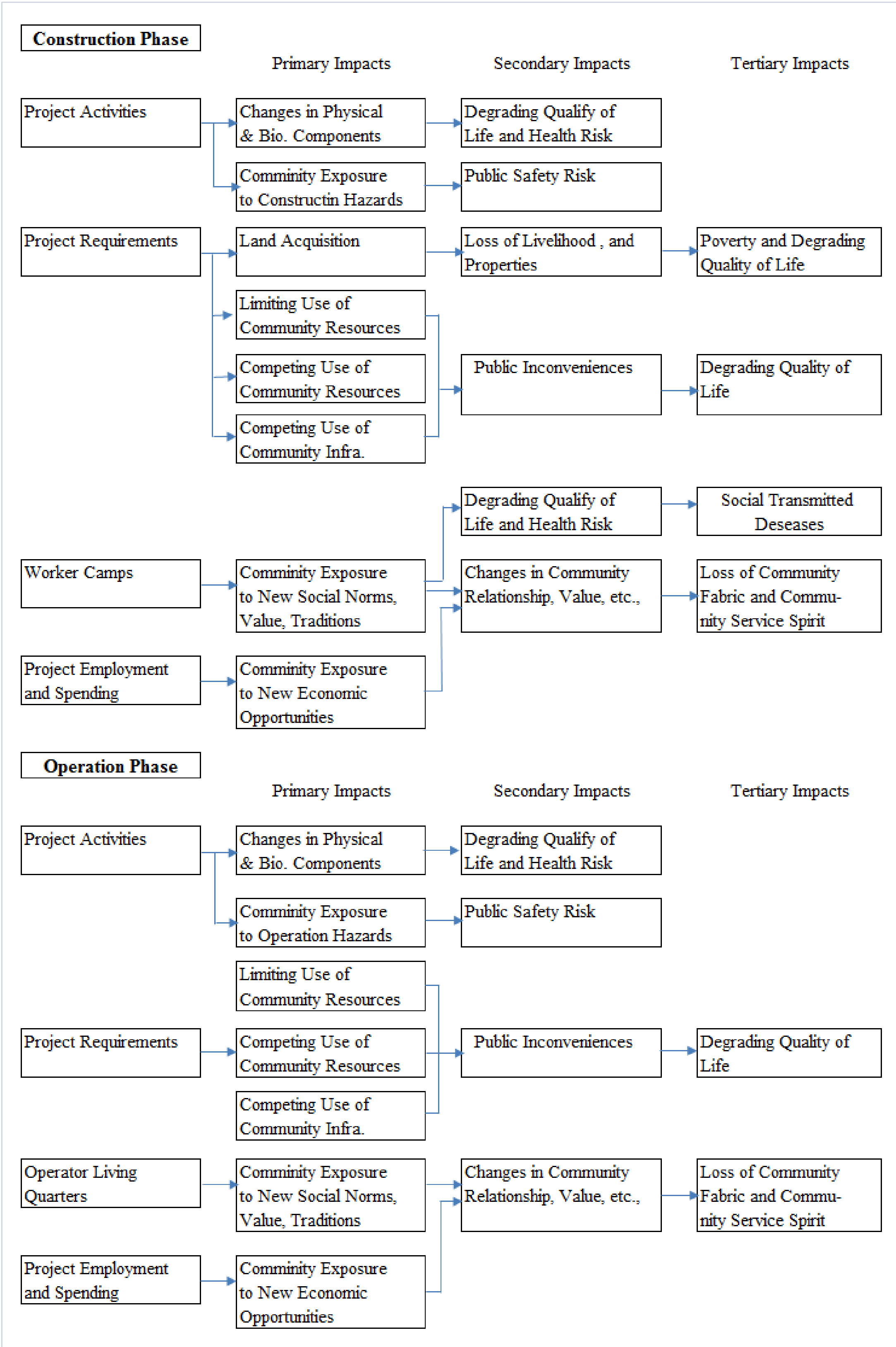


FIGURE 6.4.1-1 : GENERIC SIA CONCEPT

6.4.1.3 Determining the Magnitudes of Changes of Socio-Economic Components

The SIA will qualitatively determine the magnitudes of changes of biophysical and socio-economic components, which could have social impacts at the individual and/or village levels. The magnitudes of changes of biophysical components in the construction and operation phases have already been discussed in ***Sections 6.3***, and the results will be used in determining the magnitudes of changes of related socio-economic environment.

6.4.2 Justifications for Excluding Ten Socio-Economic Components

(1) Population and Communities

In the context of social impact assessment, this component should cover two aspects- changes in population structure, and changes in settlement pattern in the project area. This category of social impacts is normally of concern only in a large development project employing thousands of construction workers or requiring thousands of operation workers. The number of workers, if significantly large compared to population in the nearby communities, could create these social impacts if the workers decide to settle in the area after the construction, thus creating new settlements[3]. A project employing a large number of workers during operation could also generate unplanned settlements set up by the workers.

This socio- economic component is considered irrelevant and will be excluded from the social impact assessment.This conclusion is supported by the following considerations: (i) the Project will employ only about 300 workers during project construction and only 50 persons during project operation; and (ii) most of the construction workers would be sourced from surrounding villages.

(2) Vulnerable Groups

Vulnerable groups are old people, widows, handicapped people who deserve special attention in the social impact assessment. However, the vulnerable people are taken care and supported by their relatives; therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

(3) Energy Sources

In the context of social impact assessment, this component should cover impacts of the Project on energy sources currently used in the nearby communities. For a large storage dam project, inundation of a large land area could reduce firewood supply of villagers. This Project will not flood a large land area. Therefore, it will not affect local energy sources. This component is considered irrelevant and will be excluded from the social impact assessment.

(4) Navigation

The Scoping Study found no navigation in the river between the dam site and Yeywa Dam. Therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

[3] Small settlements of construction workers of Yeywa dam are found along the road to the dam.

(5) Forestry

The Project area has no forestry resources. Therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

(6) Fisheries/Aquaculture

The Scoping Study found no fisheries/ aquaculture in the river between the dam site and Yeywa Dam due to poor fisheries resources. Therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

(7) Industries

The Project area has no industries. Therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

(8) Mineral Development

The Project area has no mineral developments. Therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

(9) Tourism

The Project area has no tourism. Therefore, this component is considered irrelevant and will be excluded from the social impact assessment.

(10) Vulnerability to Natural Hazards and Climate Change

For a large storage dam project, the reservoir could cover a very large area. This could cause microclimate change and the dam could make the downstream areas vulnerable to natural hazards such as earthquakes and river bank instability. These environmental changes could affect livelihood of the people.

As the Project is a run-of-river hydropower project, the size of river pondage area will not be large enough to cause microclimate change or to induce earthquake. Therefore, this socio-economic component is considered irrelevant and will be excluded from the social impact assessment.

6.4.3 Social Impacts Related to the Relevant Socio-Economic Components

The SIA framework in ***Figure 6.4.1-1*** is used in identifying the project related causes of changes of each relevant socio-economic component, assessing the magnitudes of changes, assessing the magnitudes of social impacts, and evaluating its priority. Results of the SIA are discussed below:

6.4.3.1 Communities and Services

Impact Category

(1) Tertiary impact, loss of community fabric and community service spirit

The disintegration of the community fabric would adversely affect existing voluntary community services. The underlying causes of this category of impact are normally significant changes in social and economic conditions of the communities. These changes, if abrupt and most of the community members are not well prepared for the changes, could instill materialism and disintegrate the community fabric, which could result in various social ills especially drug and alcoholic abuses and spread of sexually transmitted diseases. However, this type of social impact is normally a matter of concern only in large development projects that will bring significant changes to surrounding communities. For example, a large industrial estate development project could create this category of social impact due to its large effect on the local economies and local culture and traditions.

(2) Secondary Impact

Changes in community relationship, way of life, value, tradition, moral value, sense of community.

(3) Primary Impact

Exposure of the affected communities to new social norms, value, traditions, practices, and new economic opportunities brought about by an influx of external workers and cash inflow into the village economy through project spending and employment.

(4) Villages at Risk

The villages at risk are Hnget Gyi Thaik village and Thayet Pin village which are near the project construction site and quarry site respectively.

(5) Impact Assessment-Pre-Construction and Construction Phase

a. Potential Impacts

The Project will employ about 300 people at peak during project construction. Most of the workers will be local, therefore, socio-cultural changes induced by the construction workers will not be significant. Assuming an average wage of about US$ 250 equivalent per month, and about 20%would be injected into the village economy, only about US$15,000 equivalent per month would be spent for buying village services. Assuming a velocity of money of 2.5, the village economy will involve about US$37,500 equivalent of transactions. This level of economic stimulant would not be large enough to induce significant socio-cultural changes which could threaten the community fabric.

b. Proposed Mitigation Measures

(i) Hire construction workers from local sources as many as possible.

(ii) Initiate livelihood development programs designed to make the best use of new economic opportunities that will come with the project spending and employment.

(iii) Village headmen and the responsible authorities should establish local rules and regulations for control of alcoholic abuse and sexually transmitted diseases.

(iv) Stay on-site workers should be accommodated in more than one camp to be located far from the villages

c. Residual Impacts

The proposed measures should reduce the impacts to acceptable levels. The impact significance is evaluated as follows:

Impact category	Indirect impact from project spending and employment
Impact duration	Throughout the project life.
Impact extent	60 households, 300 persons
Impact magnitude	Significant if not adequately handled.
Impact severity	Minor, residual impacts acceptable to the affected persons
Control priority	Medium

The social impacts related to the communities and services component should receive medium control priority.

d. Monitoring

A social monitoring program should be designed and implemented to monitor undesirable socio-cultural changes in the villages.

(6) Impact Assessment-Operation Phase

The Project will employ 80 persons in the operation phase. The social impact on the communities and services will not be significant and could be neglected.

6.4.3.2 Economic Activities

(1) Pre-Construction and Construction Phase

a. Potential Impacts

Land acquisition by the Project will have impacts on economic activities of the affected persons (Aps) with adverse consequences on their livelihood. The Project will acquire about 153.35 acres for the construction of the hydropower component, quarry sites, crushing plant, worker camp site, embankment protection facilities, access roads and the transmission line towers. However, 34.61 % of which is forest land and most of the area will be temporarily affected, when the project construction is completed, around 60% of construction area will return to its previous condition. Therefore, its impact on livelihood will be insignificant. Information on the impacts is presented in ***Table 6.4.3-1***.

TABLE 6.4.3-1

IMPACTS ON ECONOMIC ACTIVITIES RELATED TO LAND ACQUISITION

Villages	Affected Households	Affected Persons	Acquired Area (acre)	Land Use
Hnget Gyi Thaik	7	35	18.94	Field crop, Mixed orchard, Idle land, Perennial crops
Thayet Pin	30	150	109.09	Forest, Mixed orchard, Perennial crop, Field crop, Rock pit
Ma Gyi Inn	6	30	23.71	Forest, Rock pit, Community area
Hpa Lan Pin	10	56	0.95	Idle land, Forest
Inn Kone	7	29	0.66	Idle land, Forest
Total	**60**	**300**	**153.35**	

b. Proposed Mitigation Measures

The mitigation measures will be compensation for the loss of land and crops, and livelihood development assistance. The measures are presented in the resettlement action plan (RAP) in ***Appendix 6A***. The RAP will include the following:

A detailed compensation plan identifying individuals/ families, which will lose their land due to project development.

An adequate compensation package to be developed in close collaboration with all stakeholders.

Compensation should be for both land and crops as well as for other properties such as valuable trees.

The compensation should be done according to international standards and with the overall objectives of improving the standard of living for those who will be affected. All crops, valuable trees should be compensated. Cash compensation is the mode agreed with the people in project affected village during consultations.

Set up grievance redress mechanism for project affected people.

Arrange vocational extension activities in accordance with peoples' need and site condition especially agricultural production, marketing and supplementary occupational support to compensate for reduced agricultural production.

Cooperation with local and district authorities regarding improved infrastructural development could enhance mitigation measures dealing with health, drinking water supply education, electricity supply and general social uplift. This means the project could become development opportunity with long- term, positive implications for the project area and the region as a whole.

c. Residual Impacts

1) Level of Residual Impacts

The compensation and livelihood development assistance will minimize the impacts to a level that the residual impacts will be acceptable to the Affected People.

2) Evaluation of the Significance of Impact

The impact on livelihood is evaluated as follows:

Impact category	Direct impact from land acquisition
Impact duration	Throughout the project life.
Impact extent	60 households, 300 persons
Impact magnitude	Significant if not adequately compensated.Livelihood shall be restored to the level before the Project.
Impact severity	Minor, residual impacts acceptable to the affected persons
Control priority	Medium

The land acquisition issue should receive medium control priority.

d. Proposed Monitoring

The implementation of RAP will be closely monitored throughout its implementation period. Details are presented in the RAP.

(2) Operation Phase

a. Potential Impacts

During the operation phase**,** economic activities will be affected by the inundation of river bank agricultural area used by affected persons (APs) with adverse consequences on their livelihood. The loss of river bank land used in local agriculture is estimated at about 174.53 acres. Information on the impacts is presented in ***Table 6.4.3-2***.

TABLE 6.4.3-2

IMPACTS ON ECONOMIC ACTIVITIES RELATED TO LOSS OF RIVER BANK AGRICULTURE

Villages	Affected HH	Affected Persons	Loss of River Bank Agricultural Land	Major Crops
Hnget Gyi Thaik	8	40	59.99	Lemon, Banana and Mango
Ma Gyi Inn	10	50	32.97	
Thayet Pin	22	110	81.57	
Total	**40**	**200**	**174.53**	

b. Proposed Mitigation Measures

The mitigation measures will be compensation for the loss of land and crops, and livelihood development assistance. The measures are presented in the resettlement action plan (RAP) in ***Appendix 6A***.

c. Residual Impacts

1) Level of Residual Impacts

The compensation and livelihood development assistance will minimize the impacts to a level that the residual impacts will be acceptable to the Affected People.

2) Evaluation of the Significance of Impact

The impact on livelihood is evaluated as follows:

Impact category	Direct impact from the dam operation
Impact duration	Throughout the project life.
Impact extent	40 households, 200 persons
Impact magnitude	Medium if not adequately compensated. Loss of livelihood or supplementary income should be compensated.
Impact severity	Minor, residual impacts acceptable to the affected persons
Control priority	Medium

The issue of loss of river bank agriculture should receive medium control priority.

d. Proposed Monitoring

The implementation of RAP will be closely monitored throughout its implementation period. Details are presented in the RAP in ***Appendix 6A***.

6.4.3.3 Land Use

(1) Potential Impacts

This Project will change land use only at the dam site, transmission line tower base and small areas along the river banks as indicated in ***Sections 6.4.3.2***. The total area affected by the Project will be about 677.21 acres comprising 338.52 acres of private land and 338.69 acres of government land. Economic impacts of the land use change will be small. Social impacts of the land acquisition and the loss of river bank agriculture have been included in the impacts on Economic Activities in ***Section 6.4.3.2***.

(2) Proposed Mitigation Measures

No mitigation measures for the land use change will be required.

(3) Residual Impacts

Residual economic impacts of the land use change will be minor and should be acceptable.

The impact on land use is evaluated as follows:

Impact category	Direct impact from the construction
Impact duration	Permanent, throughout the project life.
Impact extent	677.21 acres (338.52 acres of private land and 338.69 acres of government land)
Impact magnitude	Small
Impact severity	Minor, residual impacts should be acceptable
Control priority	Low

The issue of impact of the land use change should receive low control priority.

(4) Proposed Monitoring

Monitoring on the economic impact of land use change will not be necessary.

6.4.3.4 Infrastructure Facilities

The only major infrastructure in the project area is the existing roads on both banks connecting Yeywa Dam with Mandalay. The road on the right bank is a narrow concrete road providing access to Mandalay. The left bank road is mostly unpaved connected with Kyaukse-Mandalay highway at Sintgaing Township. The two roads are in poor conditions.

The Project will increase traffic load on the roads during the construction phase. This will cause inconvenience to users of the roads.

(1) Potential Impacts

The Project will increase traffic load on the roads during the construction phase. This will cause inconvenience to users of the roads. However, for the right bank road the traffic load measured on April 2015 was only about 41 pcu/hour on average at Hnget Gyi Thaik village (TC1) and 4.15 pcu/hour on average at Thayet Pin village (TC2). Results of traffic count are given in ***Appendix 5C***.

- **Estimates of Traffic Loads**

A traffic load is expressed as the number of truck trips per hour. It will depend on the total quantity of materials that will need to be transported into and out of the construction site. The traffic load related to the transport of materials into the dam construction site will be much higher than the traffic loads related to the construction of transmission line. The assessment of construction impacts on local traffic is therefore focused only on the dam construction.

According to data on civil works construction materials in the Feasibility Study Report, as shown in ***Table 6.4.3-3***. Traffic load for construction materials transportation has been estimated based on the following assumptions:

- Rock and concrete aggregate will be used as fill material for rock-fill and river protection works.
- Estimated weight of aggregate rock volume 1 m^3 = 1,500 kg
- Estimated weight of fine rock volume 1 m^3 = 1,200 kg
- Estimated weight of concrete volume 1 m^3 = 1,400 kg
- Sand will be used as fill material for embankment dam.
- Estimated weight of sand volume 1 m^3 = 1,500 kg
- The fill works and concrete works will be about 4 months in Phase I, 3 months in Phase II and 3 months in Phase III, about 10 month (300 days) in total.
- Trucks will transport fill materials to the site 10 hours per day.
- Capacity of a dump truck = 20 tonnes

TABLE 6.4.3-3

CIVIL WORKS CONSTRUCTION MATERIALS FOR DEEDOKE HPP

Item	Description	Unit	Quantities
1	**Open Excavation**		
1.1	Clear ground - strip vegetation	m^2	50'000
1.2	Dam foundation	m^3	302'500
1.3	Dam foundation rock	m^3	247'500
2	**Fill works**		
2.1	Right embankment	m^3	12'100
2.2	Left embankment	m^3	34'500
2.3	Rip-rap protection	m^3	10'000
2.4	Preparation of foundation	m^2	37'500
3	**Concrete Works**		
3.0	Mass concrete for spillway base	m^2	58'000
3.1	Structural concrete high demands for spillway structure	m^3	11'125
3.2	Structural concrete high demands for powerhouse	m^3	88'700
3.3	Structural concrete for tailrace	m^3	12'000
3.4	Instrumentation		
4	**Drill and grout foundations**	**m**	
4.1	Grout curtain spillway	m	4'200
4.2	Consolidation grouting spillway	m	4'750
4.3	Grout curtain power house	m	1'500
4.4	Consolidation grouting power house	m	4'500
5	**Embankment cofferdams by**		
5.1	Excavation and fill	m^3	550'000
6	**Roads and bridges**		
6.1	Upgrade existing roads		
6.2	Construction road	m	600
6.3	Permanent access road incl.	m	700
6.4	Construction bridge	m	210
7	**site intsllation**		
7.1	Site offices and installations	ls	-
7.2	Sanitary installation		-
7.3	Communication		-
7.4	Power connection		-
7.5	Miscellaneous		
8	**Lateral dams at reservoir**		
8.1	Fill works	m^3	30'000
8.2	Construction road	m	500

Volume of construction materials for fill works of Deedoke HPP is estimated as follows;

1) Sand for fill works, embankment cofferdam and lateral dam is 802,000 m^3 (1,203,000 tonnes) during month 23^{th}-25^{th} and 36^{th}-38^{th};
2) Aggregate rock for fill works and concrete work is 178,500 m^3 (267,750 tonnes);
3) Fine sand for concrete work is 85,800 m^3 (128,700 tonnes);
4) Cement for concrete work is 66,600 tonnes;
5) Reinforced steel bar for concrete work is 22,950 tonnes.

Total volume of construction materials for fill works is about 1,689,000 ton (1,203,000 + 267,750 + 128,700 + 66,600 + 22,950).

Based on the above data, the total number of truck trips will be about 84,450 trips = 1,689,000/20. The traffic load will be about 282 trips per day or 28 trips/hr. Additional traffic volumes during project construction period is equal to 140 pcu/hr (28x2.5x2), when PCE for heavy truck is 2.5 and calculated per round-trip.

It is then clear that the traffic loads related by the fill works and concrete will be not much greater than existing traffic load of small vehicles. Therefore, the traffic impacts will be negligible during construction period.

(2) Proposed Mitigation Measures

Mitigation measures will be proposed to improve road safety rather than to improve traffic flow. The measures are included in the EMP.

6.4.3.5 Water Use and Water Supply

(1) Pre-Construction and Construction Phase

a. Potential Impacts

During the construction phase, social impacts of the Project on water use and water supply will be caused by: (i) exclusion of river water use at the construction site; and (ii) increased turbidity during project construction. The affected villages will be Hnget Gyi Thaik village and Warnet village.

b. Proposed Mitigation Measures

The river water should be pumped and distributed to the affected villages throughout the construction phase.

c. Residual Impacts

There should be no residual impacts if the river water is adequately distributed to the affected villages.

The impact on water use and water supply is evaluated as follows:

Impact category	Direct impact from the construction
Impact duration	Throughout the construction phase
Impact extent	2 villages, about 1,084 people
Impact magnitude	Small
Impact severity	Minor, residual impacts should be acceptable
Control priority	Low

The issue of impact on water use and water supply should receive low control priority.

d. Proposed Monitoring

The river water pumping and distribution program should be closely monitored. Details will be presented in the EMP.

(2) Operation Phase

a. Potential Impacts

During the operation phase, the increased water depth in the river section between Yeywa Dam and Deedoke Dam will make it more convenient for villagers to use the river water compared to the situation before the Project. Only people in Hnget Gyi Thaik village that will not be able to go down the slope embankments for a distance of about 250 m upstream and downstream of the dam.

b. Proposed Mitigation Measures

The design of embankment on both banks should have steps to facilitate walking down to the river.

c. Residual Impacts

There should be no residual impacts if the step walkways are provided on the embankment.

The impact on water use and water supply for the operation phase is evaluated as follows:

Impact category	Direct impact from the operation
Impact duration	Throughout the operation phase
Impact extent	Hnget Gyi Thaik village, about 317 people
Impact magnitude	Small
Impact severity	Minor, residual impacts should be acceptable
Control priority	Low

The issue of impact on water use and water supply for the operation phase should receive low control priority.

d. Proposed Monitoring

No monitoring will be required apart from maintenance of the step walkways.

6.4.3.6 Transportation

Road is the only transport system in the project area. Socio-economic impact of the Project on the local road is included in ***Section 6.4.3.4***.

6.4.3.7 Public Health

1) Construction Phase

A. Potential Impact

Construction Phase

The influx of 300 workers during the 4.5 years construction period could have both positive and negative impacts on the local communities as follows:

- **Creation of Demand for Local Goods and Services:** The influx of workers will create demands for local goods and services, such as foods, handicrafts, and personal services. These demands would be met locally and would create business opportunities to local people. This impact is therefore positive in nature.
- **Competing Use of Local Resources:** The influx of workers could compete with the locals for limited local resources such as foods, water, health service, and infrastructure services. This competition could have impacts on the locals such as increased food prices, and inconveniences in using infrastructure.
- **Health Risks:** Without proper management, the influx of workers could pose health risks to the communities. Communicable diseases such as sexually transmitted diseases, TB, hepatitis and pneumonia could be areas of concern. An increase of dengue fever, malaria, severe diarrhea is expected. Common cold and flu caused by probably new strains are very well possible, as well as respiratory tract diseases. Non-communicable diseases, among adults and the elders, stress and hypertension are common. Moreover, the construction activity will create noise and air pollution and will impact to villager which the major effects such as nuisance and stress, allergy, eye irrigation, respiratory tract infection and asthma;
- **Conflicts with Locals:** Workers from other areas, including foreign workers, could have conflicts with locals due to differences in culture, value and ways of life.
- **Accidents and Injuries:** An increase in the number of cars and motorcycles will cause the incidence of vehicle accidents and other injuries to rise, which will be a burden of health services and families.

The presence of Deedoke Hydroelectric Power Project will directly cause an influx of outside workers who will bring new diseases affecting community health and the community may also contract endemic diseases. The most serious threats to long-term health status in the project area are Sexual Transmitted Diseases (STD), malaria and dengue fever will occur. Moreover, influx of worker will create social tension to the community health such as violence and anxiety will be increased. The relatively low level of health services, limitation of medical and medical care unit will increase the risk.

B. Mitigation Measures

- Vigorous public relations and health education programs shall be launched. The programs should cover positive impacts such as economic benefit, better income, work opportunity, and improvement of standard of living. Local people shall be well informed about possible negative consequences like the possible spread of STD, dengue fever and malaria;
- Strengthening of health services. Local or village health stations, health centers or dispensaries shall be established particularly for drug kits distribution. Sufficient number of health personnel shall be employed, trained and supported to provide sufficient and effective health care. Besides, community health volunteers and traditional healers shall be recruited and trained and provide primary care for communities;
- Community efforts. Strong community efforts shall be organized with full support from local authorities and health facilities. Activities are to be focused on water supply and sanitation, environmental sanitation, solid waste disposal, sanitary toilet, fly and insect control and housing sanitation.
- Communicable diseases. There should be close surveillance on STD, dengue fever, malaria, influenza, diarrhea, dysentery and hepatitis. Case detection and distribution should be thoroughly studied and adequate treatment provided. Full course of immunization for infants and young children must be assured.
- Regular routine checks of vehicles, improvement of road conditions and traffic signs, and educating drivers and pedestrians will decrease the incidence of accidents and injuries. Traffic and drinking regulation with project staff should be strictly reinforced.

2) Operation Phase

A. Potential Impact

Accidents and Injuries: Generally, the economic status of the villagers will be better and many cars and other vehicles will be seen on the roads with undisciplined drivers. The ensuing wide range of injuries and disabilities will be a burden for the health services. Deaths from traffic accidents will increase.

B. Mitigation Measures

- Local district hospitals, local health stations should be adequately equipped and personnel trained to handle emerging health hazards and problems such as accidents. Collaboration with health facilities in Pyin Oo Lwin and Kyaukse Townships should be established and strengthened, an effective referral system should be established;
- Accidents and injuries. Many cars and motorcycles caused the incidence of vehicle accidents and other injuries will be on the rising trend and be the burden of health services and families. Regular routine checks of vehicles, improvement of road conditions and traffic signs, and educating drivers and pedestrians will decrease the incidence of accidents and injuries. Traffic and drinking laws should be strictly reinforced.

6.4.3.8 Occupational Health and Safety

This section, discussion turns to the specific issue of the work force employed in the dam and power house construction and operation. While some of these workers may be recruited locally, it is assumed that most will be temporary migrants from outside the community and that they will leave at the end of the construction phase.

1) Construction Phase

A. Potential Impact

The influx of 300 workers during the 4.5 years construction period could have the impacts as follows:

- **Health Risks:** Without proper management, Communicable diseases such as sexually transmitted diseases, TB and hepatitis could be areas of concern. Non-communicable diseases such as asthma and allergy can be founded.
- **Accidents and injuries:** Work accidents and injuries will be predominant especially among the untrained group. Injuries from blunt instruments (tools), cuts and wounds, falling, as well as eye irritation and burns are common. When protective devices are not adequately or properly used, the incidences will be high level. Beside unsafe vehicular transport, poor road conditions and inadequate traffic signs may be expected to a greater degree, which will in turn lead to more vehicle accidents and injuries.
- **Psycho-social disorder:** Being away from home and family, workers easily precipitate to more alcoholic drinking, smoking and substance abuse. Violence and social disturbances are frequently encountered.

B. Mitigation Measures

The contractor will need to design and implement an effective program for control of communicable diseases among the workers. Such program should include:

- Health screening of job applicants before employment;
- Periodic health examination or health surveillance program of workers for early detection of communicable diseases;
- Onsite health clinic and referral system;
- Survey, investigate and document all disease outbreaks within the workforce. Consultation should be available and should be followed the epidemiologic approach;
- Any suspected case of Sexually Transmitted Diseases (STD) should be adequately treated and followed up with practical health education;
- Provide appropriate information and health education to the workforce on prevention of diseases, including, malaria, diarrhea and food poisoning;
- Conduct safety training courses and rehearsals for the workers, to prevent and reduce work accidents;
- Provide adequate material and equipment used in construction activities in order to increase effective working and decrease the risk of causing accidents or injuries;
- Prepare and enforce the wearing of safety protection equipment or devices to prevent accidents or reduce their severity, such as eye glasses (goggles), safety shoes, ear muffs, safety belts, protective clothing and helmets with regular inspection;

- Implement regular surveillance and inspection on occupational hazard, equipment and protective devices;
- Regular routine checks of vehicles, improvement of road conditions and traffic signs, and educating drivers will decrease the incidence of accidents and injuries. Traffic and drinking regulation with project staff should be strictly reinforced.

2) Operation Phase

A. Potential Impact

Although the numbers of dam-related personnel during this period may be limited, the related health problems and work hazards still remain. The common problems are occupational hazards, injuries, accidents and ergonomic risks.

B. Mitigation Measures

- Health promotion and health education focusing on health behavior like smoking and alcohol drinking
- Regularly conduct health check-ups and analyses to forecast and prevent possible health problems and damages among particularly high-risk groups such as new workers, the elderly or diseased employees;
- Regular training, supervision, checking and support concerning protective device use and machine or equipment functioning and maintenance;
- Implementation of good and fair compensation plan and assurance.

6.4.3.9 Worker Camp Sanitation

1) Construction Phase

A. Potential Impact

The project construction will take about 4.5 years to complete and will use about 300 workers. The workers will be hired by the contractor and subcontractors. It is expected that most of the workers will be recruited from villages in the project area and beyond. Most skilled technicians and professionals would come from the country of origin of the contractor and subcontractors. It is expected that the workers will be accommodated in a camp. Inadequate space and facilities and inadequate management of the worker camp could have such impacts as: (i) unhygienic living conditions with implications on health of workers; (ii) pollution or contamination of the natural environment outside the worker camp, such as fly infestation, water pollution, and odor; and (iii) exposure of workers on accidental risks or worker safety.

B. Mitigation Measures

The design, operation, and management of worker camp is the responsibility of the main contractor and subcontractors. Therefore, the Project Proponent will ensure that the construction contract will cause the main contractor and subcontractors to meet all requirements of the design, operation, and management of the worker camp. The requirements for the worker camp should be as follows:

- Basic camp infrastructure will include:
  - Power supply: The supply will be sufficient to ensure normal living and working supply for critical aspects.

– Water supply: The source of supply will be ground water taken from a deep well to be bored within the site. A water storage tank with 100 m^3 capacity will be provided as part of the water supply system.

– Drinking water: Clean drinking water will be provided in small tanks.

– Drainage: Drainage in the worker camp area will be adequate to ensure no water pools in the area.

– Sanitation: Wastewater will be drained separate from the storm drainage system to a wastewater treatment plant.

– Solid wastes: Solid wastes bins will be provided at various locations, such as canteen and sleeping quarter. A solid waste collection system will need to be established to ensure daily hauling of all domestic solid wastes to the disposal site.

- Set up waste collection system in the construction camps and coordinate with local authority to dispose such waste properly.
- Prepare garbage bins or containers with covers for garbage collection at the workers' camp sites and construction area. Also, inform concern local authorities or sub-contractor that gets permission from government section to collect and dispose garbage.
- Solid waste disposal procedures will comply with solid waste management regulations, as well as any additional disposal facility requirements.
- Separate each type of wastes and collected solid waste in appropriate and safety container for recycling where facilities are available. Any surplus to the recycling activity will be disposed of at an approved waste disposal site.
- Prohibit dumping waste in watercourse.
- Hazardous wastes will be collected and disposed of in accordance with the appropriate regulatory requirements.
- Prohibit burning waste in construction area and worker camp site
- The worker camps should be made of decent materials that could withstand heavy rains and storms. The worker camps should be adequately ventilated and lighted;
- Workers' camp site shall consist of living facilities with housing, canteen, sanitary facilities for all workers accommodated within the camp.
- Camp sanitation facilities should be provided and inspected.
- The number of toilets and baths should be 1 unit for 15 workers;
- A common canteen should be planned to accommodate for 300 persons and shall be equipped with mosquito nets and screens;
- Common areas for cloth washing and drying should be provided with adequate water supply and drainage;
- Fly, insect and rodent control needs to be strictly implemented in integration with solid waste collection;
- Ventilation of buildings within the camp areas shall be in accordance with Applicable Laws and Standards;
- Fire and safety plan for the camps should be prepared. Fire extinguishers need to be provided in each camp. Clear fire escape routes should be clearly marked with no obstructions. Workers will need to be informed on fire safety arrangements;
- Adequate measures for mosquito control, including dengue fever control;

- Health awareness training for the workers on hygiene and sanitation, good housekeeping practices, communicable and infectious diseases including an STD awareness program.
- Medical and first aid facilities shall be provided at camp site. Workers should be trained how to use them; and
- Providing emergency treatment and first aid for major accident/injuries and also emergency patient transfer.
- Train and educate staff in EMP/EIA requirements and conditions. Training is to be carried out in the three main areas;
- General environmental awareness, including rules and regulations to be followed on construction sites and workers' camp.
- Job-specific training for workers with responsibility for high risk activities that could have adverse impacts on the environment and humans.

2) Operation Phase

In the operation phase, the worker camp will be moved out from the project area since it is no activity and any impact for this phase.

6.4.3.10 Agriculture

Considering the nature of this Project, social impacts related to agriculture will be confined to agriculture in the land to be acquired by the Project and the river bank agriculture. The Project will have no impacts on nearby agricultural land apart from that already indicated. Therefore, the impacts under this heading are captured under loss of livelihood in ***Section 6.4.3.2***.

6.5 RISK ASSESSMENT

6.5.1 Context of the Qualitative Risk Assessment

6.5.1.1 Concept and Definition of Environmental Risk

In most documents on environmental risk assessment, an environmental risk is narrowly defined to focus on a hazard from an environmental event which could affect receptors through an environmental pathway. For example:

- **Environmental event**: disposal of toxic and hazardous wastes on land causing soil contamination which could pollute groundwater
- **Environmental pathway**: groundwater
- **Consequences on receptors**: health impacts on communities nearby the disposal site that rely on groundwater for domestic use and consumption

In these environmental risk assessment documents, impacts could be easily confused with risks if the risk context is not clearly established. In the above example, if toxic and hazardous wastes are not properly disposed of in the site, soil will be contaminated and pollutants could reach the aquifer. If the disposal site is on the aquifer used by the communities, it is certain that the groundwater will be polluted causing adverse consequences on the communities. In this respect, groundwater pollution is certain and the issue needs to be investigated in the context of EIA not in the context of environmental risk assessment. On the contrary, if the wastes are properly disposed in engineered landfill, there still is a concern that the liner may possibly leak. **This concern is a risk** that should be investigated in the context of environmental risk management and will have to be managed to minimize the possibility of leak.

The Consultant considers environmental risk within the context and framework of project risk management as environmental risk is one of several categories of project risks, such as technical risk, financial risk, legal risk, and market risk. Environmental risk will need to be managed. as part of project risk management which is an integral part of project management, during the project construction phase and the project operational phase in parallel with other categories of project risks.

A project risk is variously defined in risk management documents but all definitions share three key words: ***event, likelihood of occurrence of the event, and consequence of the event, if occurred, on the project.*** The Consultant defines a project risk in general as:

"A project risk is an undesirable event which may or may not occur, but if it occurs it will have negative consequences on the achievement of project objectives."

In investigating environmental risk of this Project, the Consultant, based on the above definition of a project risk, treats an environmental risk as:

"an event which may or may not occur, but if it occurs it will have negative consequences on the achievement of the Project's environmental management objectives, i.e. compliance with environmental performance requirements prescribed by MONREC and other authorities, and as agreed or committed with the stakeholders, particularly the surrounding communities."

6.5.1.2 Objectives of Environmental Risk Assessment

In line with the objectives of EIA, the objectives of environmental risk assessment (ERA) are to: (i) identify and assess environmental risks during the construction and operational phases of the Project; and (ii) prepare an environmental risk management plan (ERMP) for the Project covering the construction phase (CERMP) and the operational phase (OERMP). The ERMP will be part of the project risk management plan (PRMP) to be implemented as part of project management.

6.5.2 Methodology

The methodology or the process for environmental risk management (ERM) planning is similar in principle to the project risk management planning process, and the planning process for the construction phase is similar to that for the operational phase. The project risk management planning is different from the environmental risk management planning only in the scope and risk management context.

The ERM planning process adopted for this Project, in general, consists of the following steps:

(1) Establish the Environmental Risk Management Context

The establishment of environmental risk management context is to gain a clear understanding of the following subjects: (i) project management arrangements, especially project risk management; (ii) arrangements for environmental management of the Project during the construction phase; (iii) responsibilities of contractors, project owner, project management team, and supervision consultants; and (iv) linkage between environmental risk management and project risk management, and between environmental risk management and environmental management.

Information on the Project implementation and its environmental impacts will be the basis for forming judgmental views on the potential uncertain events which constitute risks, likelihood of occurrence of the events, and their impacts on the environmental management objectives of the Project.

(2) Risk Identification

Risk identification is to identify various concerns related to possible events that, if occur, could result in the Project being unable to comply with environmental requirements prescribed by MONREC and other authorities and as agreed or committed with the key stakeholders. Such events would consist of external events and internal events.

(3) Risk Analysis

In this step, each identified event will be analyzed to come up with a rational conclusion on its likelihood of occurrence (high medium, low), its impacts on the achievement of the Project's environmental management objectives and direct and indirect on-site and off-site costs, and causative factors related to the occurrence of the event.

(4) Risk Classification

The results of risk analysis are used to prepare a risk classification matrix based on the likelihood of occurrence and the magnitude of impact. ***Figure 6.5.2-1*** shows an example of a simple risk classification matrix[4]. In this example, risks are classified into minor, moderate and major risks.

- Minor risks are characterized by low impact and low likelihood of occurrence. Minor risks can be accepted or ignored.
- Moderate risks are characterized by high impact and low likelihood of occurrence or by low impact and high likelihood of occurrence. Moderate risks will need treatment.
- Major risks are characterized by high impact and high likelihood of occurrence. Major risks will need close attention of the management and significant levels of treatment.

A risk profile should be prepared for each risk to be managed. The risk profile should include:

- A description of the risk;
- Potential cause of the risk;
- Likelihood of the risk occurring;

4 Modified from the matrix in NASA Risk Management Presentation - Imsworld.org www.imsworld.org/.../NASA%20risk%20managemnt%20power%20poin...

- Potential effect or consequences of the risk;
- Ranking or severity of the risk;
- The evaluation of the acceptability of the risk.

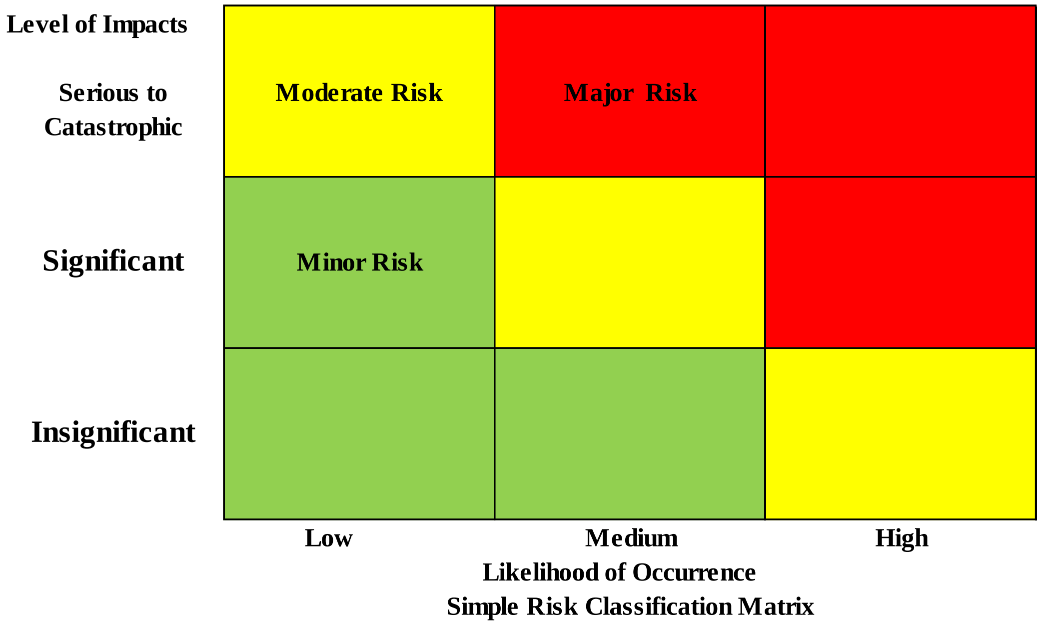


FIGURE 6.5.2-1 : SIMPLE RISK CLASSIFICATION MATRIX

(5) Formulation of Cost Effective Risk Treatment or Mitigation Measures

For a risk related to uncontrollable external event, such as a major earthquake, risk mitigation measures will either aim at protection or minimizing the impacts or both. For example, a risk mitigation for earthquake in this Project is to incorporate required safety measures in the dam design and to prepare an emergency plan for implementation should the earthquake is stronger than the design earthquake.

For a risk related to internal event, the risk mitigation measure to be adopted could be designed to reduce the likelihood of occurrence, reduce consequences if the event occurs; avoid the event by not taking actions that have risks; and transfer the risk. A minor risk would be accepted if the mitigation measure is not financially justified. Designing a cost effective mitigation measure needs to consider the root cause of the event constituting the risk.

(6) Arrangements for Implementing and Managing the Risk Mitigation Measures

This step will propose arrangements for implementing the proposed risk mitigation measures, including: (i) responsible person for each risk; (ii) organization for environmental risk management; (iii) risk monitoring and evaluation; and (iv) reporting and corrective actions.

The environmental risk management plan(ERMP) will need to be linked with the environmental management plan (EMP) as well as the project risk management plan to ensure that any dependencies or potential resource conflicts between project and environmental management tasks and environmental risk mitigation are identified and resolved. Managing environmental risk is essentially an element of project risk management. For example, the individual environmental risks will need to be included in the project risk registration process.

Where appropriate, the ERMP should also be linked to other business plans within the power plant management entity such as the corporate risk management plan.

6.5.3 Environmental Risk Assessment-Pre-Construction and Construction Phase

6.5.3.1 Environmental Risk Management Context

For this Project, the Contractors would be contractually responsible for: (i) preparation of detailed designs and specifications of all equipment and facilities; (ii) procurement and construction; and (iii) testing and commissioning the dam and hydropower plant and associated facilities before handling over to the Project Proponent. The environmental performance requirements of the Project construction and operation will need to be adequately incorporated in the designs, specifications, and construction. All environmental mitigation measures recommended in this Final EIA Report and accepted by the Project Proponent and MONREC will be implemented by the Contractors and his subcontractors under the supervision of construction supervision consultants of the Project Proponent. Monitoring of environmental performance of the Contractors will be carried out by the Project Management Team of the Project Proponent.

Environmental risk management during project construction will be carried out by the Project Management Team as part of the overall project risk management. Environmental risk mitigation measures will be implemented by the project management team within the scope of and procedures for project risk management.

6.5.3.2 Risk Identification

During the construction phase, two uncertain events or two environmental risks would be of concern to the Project Proponent:

1) The Project may not be able to comply with environmental requirements prescribed by MONREC or other concerned authorities.
2) The Project may be opposed to by stakeholders, especially the nearby communities.

6.5.3.3 Risk Analysis

The two identified risk events could be caused by the following:

A. Failure to comply with the environmental requirements

Consequences:

- The authorities may order the Project to suspend the construction or in the worst case they may revoke the construction permit.
- Public complaints could be filed against the Project and could lead to litigations.
- Bad publicity to the Project

- Physical damages or body damages on-site or off-site with cost to be incurred by the Project

Underlying Causes:

- the Contractors and subcontractor have inadequate understanding of the environmental performance requirements of the Project
- the Contractors and subcontractor unintentionally omit the environmental requirements due to ambiguity of the environmental requirements in the contract
- inadequate supervision and monitoring of environmental mitigation activities of the Contractors and subcontractors
- changes in designs or construction methods without revising the originally proposed mitigation measures
- changes in the environmental requirements during the construction without the revision of the originally proposed mitigation measures

Likelihood of Occurrence

The likelihood of occurrence of minor incompliance with environmental management requirements would be medium.

B. Public opposition to the Project

Consequences

- The Project could be delayed.
- Public complaints could be filed against the Project and could lead to litigations, or bad publicity to the Project
- The authorities may order the Project to suspend the construction or in the worst case they may revoke the construction permit.

Underlying Causes:

- misunderstanding or misinformed of the nature, severity and extent of impacts of the Project
- rough relationship between the Project and the surrounding communities
- most of the affected people are not satisfied with the compensation for losses of land, properties, or livelihood.

Likelihood of Occurrence

The likelihood of occurrence of this risk will be low if the affected people are fairly compensated, the Project Management Team maintains good relation with the surrounding communities, representatives of the communities participate in project monitoring, and grievance redress process is effective.

6.5.3.4 Risk Classification

Figure 6.5.3-1 shows a risk matrix for the construction phase.

Risk A is considered moderate risk as it would have a medium level of likelihood of occurrence and a significant level of impacts.

Risk B is considered minor risk as it would have a low level of likelihood of occurrence and a high level of impacts.

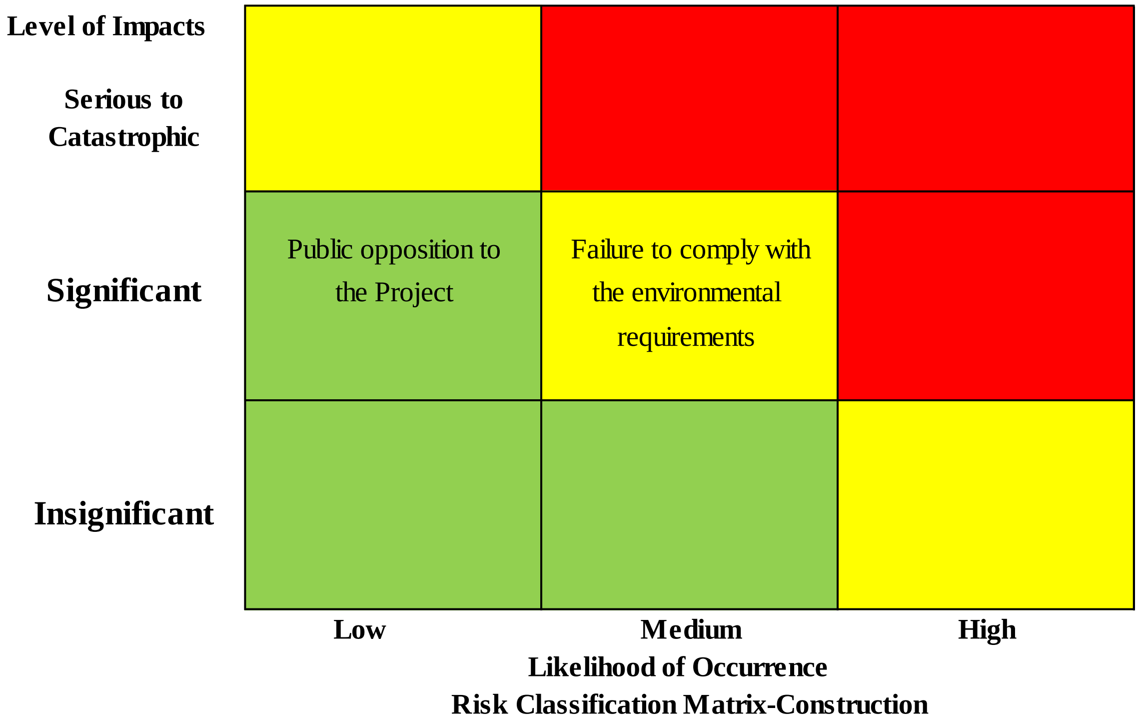


FIGURE 6.5.3-1 : RISK MATRIX FOR THE CONSTRUCTION PHASE

6.5.3.5 Risk Mitigation Measures

Risk mitigation measures need to address the identified causes of the risk. Mitigation measures for the two identified risks correspond to the identified causes are presented in ***Table 6.5.3-1***. The measures will be implemented through contractual arrangements and stakeholder engagement.

TABLE 6.5.3-1
MITIGATION MEASURES FOR ENVIRONMENTAL RISK MANAGEMENT DURING CONSTRUCTION PHASE

Cause	Mitigation Measures
EPC contractor and subcontractor have inadequate understanding of the environmental performance requirements of the Project.	1.Require the Contractors to: --prepare a CEMP based on the EIA report and the associated CEMP, detailed design and construction plan and schedule. The CEMP must clearly define: --the Project's environmental requirements and obligations --physical measures that are needed to comply with the requirements and obligations --construction measures that are needed to comply with the requirements and obligations --assignment of responsibilities to each subcontractors 2. Require the Contractors to clearly incorporate environmental requirements and mitigation measures in the Project Understanding, the Statement of Criteria, and the Basis of Designs-these three documents would be required by the Project Proponent as part of the design risk management.
Ambiguity of environmental requirements in the Contract.	1. TOR for procurement of the Contract must clearly state the Project's environmental requirements during the construcion phase that the Contractors must ensure that the Project construction will meet the requirements. 2. The Contract must clearly prescribes environmental management responsiblity of the Contractors.
Inadequate supervision and monitoring of environmental mitigation activities of the Contractors and subcontractors.	1. The supervision consultant will be required to submit a supervision and monitoring plan that clearly indicates the environmental tasks to be supervised and monitored. This supervision and monitoring plan for the implementation of the environmental mitigation measures would be part of an overall project supervision and monitoring plan. 2. Weekly and monthly reviews of the Contractors environmental performance. 3. Close supervision of truck operations especially during the site filling period.
Changes in designs or construction methods without revising the originally proposed mitigation measures accordingly.	Changes in designs or construction methods may be initiated by the Contractors or the Project Proponent. The request for changes must be subject to the change procedure in project management. The request for changes must be accomodated by an analysis of environmental implications and revised mitigation measures.
Changes in the environmental requirements during the construction without revising the originally proposed mitigation measures.	Changes in the environmental requirements may be initiated by MONREC or the Project Proponent with approval of MONREC. The changes must be subject to the change procedure in project management. The Contractors will analyse environmental implications of the changes and revise the originally proposed mitigation measures accordingly.
Misunderstanding or misinformed of the nature, severity and extent of impacts of the Project.	1. Pay attention to the clarity and adequacy of the information on impacts of the Project using non-technical language that could be easily understood by villagers. Information in audio visual forms should also be prepared. 2. Design an effective public information program to ensure the intended information reaches the target groups. 3. Ensure that the tripartite committee (proposed in the CEMP has a clear understanding of the Project's impacts). 4. Organize a study tour to other similar power plants in Myanmar or some neighbouring.
Rough relationship between the Project and the surrounding communities	1. Establish a village development fund in consultation with the Electricity Board. Representatives of the villages should participate in the management of the fund. 2. CSR activities should be initiated as soon as possible in the construction phase. 3. The Project management team should visit as often as possible the villages located within the area of influence of the Project.

6.5.3.6 Implementation Arrangements

A. Responsible Persons and Organization

Environmental risk management needs to be an integral element of environmental management of the Project. Therefore, the organization for environmental management proposed in the CEMP will also implement the environmental risk mitigation measures in cooperation with the construction supervision manager.

B. Risk Monitoring and Evaluation

Risk monitoring involves periodic monitoring of risk triggers. A risk trigger is an event which could lead to the occurrence of the risk event. For example, a risk trigger for a flood risk is the intensity and frequency of rain falls in the catchment area. The rainfall data will be analyzed to evaluate the likelihood of occurrence of the flood.

Risk monitoring and evaluation in environmental risk management will be carried out as part of the environmental monitoring program for environmental management. Some data could serve both risk monitoring and environmental monitoring.

Failure to comply with the environmental requirements

The monitoring and evaluation should cover the following risk triggers:

- inadequacies of the CEMP prepared by the Contractors and the timeliness in correcting deficiencies in the CEMP found by the Project Management Team;
- trend of the Contractors and subcontractors not conform with the construction requirements related to the CEMP;
- response of the Contractors to the instructions of the supervision engineers and the EHS manager regarding the implementation of environmental impact mitigation measures and monitoring of the environmental management performance.

Public opposition to the Project

The monitoring and evaluation should cover the following risk triggers:

- trend of public complaints-the increasing trend would suggest the increasing likelihood of occurrence of the risk event; and
- monthly surveys of public views and opinions on the Project-the frequency of surveys would be reduced if the public opinions are positive.

C. Reporting and Corrective Actions.

The process for reporting and corrective actions in environmental management will also be applied to the environmental risk management.

6.5.4 Environmental Risk Management-Operational Phase

6.5.4.1 Environmental Risk Management Context

During the operational phase, the hydropower plant operational team will routinely implement, as part of the hydropower plant operations, all environmental mitigation measures recommended in this Final EIA Report and accepted by the Project Proponent and MONREC. It is essential that the environmental performance requirements of the operational phase will need to be adequately incorporated in the designs, specifications, and construction. Monitoring of the environmental performance of the hydropower plant operation will be carried out by the power plant team as discussed in the OEMP section in Volume II EMP.

Environmental risk management during the operational phase will be carried out by the EHS unit as part of the overall hydropower plant risk management. The environmental risk mitigation measures will be implemented by the hydropower plant management team within the scope of and procedures for the hydropower plant risk management.

6.5.4.2 Risk Identification

During the operational phases, the major risk of this hydropower project will be the concern on dam failure as expressed by some villagers in one of the public consultation meetings. Other environmental risks would be related to concerns on the quality of water discharged from the dam, and the actual river water levels upstream of the dam could be significantly higher than the calculated levels, thereby increasing the inundation along some river sections upstream of the dam.

6.5.4.3 Risk Analysis

A. Dam Failure

Consequences

As the dam is the run-of-river dam, it will store only about 23 million m^3 above the normal water level (see Section 6.3.5). In case of the dam failure, most of the flood water would be contained within the downstream river channel. However, the flash flood may overflow low lying sections downstream of the dam. The flood duration would be short and the flood levels would not be excessive. The flood would not cause extensive damages to properties and would not endanger people living along the banks downstream of the dam. Nevertheless, a detailed flood study should be carried out during the construction period to determine the flood problem in case of the Deedok dam's failure and also the Yeywa dam's failure. As Yeywa dam is a high storage dam, its failure could cause major impacts downstream compared to the Deedok dam.

Underlying Causes

The failure of the Project dam may be caused by catastrophic earthquakes in the region exceeding the level 8 in Richter scale, or by serious design and construction omissions and/or deficiencies.

Likelihood of Occurrence

The likelihood of occurrence of the dam failure will be extremely low if: (i) design specifications and technical performance requirements of the dam are clearly prescribed in the design, especially the design earthquake which needs to be above existing earthquake level; (ii) strict design quality control; and (iii) strict construction quality control.

B. Water Quality

Consequences

If the water discharged from the dam is of poor quality, the downstream water users and aquatic ecosystems will be adversely affected.

Underlying Causes

Water released from the dam could be polluted only by wastewater from industries or large communities located upstream or decaying submerged vegetation.

Likelihood of Occurrence

Considering the nature and design of the Project, it is extremely unlikely that industries and large communities will be established upstream of the dam in the distant future. The backwater effect of the dam will not flood vegetated areas beyond the river banks apart from vegetation along the river banks. Therefore, the upstream reach would have insignificant quantities of submerged and decayed vegetation after the dam is completed. It can be concluded that the likelihood will be low for the water discharged from the dam to have poorer quality than the existing condition.

C. **Backwater Levels Higher than the Calculated Levels**

Consequences

If the actual backwater levels turn to be significantly higher than the calculated levels, some low lying areas along the river banks upstream of the dam could be flooded. However, the flood would be confined to short distances from the river banks due to topographical conditions along the river banks. The flood could cause loss of some agricultural land.

Underlying Causes

This concern could be caused by calculation errors or incorrect basic data used in the calculations.

Likelihood of Occurrence

The hydraulic design and calculations presented in the feasibility study report are thorough and based on reliable data. Therefore, the likelihood would be low for the actual backwater levels to be significantly higher than the calculated levels.

6.5.4.4 Risk Classification

A simple risk matrix for the operational phase is shown in ***Figure 6.5.4-1***. All the three risks are classified as minor risks.

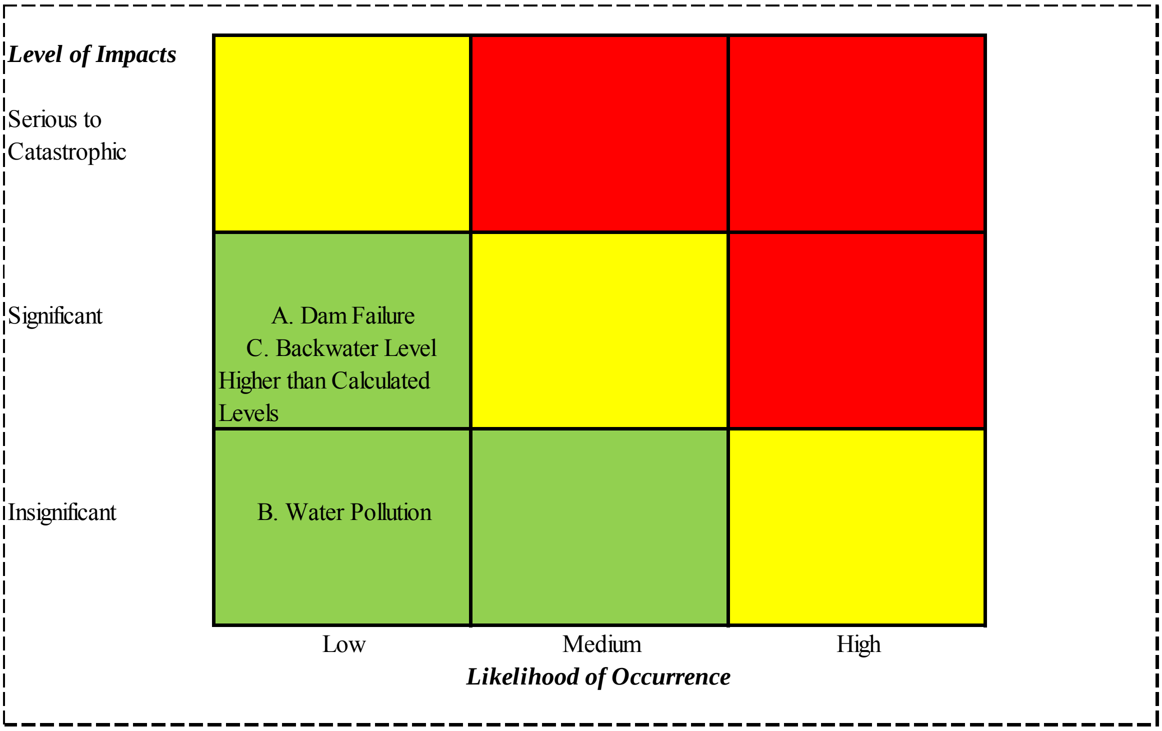


FIGURE 6.5.4-1 : RISK CLASSIFICATION MATRIX-OPERATIONAL PHASE

6.5.4.5 Risk Mitigation Measures

A. Dam Failure

Measures for managing the dam failure risk will need to be taken in the design and construction of the dam. The following risk mitigation measures are proposed:

1) The Project Proponent will design the dam and spillway with their appurtenances in comply with the internationally recognized design standards and guidelines.
2) The Project Proponent should select qualified and experienced Contractors with good track records. The Contractors will ensure that the construction methodology, selection of equipment, installation and construction of the dam and its appurtenances will follow the internationally recognized guidelines and standards for dam design and construction such as those issued by the Mekong River Commission (MRC).
3) The Project Proponent will be required to clearly incorporate operational risk management requirements, including dam failure, and designs of mitigation measures in the Project Understanding, the Statement of Criteria, and the Basis of Designs-these three documents should be required by the Project Proponent as part of the design risk management.
4) A safety review of the design, proposed equipment, and methods of installation and construction should be conducted by the Project Management Team of the Project Proponent. An independent dam engineer should be engaged for such review.
5) The Project Proponent will prepare a detailed dam safety surveillance and monitoring plan (DSSMP) for operations, inspection, and maintenance of the dam after its commissioning. The DSSMP will need to be based on established and internationally accepted good practices.

6) Conduct a detailed flood study in case of two dam failure scenarios-(i) only the Deedok dam fails; and (ii) both the Deedok dam and Yeywa dam fail. The flood study will prepare inundation maps and calculate flood durations for the two dam failure scenarios. Such a scenario will be consulted and agreed with MOEE who is the owner of Yeywa and responsible for electric supply in the nation.
7) Prepare an emergency response plan to cope with the flood problems under the two scenarios. The emergency response plan should clearly outline actions to be taken related to flood warning, evacuation, relieve operations, rehabilitation, compensation procedure, implementation arrangements, and budget.

B. Water Pollution

The Project Proponent will, as part of the contract, require the Contractors to ensure removal of all vegetation on the upstream river banks below the design flood level.

In addition, the Project Proponent should request the concerned regional authorities to prohibit industrial use of land along the upstream river banks.

C. Backwater Effects

Risk management measures for the backwater effects will be focused on design review and data verification. The Project Proponent will be required to take the following actions:

1) Review to verify the method of calculation of the backwater effects and the data used in the calculations. Should the updated calculated backwater levels be significantly higher than the levels reported in the feasibility study report, the Project Proponent should review the dam design.
2) Verify the level profiles of the two upstream river banks. Should the updated levels be significantly lower than the levels established in the feasibility study report, the Project Proponent should review the dam design.
3) The design operating level of the dam will need to be reviewed and revised as appropriate subject to the findings of 1) and 2) above.

6.5.4.6 Implementation Arrangements

A. **Responsible Persons and Organization**

Environmental risk management during the operational phase will need to be an integral element of environmental management and risk management and operations of the dam and hydropower plant. Therefore, the organization for environmental management proposed in the OEMP will also be responsible for environmental risk management.

However, the proposed measures for managing the dam failure risks will also need to be implemented by the Project Management Team during the design and construction phase.

The dam and hydropower plant management organization should have a risk management committee to be chaired by the General Manager and participated by the dam operational manager and the EHS manager. Other members of the safety management committee would be head of various units of sections of the dam and hydropower plant. The risk management committee will be focused on dam safety and general work and public safety. The risk management committee will consistently review and evaluate the dam monitoring reports, and recommend necessary improvements of the work procedures to ensure the risks are minimized or avoided.

B. Risk Monitoring and Evaluation

Risk monitoring and evaluation during the operational phase will be focused on dam safety and will follow prescribed activities and review process presented in the DSSMP.

C. Reporting and Corrective Actions.

The process for reporting and corrective actions in environmental management will also be applied to the environmental risk management. The main concern will be on dam safety. The dam safety monitoring results will be reviewed by the risk management committee for taking corrective actions.

C H A P T E R 7

CUMULATIVE IMPACT ASSESSMENT

CHAPTER 7

CUMULATIVE IMPACT ASSESSMENT

7.1 CONCEPTUAL FRAMEWORK FOR CUMULATIVE IMPACT ASSESSMENT FOR THIS PROJECT

The EIA Procesure requires an EIA investigation to consider cumulative impact (Article 53).

Numerous definitions of cumulative impacts (CIA) or effects exist with slight differences in meaning. The EIA Procedure gives the following definition of cumulative impacts:

> Cumulative impacts can be defined as "*the impact or impacts of a project that in itself or themselves may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse projects or undertakings in the same geographic area or region.*"

In general, cumulative impacts can be defined as

"the changes to the environment caused by a proposed project in combination with other past, present, and reasonably foreseeable projects or human activities".

It should be noted that baseline environmental quality of the EIA study area, such as baseline ambient air quality, is the results of existing economic activities and projects already in operations. Therefore, the impacts of this Project discussed in ***Chapter 6*** are actually cumulative impacts of the Project and other existing economic activities or projects in the study area. For example, the predicted noise level caused by the Project is the incremental increase in the noise level. The impact is the net noise level i.e. ambient noise level and the predicted increase in noise level. ***Figure 7.1-1*** illustrates the cumulative impact of the Project and other existing economic activities.

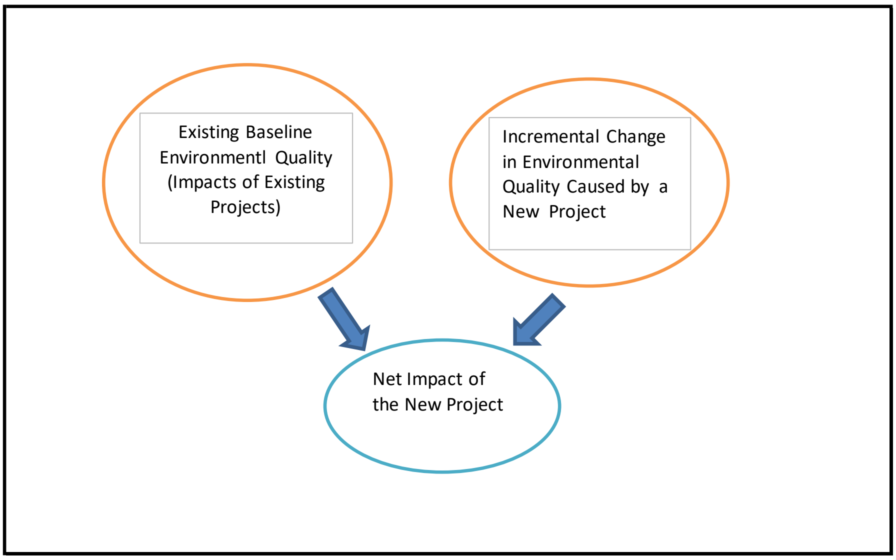


FIGURE 7.1-1 : CUMULATIVE IMPACT OF NEW PROJECT AND EXISTING PROJECTS

The development of multiple hydropower projects within a watershed can severely degrade the riverine ecosystem and cause significant adverse impacts on river resource users, primarily by altering river water, sediment and biodiversity flow (daily and seasonal) and segmenting rivers with dams and weir that may impair human navigation as well as passage of sediments and native biota (e.g. fish, macro-invertebrates and mammals). In addition, the social dimensions of hydropower are well known and potentially involve economic and physical displacement of people, impact on local people's access to natural, religious or cultural resources essential to their livelihoods, worships and sustainability of traditions.

Cumulative Impact Assessment is the process of analyzing the potential impacts and risks of existing and proposed projects in the context of the potential impacts of other human activities and natural environmental and social external drivers on the chosen valued ecosystem components (VECs) over time. VECs that are likely to be relevant to hydropower projects comprise:-

- Air Quality and noise;
- Affected peoples, resettlement and livelihoods;
- Cultural and ethnic archeology and heritage;
- Erosion and sedimentation process;
- Fish and aquatic habitats;
- Important agricultural and forest areas;
- Terrestrial habitat (protected areas and critical habitats);
- Water quality and quantity

Examples of cumulative impacts that could be attributed to a set of hydropower projects include:

a) Effects on ambient conditions such as the incremental contribution of air pollutant and noise level in the air shed.

b) Increase in pollutant concentrations in a water body through both construction and operation of the hydropower projects.

c) Alteration of water flow in a watershed due to multiple reservoirs.

d) Increase in sediment loads/ erosion.

e) Impacts on flora and terrestrial fauna.

f) Impacts on fish and aquatic habitat.

g) Secondary, consequential or induced social impacts, such as in-migration, from construction workers into the project areas.

7.2 NEED FOR CUMULATIVE IMPACT ASSESSMENT FOR THIS PROJECT

There are 1 dam in operation, 1 dam under construction and 3 planned dams on the Myitnge (Doktawady, Namtu) River.

The existing dam in operation is the Yeywa dam which is currently the largest dam in Myanmar. The dam under construction is the upper Yeywa dam. The 3 being planned dams are namely Deedoke dam, Middle Yeywa dam and Namtu dam (***Figure 7.2-1*** presents location of existing and planned dams on the Myitnge River). These dams will form a cascade along the river, turning the fast flowing river into large stretches of still reservoirs (***Table 7.2-1*** presents a list of the existing and planned dams on the Myitnge River from downstream to upstream).

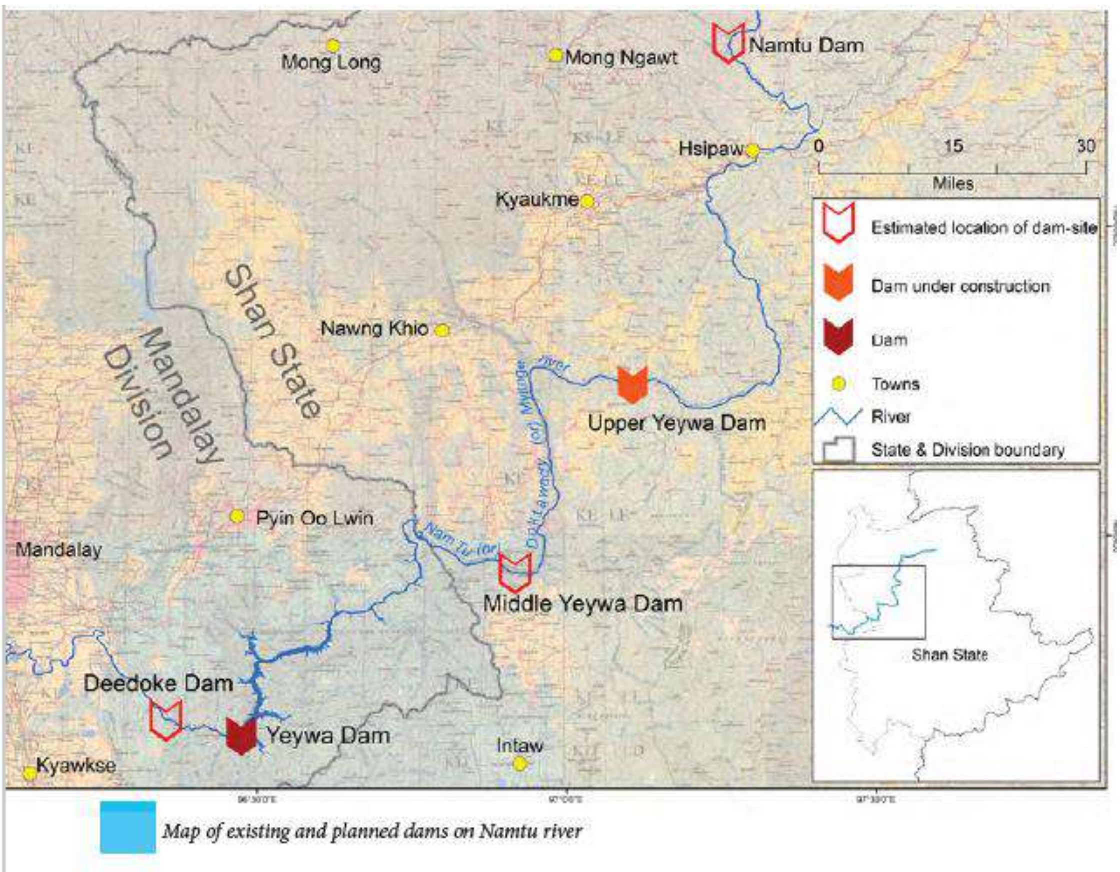


FIGURE 7.2-1 : LOCATIONS OF EXISTING AND PLANNED DAMS ON MYITNGE RIVER

These 5 dams are the whole dams constructed and likely to be constructed on the Myitnge River since construction of a new hydropower project downstream of Deedoke dam site would be unlikely due to topographical constraint and construction of a new hydropower project between Yeywa dam and Deedoke dam site would also be unlikely for the same reason.

TABLE 7.2-1

A LIST OF THE EXISTING AND PLANNED DAMS ON THE MYITNGE RIVER

Name/ Type of Dam	Location	Installed Capacity	Status	Directly Impacted Communities
Deedoke/ Run-of-the-river dam	Kyaukse, Mandalay (21.1 km downstream of Yeywa dam)	66 MW	MOU signed in Nov 2014	Hnget Gyi Thaik, Thayetpin, Ma Gyi Inn, Gwebin, Pein, Yeywa and Kyaungywa
Yeywa/ Conventional dam	Kyaukse, Mandalay (21.1 km upstream of Deedoke dam)	790 MW	Operation since 2010	3 villages relocated with 1,000 years old Sappa Sukha Htattaw Pagoda submerged
Middle Yeywa/ Conventional dam	Nawng Khio, Shan State	700 MW	Pre-feasibility study underway	Unknown
Upper Yeywa (Kyaukme)/ Conventional dam	1.5 miles from Taung Che village, Kyaukme Township (65.19 km upstream of Middle Yeywa dam site)	280 MW or 380 MW	23.62% completed (in October 2015)	Ta Long village and some areas along the riverbank in Hsipaw Town
Namtu/ Conventional dam	Hsipaw, Shan State (128.65 km upstream of Upper Yeywa dam site)	100 MW	MOU signed; road construction to the dam site underway	unknown

The precise assessment of cumulative impacts of existing and planned dams on the Myitnge River would not possible at this stage due to the lack of crucial information of each project such as project components, the proposed construction method, details of construction and operational equipment to be used for all projects, the precise location of works to be undertaken for each project, detailed description of social and economic impacts of each project, propose safeguards and mitigation measures to deal with relevant impacts of the projects, etc.

7.3 CUMULATIVE IMPACT ASSESSMENT FOR EXISTING AND PLANNED DAMS ON THE MYITNGE RIVER

Despite the lack of crucial information for precise assessment the cumulative impacts of existing and planned dams on the Myitnge River can be conceptually described as follows:-

(a) The incremental contribution of air pollutant and noise emissions in the air shed during construction phase:

Given that the sites of Deedoke dam, Yeywa dam, Middle Yeywa dam, Upper Yeywa dam and Namtu dam are forest area and rural communities where air quality is likely to be high and the level of noise is relatively benign the cumulative impact in term of effects on ambient air and noise condition can be negligible.

(b) Increases in pollutant concentrations in the Myitnge River:

Pollution in the Myitnge River could occur as a result of organic and nutrient wastewater discharge from existing riparian communities, agricultural land and project construction workers camp sites.

Cumulative impact during operation phase can be considered in terms of upstream discharge of substances including sediment, nutrients, organic matters and toxic substances. These pollutants would accumulate in the reservoirs, particular at the front of the dams. The organic matters in the sediment would undergo an anaerobic reaction, causing carbon dioxide, methane, hydrogen sulfide, etc. The accumulation of nutrients can also lead to eutrophication in some areas wherever the condition is suitable for such phenomena.

These situation would be possibly serious for the upper 4 dams which are conventional storage dams but not for Deedoke dam. As Deedoke HPP is a run-of-river scheme, it is believed that the pollutant concentration would be minor issue since during Deedoke HPP operation about 80% of sediment will be sluiced naturally through the turbines or/and 7 gates would be opened, this would allow the majority of the bed load to move through the gates and then, pollutant concentration would decrease.

(c) Alteration of water flow

The major hydrological impact of conventional hydropower dam is to impose on the river an unnatural pattern of flow variation. Pattern of downstream flows are short-term daily or even hourly fluctuations in river levels, sometimes of as much as several meters, due to releases to meet peak demands for power. Increases in demand for power from the upper 4 conventional storage dams can cause the downstream water level to rise by many meters in just half an hour. Areas to be affected from water fluctuations are the river sections downstream of Yeywa dam, Middle Yeywa dam, Upper Yeywa dam and Namtu dam.

Flow alterations could have numerous ecological consequences. Rapid water level fluctuations speed up erosion downstream and can wash away the trees, shrubs and grass along its banks. Without the riparian vegetation to hold it in place, the bank then erodes even faster.

For Deedoke HPP context, the project receives the water from Yeywa dam and all received water will be discharged downstream. Being a run-of-river project, Deedoke HPP would generate energy using flows that are directly available from Yeywa dam located upstream. The retention time of flows in the small head pond is in the order of 2-4 hours and there no necessity to store water for later use.

(d) Increases in Sediment Load / Erosion

During construction of the dams, the major cumulative impact is from construction activities. Construction of each project will take about 5 years including land preparation and construction of main dam, coffer dam, construction camps, office and living facilities, warehouses, E&M equipment assembly yard, auto and machinery repair workshop, machinery depot, concrete batching plant, quarry sites, disposal areas, etc. These construction activities involve clearing of the forest biomass within the proposed dam construction site and reservoir area, which would induce erosion and release sedimentation into the river.

During operation period, erosion and sediment can take place at the location where degraded forest exists.

Accumulation of sediment could take place in the reservoirs causing suspended solid dispersion in the downstream river to be lower than the existing natural condition, this might induce erosion and scouring effect in downstream sections of the dams. This situation would not occur for Deedoke HPP since approximately 80% of sediment would be sluiced naturally through the turbines, only a few portion of sediment would deposit in the headpond and there would be periodically opening of dam gates to allow the sediment move through and pass the dam site to downstream area.

(e) Impact on Flora and Terrestrial Fauna

The vegetation at and around the dam site and other construction areas would be destroyed by the construction activities and the plant population below the high water level of the pondage area would be lost. The destruction of the vegetative cover affects the terrestrial fauna that depends on these habitats.

The construction of access roads, diversion and power tunnels and the dam can have negative impacts on biological environment, as existing habitat in and around these areas would be degraded to some extent.

The four conventional reservoir-type dams contribute to cumulative impact on flora and terrestrial fauna but for Deedoke HPP the situation is different. Deedoke HPP will be operated as run-of-river and therefore no significant changes in surface elevation of its pondage area are anticipated. The development of water dependent vegetation along the river banks, which may occur in hollows and depressions, is beneficial for water birds. This water dependent vegetation will serve as a nesting place and feeding area.

(f) Impact on Fish and Aquatic Habitat

Construction of dams would divide the river ecosystem causing separation of living organism upstream and downstream. It would impact the movement of living organisms that migrate for reproduction and spawning as part of their normal life cycle.

This situation might be serious in the upper sections of the Myitnge River in Shan State between Middle Yeywa, Upper Yeywa and Namtu dam sites where there are many kind of fish and villagers living along the river rely heavily on fishing in the river mostly in June and July.

For Deedoke HPP, currently there is no fish in the river at the project site due to an impact from Yeywa dam. However there would be fish between Yeywa dam and Deedoke dam when Deedoke HPP exists because the water level would be deeper.

(g) Social Impacts

Cumulative social impacts consist of positive and negative impacts.

Positive impacts are related to the improvement of basic social infrastructures and facilities such as roads, bridges, water and electricity supply system, education and health facilities, markets and other economic benefits like employment, etc.

Negative impacts are mainly concerned with compensation of lost assets and relocation and resettlement of directly affected people.

Yeywa HPP and Upper Yeywa HPP caused lost of a lot of land and properties including relocation of hundreds of households but Deedoke HPP would not much contribute to this cumulative social impact since it would not cause relocation of any households but cause only small scale of impact on agricultural land along the banks of the Myitnge River.

Conclusion

In summarize, for further assessment of CIA which need to be completed with involvement of all others hydropower development on the Myitnge River. Other sectors including forestry, road and transport, agriculture and mining which need to be stakeholder in CIA. Deedoke project will participate in CIA process.

Therefore, Deedoke project had submitted official letter to Department of Electricity Power Planning in order to inform that Deedoke project will participate in CIA process which may be initiated by DEPP in cooperation with other hydropower developers and existing hydropower stations on the Myitnge River to carry out CIA and cooperation in management of such impacts as presented in ***Appendix 7A***.

C H A P T E R 8

ENVIRONMENTAL MANAGEMENT PLANS

CHAPTER 8

ENVIRONMENTAL MANAGEMENT PLANS

For convenience in the use of EMPs during Project implementation and as prescribed in the EIA procedure 2015, the construction phase EMP and the operational phase EMP are presented in Volume 2 of this Final EIA Report. This Chapter presents the conceptual framework of EMPs and a summary of each EMP.

8.1 THE CONCEPTUAL FRAMEWORK

8.1.1 Scope of Environmental Management Plans

The results of EIA investigation will not lead to any results if they are not translated into two implementable environmental management plans (EMPs): one EMP for implementing in the construction phase of the Project and another EMP for implementing in the operational phase of the Project. Recognizing this fact, the EIA Procedure requires the Final EIA Report to include two environmental management plans - a construction phase environmental management plan (CEMP) and an operational phase environmental management plan (OEMP).

The two EMPs are defined in the EIA Procedure as follows:

Construction Phase EMP *means a detailed and comprehensive Environmental Management Plan (EMP) for the construction phase of a Project. Such plan shall present all relevant commitments, Emission Limit Values, Environmental Quality Standards and other environmental requirements and include a description of the construction works, present an overview of Adverse Impacts, present mitigation measures and monitoring programs together with time schedules, overview maps, images, aerial photos, satellite images, site layout plans, cross- sections, transects, environmental management and monitoring sub- plans for each construction site, thematic sub- plans, and management procedures as appropriate.*

Operational Phase EMP *means a detailed and comprehensive EMP for the operational phase of a Project. Such plan shall present all relevant commitments, Emission Limit Values, Environmental Quality Standards and other environmental requirements. The plan shall include a description of the Project operations, installations, and infrastructure, and shall present an overview of Adverse Impacts, present mitigation measures together with time schedules, overview maps, images, aerial photos, satellite images, site layout plans, cross- sections, transects, environmental management and monitoring sub-plans for each Project site, thematic sub-plans, and management procedures as appropriate.*

The above definitions make clear that the two EMPs required by MONREC will need to be comprehensive and have more details than very brief EMPs presented in EIA reports of the past. This requirement of MONREC is in line with current EIA practices in developed countries.

It should be noted that the two EMPs prepared as part of this EIA study are invariably framework plans as they are based on outline designs of the Project. They are therefore intended to provide framework and prescribe requirements for the preparation of detailed CEMP and OEMP by the appointed Contractors. Consequently, they could be considered and referred to as the Project Proponent's or Owner's EMPs to distinguish them from the Contractor's EMPs after the EIA during project implementation.

8.1.2 Application of the Owner-EMPs

The Project Proponent will require in the Contracts, the Contractors to prepare a detailed CEMP in due course before commencing the construction. The Contractor will use the Owner- CEMP as the basis for preparing a detailed Contractor-CEMP. The Contractor-CEMP will be based on the Contractor's final designs, construction methods, and construction schedule. The scope and content of the Contractor-CEMP will not be less than the scope and content of the Owner- CEMP. The Contractor-CEMP shall be contractually binding. During the construction, the Contractor will implement the Contractor-CEMP under the supervision of a Project Manager to be appointed by the Project Proponent.

As the Contractor will also be responsible for the design, supply, installation, testing, and commissioning of the hydropower system and its associated facilities, the Project Proponent will require in the Contract the Contractor to prepare a detailed Contractor-OEMP in due course before the commissioning. The Contractor will use the Owner- OEMP as the basis for preparing the Contractor-OEMP based on the actual construction and final operational procedures to be prepared by the Contractor. The Contractor-OEMP may need to be refined based on results of the commissioning. The Owner's Power Plant Operation Team will review and revise the Contractor-OEMP as appropriate to prepare the Final OEMP for implementation in the operational phase.

For clarity, the application of the Owner- EMPs as above described is shown as a diagram in ***Figure 8.1-1***.

8.1.3 Scope of Project Environmental Management

Environmental management during the construction and operational phases of the Project is based on the same basic principle of management known as the PDCA cycle (see ***Figure 8.1-2***). Environmental management in each project phase thus consists of four related tasks:

(i) Plan (P)-what need to be done to minimize the anticipated impacts;
(ii) Do (D)-implement the plan;
(iii) Check (C)-monitor and evaluate the results of implementation
(iv) Act (A)-taking corrective actions to improve the results, if found inadequate

Project Planning/ EIA Stage	Pre-construction Stage	Design and Construction Phase		Commercial O&M
		Construction	Commissioning	

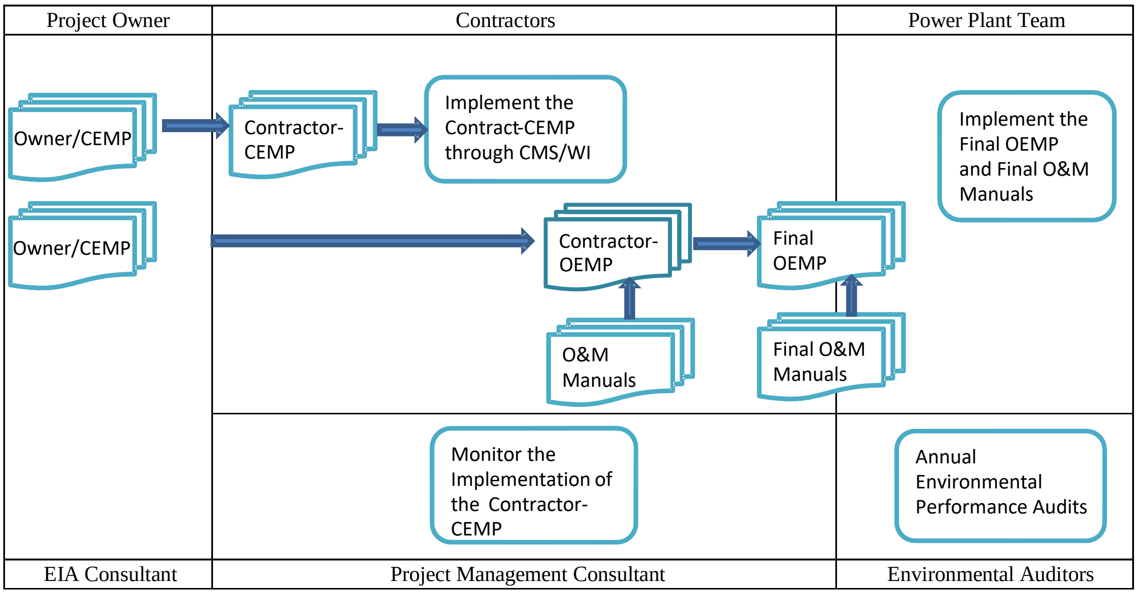


FIGURE 8.1-1 : APPLICATION OF THE EIA-EMP

FIGURE 8.1-2 : PDCA CYCLE FOR ENVIRONMENTAL MANAGEMENT

Therefore, the CEMP and OEMP will need to cover the following subjects: (i) mitigation measures to be implemented; (ii) arrangements for the implementation of mitigation measures; (iii) monitoring, evaluating and reporting of the implementation of mitigation measures to provide feedback information on whether the environmental performance deviates from the prescribed benchmarks; (iv) corrective actions process if the environmental performance below the benchmarks, environmental incident response, and emergency plan; (v) arrangements for operating the EMS, including organizational structure, responsibilities, documentation, training, communication, and management review; and (v) involvement of stakeholders or affected people in environmental management, including public grievance redress mechanism.

8.2 PROJECT'S EHS POLICY AND COMMITMENTS, AND LEGAL REQUIREMENTS

The Owner's EHS policy and commitments and legal requirements will set the levels and targets of environmental performance of the Project both during construction and operation.

8.2.1 Owner's Policy and Commitments

Environmental management of the Project will follow the EHS policy of the Project Proponent as stated in ***Section 3.1** of **Chapter 3*** as copied below for ready reference:

A. ANDRITZ HYDRO's Policy Statement :

Hydropower: Sustainable, renewable, and environmentally friendly

"We are strongly committed to the sustained protection of the environment, in parallel with economic growth and social progress. The tenet is meeting the needs of the present generation, without compromising the ability of future generations to meet their needs."

B. Operational Principles

Health and Safety Management

The integrated health and safety management is based on the following principles:

(1) Providing safe workplaces and working methods.

(2) Avoiding of hazards by technical measures (prevention).

(3) Reduction of negative implications by means of organization and personal measures.

Potential hazards at workplaces and construction sites are identified and evaluated. Preventive actions are applied according to the TOP-Principle: Technical before Organizational and Personal.

Environmental Management

The integrated environment management system is based on the following principles:

(1) Avoiding of negative environmental effects (prevention)

(2) Reduction of negative environmental impacts

(3) Recycling of materials and substances

(4) Disposal of unavoidable residuals.

In line with this policy, the Project will commit to the following:

During Construction: The Project will endeavor to minimize environmental impacts and meet all EHS requirements during the construction. This will be achieved through adopting designs, construction methods, construction management practices, and impact mitigation measures. The Project EHS performance will be measured and evaluated against applicable national or international standards and guidelines prescribed by MONREC or proposed in the CEMP.In addition, the Project will establish an environmental management system (EMS) for the Project construction.

During Operation: The Project will endeavor to minimize environmental impacts and meet all EHS requirements of the hydropower plant's operation and maintenance (O&M). This will be achieved through adopting: (i) best available technologies in the hydropower plant design and operation; and (ii) effective impact mitigation measures proposed in the EIA. The Project EHS performance will be measured and evaluated against applicable national or international standards and guidelines prescribed by MONREC or proposed in the OEMP. The Project will also establish an EMS specific for the power plant operation, which will follow principles and good practices in environmental management of power plants.

8.2.2 Legal Requirements

Environmental management of the Project will comply with legal requirements pertinent to the EMP prescribed in the draft Electricity Law 2013, the draft Environmental Conservation Rule 2013, and the 6th draft EIA Procedure 2014.

A. Electricity Law 2013

The draft Electricity Law 2013 aims at the development of the power sector in harmony with environmental conservation and development (Article 3 (a) and (f)). To realize this, the draft Electricity Law 2013 authorizes the relevant ministry to conduct EIA, implement the activities with minimal environment impact, compensate for the negative impacts and provide funds for environmental conservation in accordance with the Environmental Conservation Law (Article 10 (b)). It requires the permit holders of the electricity businesses to abide by the current rules, regulations, orders and directives of the relevant ministry in implementing the electricity works (Article 20). Therefore, the draft Electricity Law supports the Environmental Conservation Law, its rule and the related EIA Procedure.

B. Environmental Conservation Rules 2013

Chapter IX, Articles 41 to 46 prescribes the tasks regarding waste management under the control of MONREC and the Environmental Conservation Department. Waste management covers hazardous wastes, solid wastes, wastewater and emissions.

C. EIA Procedure 2014 (6th draft as of 27/10/2014)

Articles in the EIA Procedure relevant to the preparation and implementation of the EMPs are summarized in ***Table 8.2-1***. Preparation and implementation of the two EMPs will need to comply with relevant articles in the table.

TABLE 8.2-1

CONTENT OF THE EIA PROCEDURE RELEVANT TO THE EMPs

Subject	Relevant Articles
Content of the EMPs	60
Project Approval Requirements	
- Issuance of an ECC	67
- Conditions of the ECC	77, 78, 80, 81, 82, 83, 84, 86, 87, 88
- Submission of an CEMP and OEMP	82, 84
Revision and updating the EMPs	84, 87, 88, 89
Implementing the EMPs	93, 94
Monitoring and Reporting	
- Responsibility for Monitoring	95, 96
- Content of Monitoring Report	98
- Submission of Monitoring Report	97
- Disclosure of Monitoring Report	99
- Inspection by MONREC	100-111

8.3 SUMMARY OF CEMP

The preconstruction and construction activities will cause some environmental disturbances which will be transient and will not have significant irreversible impacts. The identified environmental disturbances and mitigation measures are presented in ***Table 8.3-1***. The mitigation measures are well-established conventional measures. Details are presented in individual management plans under the Construction EMP.

8.4 SUMMARY OF OEMP

During operation of the hydropower plant, inundation of low lying areas along the river banks will be the only environmental and social impacts. ***Table 8.4-1*** presents brief information on the impacts and mitigation measures.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES

Environmental and Social Issue	Impacts	Mitigation Measures
Air Quality	Increases in air pollutants caused by fugitive dust from rock blasting, site excavation, quarrying operation and emissions from operation of trucks and heavy construction equipment.	***Fugitive Dust Control*** • At all the construction sites, measures should be implemented to reduce fugitive dust emission. The most common measures are: • Spray water at and around the construction areas and access roads during site preparation and grading. • Enforce a speed limit for vehicles and trucks in the construction sites not to exceed 40 km/hr. Construction activities shall be kept as planned so that the disturbed areas will be minimized at any time. • Restore, resurface, and rehabilitate the disturbed areas as soon as practicable after completion of construction or disturbance • Prohibit the open burning of waste in the construction area • Dust masks should be provided (where applicable) to all construction workers. • Ensure all loose earth and similar material spilled or otherwise deposited within the construction sites and the transport routes is cleared and removed from trafficked areas as soon as practicable. • At the construction sites and spoil placement sites, monitor meteorological conditions, particularly wind speed and direction and where necessary take measures to avoid impacts of dust on adjacent properties. Such measures may include: ➢ Modification of construction methods; ➢ Increase in dust suppression measures; or ➢ Cessation of work when no other reasonable or practical measure is available.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Air Quality (Cont'd)		***Diesel Exhaust Emissions*** • The Contractor will be required to adopt best practices to minimize gaseous emissions at sources through the following measures: ➢ Adopt procedures to avoid construction vehicles idling for excessive periods (e.g. more than 5 minutes) if required to queue to enter the construction sites; ➢ Maintain all construction equipment in proper working conditions according to the manufacturer's specifications. The engines of the construction equipment fleet must be routinely maintained by qualified mechanics to ensure their proper conditions during operations. ➢ Provide adequate training to the equipment operators in the proper use of equipment. ➢ Use the proper size of equipment for the job. ➢ Use the equipment fitted engines with latest low emission technologies (repowered engines, electric drive trains). For example, the diesel generator set to be used must be equipped with modern pollution control equipment. ➢ Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines). ➢ Encourage and provide carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Noise	Increase ambient noise level at the construction site, quarry site and communities near the material transport routes.	• Major construction activities which generate loud noise should be limited to only during the day time. Activities that are necessary to be carried out at night time will need approval of the site engineers, and will need to have adequate noise control equipment or measures. • Speeds of vehicles in the construction site will not be more than 40 km/hr. • Noise performance requirements of construction equipment will need to be clearly stated in contract specifications. • Temporary sound barriers or shielding should be installed for non-mobile equipment. • The Contractors will be required to regularly monitor ambient noise levels at the receptors, particularly during the noise generation period such as piling. • The construction environmental management plan will need to include an efficient complaints redress procedure and an efficient corrective action procedure to address the non-compliance of noise performance
Vibration	Increase vibration at the construction site, quarry site and communities near the material transport routes.	• Contractor will prepare a blasting plan to reduce ground vibration and air pressure to the acceptable levels. The blasting plan will be reviewed for approval by the supervision engineers of the Project Proponent.
Topography, Geology and Seismology	To minimize the landslide and slope failures caused by the earthwork excavation activities could damage the project properties, and pose a health risk to the construction workers.	• Perform detailed subsurface investigations to clearly identify any problem layers, and totally remove these zones during construction to prevent stability problems; if this is not possible, make improvements in these layers, • Design the appropriate slope for areas of high potential of sliding and align the direction of excavation or slope surface perpendicular or some degrees with major joints/fault zone,

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Topography, Geology and Seismology (Cont'd)		• Use slope design with a high safety factor to prevent sliding, • Where necessary, reservoir banks should be graded to reduce erosion and slumping potential, • Construction equipment used outside the reservoir zone should be of a type that will cause minimum damage to soils with low bearing capacity and soft rock layers underneath, • Install special devices to build up rock strength and to improve stability such as line concrete on excavated rock surface, insert rock bolts and rock anchors, restore vegetable, if necessary, • Perform groundwater monitoring program and use de-watering (drainage) holes if necessary.
Erosion and Sedimentation	Soil erosion occurs naturally depending on many factors among erosivity of the rain, erodibility of the soil, slope length and steepness, crop practice and conservation practice. Prior to construction, the factor (crop practice) on which soil erosion depends is increased, because the clearing of the construction would remove protective vegetative cover. It is anticipated that until the construction site is covered by all project's facilities or re-vegetation, soil loss would be greater than existing condition.	***General Mitigation Measures*** • Minimize the area of land clearance, and retain vegetation in riparian and other suitable locations to minimize erosion of the river banks; • Carefully monitor land clearance activities throughout the pre-construction phase to ensure that vegetation is not cleared beyond pre-defined project boundaries; • Install drainage control structures at suitable locations to divert clean runoff away from disturbed area; • Install settling ponds to avoid turbid water caused by construction activities to flow out to the river; • Cover spoil bank slopes by sodding with stockpiled topsoil, and rehabilitate a surface drainage system to keep slope stability and to avoid erosion; • Progressively do re-vegetation of disturbed area as soon as practicable, to facilitate long term stabilization;

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Erosion and Sedimentation (Cont'd)		• Regularly monitor suspended sediments and sedimentation rates at key locations upstream and downstream of project facilities, during construction, to confirm the extent of impacts and implement suitable management responses; and • Strictly implement the mitigation measures for solid waste management and surface water quality. ***Clearing of vegetation*** • The extent of areas to be cleared will be minimized as far as practical. • The use of existing cleared areas will be maximized. • Clearing of sites will be undertaken in the sequence that sites are required for construction. • Progressive revegetation of exposed areas will take place as soon as practical following completion of construction works in that area. Suitable species for revegetation will be used. • If construction works are temporarily stopped in an exposed area (for longer than 14 days), temporary stabilization of exposed surfaces will be undertaken. ***Exposed areas*** • All areas required to be disturbed will be clearly identified and the boundaries marked on the ground • Areas not required to be disturbed will be retained in their original condition. • Rip-rap, or similar, will be installed at the inlet and outlet of culvert, if necessary, to prevent scour erosion. • Retention of existing vegetation along watercourses will be maximized to reduce flow velocities and to minimize erosion. • 'Clean' runoff from undisturbed areas will be diverted away from the construction site and into established watercourses.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Erosion and Sedimentation (Cont'd)		• Runoff from disturbed areas will be directed into sediment trapping or filtering devices. • Silt fences or vegetative fences should be installed along the top of river banks to intercept any sediment migrating in runoff toward the river. • Sediment collection facilities such as a settling pond should be periodically cleaned up to keep its function. • Sediment collection devices will be sized to collect and treat run-off from the site as appropriate. • Turbidity of the water discharged from the settling pond will be periodically monitored, and function of the settling basin should be secured. • All discharge from sediment collection devices will pass through a vegetative or silt filter, prior to release to an established watercourse. • All erosion and sediment controls will be visually inspected at least once a week during the dry season and every 24 hours during the wet season to ensure their ongoing effectiveness. Any required remediative or replacement works will be undertaken within 24 hours of detection. • The results of the inspections will be recorded and reported to the Project Proponent. • At least one month prior to the anticipated commencement of the wet season, a review of the effectiveness and adequacy of the existing erosion and sediment controls will be made and any necessary modification and/or augmentation of controls carried out. ***Spoil disposal area establishment*** • Long term spoil placement sites will be managed in accordance with the Contractor's CESMMP.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Erosion and Sedimentation (Cont'd)		***Temporary stockpile establishment*** • Temporary topsoil stockpiles will be developed. • Silt fences or vegetative fences will be constructed downstream of stockpiles to control runoff where necessary ***Use of access roads by construction vehicles*** • Access to and within construction sites will be limited to designated access roads and internal haul roads.
Flood	Impact from flood is not major problem in construction phase but in operation phase; the impact mitigation device e.g. flood warning system has to be put in place since construction phase.	• (In construction phase) The Project Proponent will daily inform the Contractors of the river flow data available at the Yeywa Hydropower Plant. The Contractors should analyze the data and reflect it to their flood waning and countermeasures. Information of the flood warning will be delivered to the Project Proponent and the upstream and downstream communities. • (In operation phase) Installation of flood warning system. A flood warning system in case of critical flood is planned for warning to immediate upstream and downstream peoples and communities. The system will be designed in cooperation with the plant operator of the Yeywa Hydropower Plant and government authorities responsible for monitoring water levels and meteorological data within the Lower Myitnge River basin. The system will include the possibility to raise alarms via a public annunciation system.
Surface Water Quality	Increased turbidity of river water due to in-river construction activities and river bed excavation or dredging. Degradation of river water quality due to inappropriate management of construction wastes and domestic waste from site.	• Reduce the submerged biomass to the maximum extent by means of pre-impounding clearing • Minimize earth works as much as possible in direct contact with the river. • Install sedimentation ponds for drainage water from quarries and other construction • Vegetation removal should be limited only in the construction areas. • The site preparation activities, including land clearing and site filling and compaction, should be carried out during the dry season to avoid the problem of surface runoff with high turbidity discharging into the surrounding paddy field or nearby drainage channels, if exist.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Surface Water Quality (Cont'd)		• The power plant construction site should be surrounded by temporary fences to limit the amount of sediment that could be washed from the construction area during the raining time into the surrounding paddy field. • To prevent contamination of the surface runoff, potential contamination sources will be covered with roof. The surface runoff would contain only suspended solids washed out from the open area. • Construct a temporary drainage system to collect the surfaced runoff from the construction area to avoid the discharge of surface runoff into the surrounding paddy field. • The storm water will be collected and drained quickly to the river through a surface drainage system in the construction area to avoid an increase in erosion and sediment. • Toilet wastes will be discharged into a septic tank (or more than one septic tank) with a hydraulic retention time of about 5 days. The volume of toilet wastes is estimated at about 20% of the total volume of domestic wastewater, or about 7.6 m^3/d. The septic tank effluent (seepage) will be discharged into the retention pond. Alternatively, toilet wastes and grey water could be treated in a package sewage treatment plant. • Prevent truck cleaning, lorries, and other equipment used for preparing, transporting or applying concrete in the river.
Aquatic Ecology	Monitor the implementation of mitigation measure to ensure the minimum impacts on surface water quality and aquatic ecology.	• Use of best practice to avoid/minimize releasing sediment load into the river, e.g. using nylon screens to minimize sediment from steep slope releasing to the river.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
		• Using of illegal fishing gear anywhere along the river in construction area should be prohibited. • Waste water and contaminated water from construction areas and • Worker camp site must be treated before discharge to Myitnge River. • Survey of fish species composition in the project area in both upstream and downstream must be implemented. Furthermore, the effect on fish migration or some effects during construction phase on the fish spawning ground should have been studied. • Additional survey to identify the spawning and nursing ground in the tributaries upstream must be implemented. That are should be protected as the conservation area and fishery activity must be prohibited.
Material Storage Area	Best practice for material storage is the method to prevent the problem for material and equipment to the human and environment. Moreover, the method can minimize the source of impact to human and environment.	• Fuel oil and lubricants storage areas will be suitably bunded and constructed to minimize the potential for leaks • Spill containment equipment will be available at the unloading pad for use in the event of spillage • Ignition sources will be strictly controlled and limited to avoid a fire • Appropriate firefighting materials and equipment will be available to suppress fires • For solid waste, separate each type of wastes and collect solid waste in appropriate and safety container for recycling where facilities are available. Any surplus to the recycling activity will be disposed of at an approved waste disposal site. • Mobile equipment must be maintained, cleaned, and stored in the suitable warehouse with contain the roof, close container, or covered with tarpaulin to protected wind and rain.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
		• Storage of hazardous material will be in designated, clearly marked area, and far from the waters source. • Material Safety Data Sheets (MSDS) must be located in close proximity to all areas where hazardous materials are handled and inventory is to be made available to regulatory agencies upon request. • Domestic waste will be gathered and stored in closed containers to prevent the escape of windblown materials and will be clearly labeled as permitted waste. • Paper, steel and metal scrap, cardboard, wood and tires will be collected separately and offered for recycling where facilities are available. • Training and enforce the project staff to operate following to the regulation and plan.
Excavated Soil Disposal Site	More concentration of excavated soil without proper management may cause runoff problem during the rainy season, which can change the surface water quality of the surrounding water resources such as suspended solid. Therefore, the mitigation and monitoring for excavated soil is set to manage excavated soil, protect the runoff, prevent soil erosion problem, and minimize damage due to the spoilage of excavated soil.	• Set the temporary warehouse with including the roof for storage of the excavated soil and prevent runoff from the rainfall. • Choose and set the damping site or restoration for managing the remaining excavated soil. • Ensure maximum utilization of excavated soil for the construction purpose
Rock Dumping	Most of rock dumping areas are on mountain slope or in valleys which might face erosion problems caused by precipitation. Therefore, slope of rock	• Check security of rock dumping in each area by observing and monitoring. Local people will also be encouraged to take part in this issue and report to project staff.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
	dumping area must be effectively designed in the construction period. It is necessary to monitor the conditions of rock dumping area to ensure the safety of local people and to promptly take action to prevent any possible negative effects from local community.	
Borrow Pit	Borrow of land for construction pit is cause of loss of land area. Therefore, during construction period is needed to have the permission for constructing the pit and set the management system to reduce environmental impact.	• Borrowing will preferably start on areas which are not cultivated. • Land gradients and drainage are maintained. • Excavated rock or gravel shall not compromise river bed and banks, or impede in stream flows. • Confine activities must be approved locations. • Top soil layers shall be stored for reclamation and re-vegetation and reforestation at approved locations.
Camp Site	During pre-construction and construction activities, the other region worker will be required. The construction camp needs to be set up and can generate waste, which can make the effect to water, aquatic ecosystem, and the source of vector borne. Therefore, appropriate manage of camp site is needed to minimize any impact on water quality, aquatic ecosystem, and health.	***Surface Water Quality*** • Set up the appropriate sanitary toilet for workers and at least 150 m from the waterway. • Set up wastewater treatment system at every construction camp to meet water quality standard prior to discharge to receiving water body or retention pond. ***Solid Waste*** • Set up waste collection system in the construction camps and coordinate with local authority to dispose such waste properly. • Prepare garbage bins or containers with covers for garbage collection at the workers' campsites and construction area. Also, inform concern local authorities or

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
		sub-contractor that gets permission from government section to collect and dispose garbage. • Solid waste disposal procedures will comply with solid waste management regulations, as well as any additional disposal facility requirements.
Camp Site (Cont'd)		• Separate each type of wastes and collected solid waste in appropriate and safety container for recycling where facilities are available. Any surplus to the recycling activity will be disposed of at an approved waste disposal site. • Prohibit dumping waste in watercourse or wildlife habitat. • Hazardous wastes will be collected and disposed of in accordance with the appropriate regulatory requirements. • Prohibit burning waste in construction area and worker camp site. ***Personnel Health*** • Workers' camp site shall consist of living facilities with housing, canteen, sanitary facilities for all workers accommodated within the camp. • Ventilation of building within the camp area shall be in accordance with the Applicable Laws and Standards. • Canteen and residential quarter shall be equipped with mosquito net. • Camp sanitation facilities should be provided and inspected. • Fire-fighting equipment and portable fire extinguishers shall be provided for all building. • Train and educate staff in EMP/EIA requirements and conditions. Training is to be carried out in the three main areas; • General environmental awareness, including rules and regulations to be followed on construction sites and workers' camp.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
		• General health and safety awareness, including an AIDS/HIV and STD awareness program • Job-specific training for workers with responsibility for high risk activities that could have adverse impacts on the environment and humans.
Transportation	During the construction phase, the major impacts on the traffic will be due to the transportation of removal biomass waste removal, construction materials, construction workers, machinery and supplies for workers on the site. In addition, increase number of vehicles may increase impact on road damage and accident on passer and local villagers who locate near access road. In order to alleviate and mitigate the impacts on transportation route and traffic volume, management plan on transportation shall be developed and implemented.	• Inform concerned authorities of Pyin Oo Lwin and Kyaukse Townships, and local people about the project construction activities plan. • Strictly enforce drivers in following traffic regulations during transporting material, workers, and equipment during project construction. • The speed of truck should not exceed 40 km/hr. • Repair the damaged road surface where this caused by project transportation at least after finished site clearance and construction activities. This management should be cover in CSR program. • Cover material by canvas during transportation to prevent falling and spreading of material. • Provide sufficient traffic signs and easily observed signs to clearly indicate site construction zone. • In case of accident, the concerned sections must promptly follow the Construction Emergency Response Plan. • Test alcohol and drug use on drivers before transportation. • Avoid operation of trucks at night. • The used/operated truck should be checked annually. • Establish a vehicle washing facility to minimize the quantity of material deposition on public roads.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
		• Establish a checkpoint at the project gate to ensure the vehicles leaving the project site are following the measures prescribed to reduce dust emissions.
Water Use	The major impact during construction phase came from water requirement for workers and construction activities. In addition, the village related to project sites is lack of water for drinking and domestic consumption (especially in dry seasons, 3-5 months). Main water sources for both drinking and domestic use in all villages are shallow wells and collected rainwater. Therefore, setting and checking on management of water supply for worker and construction activities to minimize impacts in term of water use disturb to local people nearby project sites.	• Prepare sufficient and appropriate water tanks to collect water for worker consumption. • Prepare sufficient potable water for workers. • Avoid use of shallow well for worker consumption since it is main water source for nearby villages
Solid Waste	Solid waste will be generated from activities associated with the Project, the main types of solid waste include; solid waste from the construction workers and solid waste from the construction activities. Solid waste from construction workers are domestic waste such as garbage, glass, and food waste, etc. For the solid waste from the project activities is biomass from site clearance activities during pre-construction	• Prepare garbage bins or containers with covers for garbage collection at the workers' campsites and inform concerned local authorities or agencies that get permission from government section to collect and dispose garbage • Prohibit open burning wastes in worker campsite and project area. • The biomass wastes should be separated into usable timber and woods • The separated timbers and woods will be sold based on the concerned laws and regulations. • The unusable wastes will be disposed of a disposal area or landfill site to be selected by the contractor with approval of the concerned authority.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Solid Waste (Cont'd)	phase, and wood, scrap steel and metals, and erosion control materials during construction phases. The management of solid waste is very important. If not properly controlled and disposed of, waste can be unsightly and cause human health and safety concerns.	• For used oil and chemicals, they will collect at a temporary warehouse before sending back or disposed by contractors or inform concerned authorities to dispose used oil and chemicals. • Prepare garbage bins or containers with covers for garbage collection at the workers' campsites and construction area. Also, inform concern local authorities or sub-contractor that gets permission from government section to collect and dispose garbage. • Solid waste disposal procedures will comply with solid waste management regulations, as well as any additional disposal facility requirements. • Separate each type of wastes and collected solid waste in appropriate and safety container for recycling where facilities are available. Any surplus to the recycling activity will be disposed of at an approved waste disposal site. • Prohibit dumping waste in watercourse or wildlife habitat. • No construction materials or debris are allowed to become waterborne. Any materials/debris that enters the aquatic environment must be removed immediately and disposed of in an approved manner. • All temporary structures, piles, false works, debris, cofferdams etc. will be removed from the waterway upon completion of the work. • Hazardous wastes will be collected and disposed of in accordance with the appropriate regulatory requirements. • Prohibit burning waste in construction area and worker camp site.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Hazardous Materials	Hazardous material will be used for this project such as lubricant, oil, and hydraulic fluid. Hazardous materials are cause of adverse effect to both human health and environment. Therefore, the mitigation and monitoring plan are required for controlling use of hazardous materials and suitable management for hazardous wastes.	• Preparation of emergency plan for all material used or store onsite the plan will cover planning, response and training measure for various scenarios. • Hazardous materials use will only handle be by personnel who are trained and qualified in the handling of these materials and in accordance with the manufacturer's instructions and government regulations. • Storage of hazardous materials will be in a designated, clearly marked area, and be at least 30 m from any watercourse. • There will be no smoking within any hazardous materials storage area. • Disposal of hazardous materials will be in accordance with applicable regulations in effect at the time of disposal. • Maintenance and cleaning of mobile construction equipment will not be carried out near residential properties, on the dam, or within 30 m of any watercourse and with no potential for POL materials to enter the watercourses. • Material safety data sheets (MSDS) must be located in close proximity to all areas where hazardous materials are handled and inventory is to be made available to regulatory agencies upon request. • Personal Protection equipment must be prepared in the site. • Ensure all vehicles and heavy equipment are equipped with a spill kit for using in the accident situation. • All containers, hoses and nozzles will be free of leaks. All fuel nozzles will be equipped with functional automatic shut-offs. • Training all workers to follow to the emergency responsible plan.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Biomass Clearance	This project implementation cannot avoid logging activities due to the project must do clearance of the tree and vegetation for construction the dam site and access road. Therefore, the plan to control logging activities must be set to minimize the problem from logging activities.	• Project optimization to minimize vegetation losses and preserve forest • Logging activities must be doing only in the proposed project area • Logging and log selling process will be based on the concerned laws and regulations and conducted by concern authorities only • Restore the clearance area after complete construction phase • Set the compensation for paying to the agriculture area that getting impact from the project
Tree Species Transplanting	The development of Deedoke Project will be carried on within forest area where tree cutting cannot be avoided.	• Survey focuses on above near threatened tree species at the appropriate size. • Trees to be transplanted are marked with color tag.
Occupational Health	Occupational health problems, injuries, and accidents may occur during construction activities due to workers' carelessness, machinery malfunction, or inadequately training. Therefore, stringent management and monitoring programs are required to reduce these injuries, accidents, occupational health problems, and fire hazards.	• Inspection of a medical care unit, its screening and caring of important infectious diseases among workers, necessary services and records. • Inspection of machinery maintenance records, occupational health and safety records of workers. • Inspection of construction camp's sanitation and living conditions. • Inspection of accident prevention measures such as traffic sings, use of seat belts, alcohol consumption. • Screening among all dam workers and personnel by taking blood examination for malarial infection. Cases found must be radically treated. • Chest radiography for workers to detect tuberculosis should be conducted. And cases detected must be closely under surveillance and treated. • Single dose treatment for helminthic infection for all workers and families should be implemented.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Occupational Health (Cont'd)		• Any suspected case of sexually transmitted diseases (STD) should be adequately treated and followed-up with practical health education. • Conduct safety training courses and rehearsal for the workers, to prevent and reduce work accidents. • Controlling pests primarily through environmental methods. When environmental methods alone are not effective, the use of pesticides shall be considered. Information for proper use of pesticides should be also provided. • Adequate measures to address mosquito control, including dengue fever control. • Pesticides shall be handled, stored, disposed of, and applied according to acceptable standards accepted by the World Bank Operational Policy (OP) 4.09, Pesticide Management. • Ensure the continued safe disposal of all solid waste and sewage. • Implement fly, insect and other pest control at construction camp sites and in the project area. • Surveillance, investigate and document all disease outbreaks within the workforce. Using the epidemiologic approach. Consultation should be available. • The construction camps shall have an adequate supply of potable water compliant with WHO criteria and Applicable Laws. • Ventilation of buildings within the camp areas shall be in accordance with Applicable Laws and Standards. • Canteen and residential quarter shall be equipped with mosquito net and screen.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Occupational Health (Cont'd)		• Camp sanitation facilities should be provided and routinely inspected. Any occurrence of water-borne diseases should be epidemiological studied. Local and provincial health agencies are good sources for advice. • Implement regular surveillance and inspection on occupational hazard, equipment and protective device. • Minimize dust, noise, air pollutants by strictly implement the mitigation plans of air quality and noise. • Prepare and enforce the wearing of safety protection equipment or devices to prevent accident or reduce severity such as eye glasses, safety shoes, ear muffs, safety belts, protective clothing and helmets with regular inspection. • Provide adequate proper material and equipment used in construction activities in order to increase effective working and decrease the risk of causing accidents or injuries. • Provide appropriate information and health education to the workforce on prevention of diseases, including, malaria, diarrhea, food poisoning, STD, AIDS and tuberculosis. • Providing emergency treatment and first aid for major accident/injuries and also emergency patient transfer. An ambulance shall be also provided. Connection can extend to neighboring countries. • Effective public relations activities and social cooperation is necessary with special attention on community leaders and young adults. • Recording of water-borne diseases, accident, dengue fever, malaria, STD, tuberculosis, and violence should be done and analyses for future prevention or reduction.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Community Health	The extent of the three health programs proposed for the Deedoke project are summarized in the table below. The three programs are integrated however will be implemented by different parties whose responsibilities will be further defined closer to detailed design stage when contracting arrangements are better defined.	At this stage, Deedoke project proposes the Community Health Management Program will consist broadly of: • constructing alternative domestic water sources for households and villages who lost their existing sources • monitoring and surveillance of vector population possibly affected by the water levels • monitoring and surveillance of nutrition status • development of outbreak preparedness
Construction Supporting Structures Dismantling		• Site Decommissioning • Decommissioning Hazardous Material & Removal • Hazardous Waste Management & Decommissioning • Non Hazardous Solid Waste Management & Removal • Sanitary & Septic Waste Management & Removal • Concrete Batching & Cleaning • Site Cleaning and Maintenance Operations
Chance Find	Although no significant archaeological sites have been identified in the project concerned areas, it is possible that during site clearance, earth moving, quarrying and excavation for construction of foundation of dam and power house archaeological objects or archaeological deposits be discovered and damaged.	• Ensure that all construction workers receive a Physical Cultural Resource awareness program upon arrival at site. Training will include identification of Physical Cultural Resource and their responsibility in terms of the Chance Find Procedure for Physical Cultural Resource. • Construction workers will be informed of the rules of not stealing or trading historic artifacts • Include in the code of conduct a rule about not buying or trading physical cultural objects.

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Compensation	To reduce the social impacts on villagers in the affected villages in the construction area and related facilities area and along the transmission line.	***Compensation Principle and Policy*** **Compensation** is defined by ADB[1] as "Money or payment in kind to which the people affected are entitled in order to replace the lost asset, resource or income". Compensation is also defined similarly by IFC[2] as "Payment in cash or in kind for an asset or a resource that is acquired or affected by a project at the time the asset needs to be replaced". This RAP adopts a general principle that the people affected will not be worse off compared to the pre-project level. Based on this principle and ADB's safeguard policy guidelines, the following compensation policy is recommended: • **For Group 1-PAPs:** who will permanently lose part of their land and crops for construction of hydropower components, the Project will provide adequate cash compensation at full replacement cost for the lost land and crops prior to construction. • **For Group 2-PAPs:** who will lose part of their land which is under contour 80 m (a.s.l.) due to inundation during project operation, the Project will provide cash compensation for the loss of land. • **For Group 3-PAPs**: who will permanently lose land and crops due to installation of transmission line support towers. Direct compensation in cash to individual PAPs in Group 3 will be provided. • **For Groups 4-**PAPs: who own the land under transmission line with in 22.5-meter right-of-way and their right on land use will be limited i.e., they cannot build house or plant perennial tree with height greater than 3 meters. Cash will be paid to PAPs to compensate for the limited right on land utilization.

[1] ADB Handbook on Resettlement (1998)
[2] IFC Handbook for Preparing a Resettlement Action Plan

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Compensation (Cont'd)		***Eligibility*** Eligibility will be determined using two criteria: cut-off date and possession of Land Use Right Certificates (LURCs). **Cut-off Date:** The cut-off date has not yet been determined. The cut-off date should be the date at which the PAPs are officially informed of the intention of the Government to acquire their land. The PAPs will be informed of the cut-off date. Any people who use or settle in the land area to be acquired for the Project after the cut-off date will not be entitled to compensation and/or assistance under the RAP. **LURCs:** The eligibility for compensation to PAPs in Group 1, Group 2 and Group 3 for land loss will be determined by the possession of LURCs or a claim that is recognizable under national laws. Persons who do not have LURCs or any recognizable claims to their land will not be eligible for compensation for land but will be entitled to compensation for their affected assets upon land and limited right on land use.
Livelihood Restoration	The Project Affected People (PAP) are people in the nearby villages of the four land categories whose land will be used by the Project. Most of them would own the land although some may be users of the four types of land requirements.	**(a) Promote agricultural product with in home lot:** For villagers in the construction site and upstream area who lose their farmland, production within home lot is one of mitigation to bring them food stuff and the surplus can be sold for addition income as well. Examples of home lot production are mushroom cultivation, growing kitchen garden and green edible fence. Activities to promote home lot productions are; • Setting up production group • Providing Fund for initiate activities • Technical supports • Training • Marketing support/coordinate

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Livelihood Restoration (Cont'd)		**(b) Livestock Raising** Develop commercially successful and sustainable Animal Husbandry by: • Improving cattle, pig and poultry raising • Promotion of forage crops • Improving veterinary techniques **(c) Fishery** • Provision of training on aquaculture or fish pond raising, cage culture. • Set new equilibrium on newly river pondage area, introducing of fish into river pondage area. Recommended releasing species should be replication of herbivorous species, omnivorous species and carnivorous species. The recommended for herbivourous species are such as Rohu and allied (*Labeo* spp), *Cirrhinus mrigala* for example. The omnivorous species are such as silver barb (*Barbonymus gonionotus*), the Sweetlips minnow (*Osteochilus hasselti*) and walking catfish (*Clarias batrachus*). The carnivorous species are such as snakehead (*Channa* spp.), *Wallago attu*, *Ompok* spp. and Bagrids catfish (*Mystus* spp.) **(d) Off-farm occupation** • For increasing the chance and efficiency for villagers to work in this project, preparing villagers to have skill and experience to work is needed. Sample of occupation that villagers can occupy are construction worker, carpenter, gardener, guard, light machine repair, trader, driver, food cooking, etc. Activities to prepare PAPs for off-farm occupation are; - To facilitate training by practice - To set up vocational education - To coordinate with contractor for PAPs employment

TABLE 8.3-1

IMPACTS DURING CONSTRUCTION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Livelihood Restoration (Cont'd)		• Woman training for supplementary income. Activities to prepare are; - Food processing/preservation - Promotions of edible fencing/home lots garden
Community Development	The Project Affected People (PAP) are people in the nearby villages of the four land categories whose land will be used by the Project. Most of them would own the land although some may be users of the four types of land requirements.	**(a) Public Health Support** • Provide equipment for health service and sanitary condition improvement in the Hnget Gyi Thaik, Thayet Pin, Ma Gyi Inn,War Net village, Yeywa and Jongywa. • Organize activities to enhance health and sanitation by educating villagers on health care and diseases prevention for people of all ages. **(b) Education Support** • Upgrading of existing facilities and capacity; • Provision of educational materials and equipment; • Scholarships for students; **(c) Provision of Basic Infrastructure** • Water pumping system and groundwater well to alleviate impact from turbidity of water due to construction activities in river bed. • Provision of bus or boat for convenient transportation during construction period • Safety signs installation or barriers provided for community safety

TABLE 8.4-1

IMPACTS DURING OPERATION PHASE AND MITIGATION MEASURES

Environmental and Social Issue	Impacts	Mitigation Measures
Noise	The project activities during operation phases will caused of potential impact to the environmental and human.	• Speeds of vehicles in the project site will not be more than 40 km/hr. • Noise performance requirements of construction equipment will need to be clearly stated in contract specifications. • The project proponent will be required to regularly monitor ambient noise levels at the receptors.
Vibration	The project activities during operation phases will caused of potential impact to the environmental and human.	• Contractor will prepare a blasting plan to reduce ground vibration and air pressure to the acceptable levels. The blasting plan will be reviewed for approval by the supervision engineers of the Project Proponent.
Flood	The project activities during operation phases will caused of potential impact to the environmental and human.	• Installation of flood warning system. A flood warning system in case of critical flood is planned for warning to immediate upstream and downstream peoples and communities. The system will be designed in cooperation with the plant operator of the Yeywa Hydropower Plant and government authorities responsible for monitoring water levels and meteorological data within the Lower Mytigne river basin. The system will include the possibility to raise alarms via a public annunciation system.

TABLE 8.4-1

IMPACTS DURING OPERATION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Surface Water Quality	Increased turbidity of river water due to in-river project activities. Degradation of river water quality due to inappropriate management of wastes and domestic waste from site.	• Deep water aeration is recommended in order to reduce water stratification and encourage mixing of water in the reservoir. • Water quality, the amount of suspended solid and its chemical parameters e.g. mercury contents should also be monitored annually.
Aquatic Ecology and Fishery	Increased turbidity of river water due to in-river project activities. Degradation of river water quality due to inappropriate management of wastes and domestic waste.	• Survey of fish species composition in the project area in both upstream and downstream must be implemented. Furthermore, the effect on fish migration or some effects during construction phase on the fish spawning ground should have been studied.
Solid Waste	Solid waste will be generated from activities associated with the Project, the main types of solid waste Solid waste from workers are domestic waste such as garbage, glass, and food waste, etc. The management of solid waste is very important. If not properly controlled and disposed of, waste can be unsightly and cause human health and safety concerns.	• Prepare garbage bins or containers with covers for garbage collection at the workers' campsites and inform concerned local authorities or agencies that get permission from government section to collect and dispose garbage • Prohibit open burning wastes in project area. • The separated timbers and woods will be sold based on the concerned laws and regulations. • The unusable wastes will be disposed of a disposal area or landfill site to be selected by the project proponent with approval of the concerned authority. • For used oil and chemicals, they will collect at a temporary warehouse before sending back or disposed by contractors or inform concerned authorities to dispose used oil and chemicals. • Prepare garbage bins or containers with covers for garbage collection at the workers' project area. Also, inform concern local authorities that gets permission from government section to collect and dispose garbage.

TABLE 8.4-1

IMPACTS DURING OPERATION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Solid Waste (Cont'd)		• Solid waste disposal procedures will comply with solid waste management regulations, as well as any additional disposal facility requirements. • Separate each type of wastes and collected solid waste in appropriate and safety container for recycling where facilities are available. Any surplus to the recycling activity will be disposed of at an approved waste disposal site. • Prohibit dumping waste in watercourse or wildlife habitat.
Livelihood Restoration	The Project Affected People (PAP) are people in the nearby villages of the four land categories whose land will be used by the Project. Most of them would own the land although some may be users of the four types of land requirements.	**(a) Promote agricultural product with in home lot:** For villagers in the construction site and upstream area who lose their farmland, production within home lot is one of mitigation to bring them food stuff and the surplus can be sold for addition income as well. Examples of home lot production are mushroom cultivation, growing kitchen garden and green edible fence. Activities to promote home lot productions are; • Setting up production group • Providing Fund for initiate activities • Technical supports • Training • Marketing support/coordinate **(b) Livestock Raising** Develop commercially successful and sustainable Animal Husbandry by: • Improving cattle, pig and poultry raising • Promotion of forage crops • Improving veterinary techniques

TABLE 8.4-1

IMPACTS DURING OPERATION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Livelihood Restoration (Cont'd)		**(c) Fishery** • Provision of training on aquaculture or fish pond raising, cage culture. • Set new equilibrium on newly river pondage area, introducing of fish into river pondage area. Recommended releasing species should be replication of herbivorous species, omnivorous species and carnivorous species. The recommended for herbivourous species are such as Rohu and allied (*Labeo* spp), *Cirrhinus mrigala* for example. The omnivorous species are such as silver barb (Barbonymus gonionotus), the Sweetlips minnow (*Osteochilus hasselti*) and walking catfish (*Clarias batrachus*). The carnivorous species are such as snakehead (*Channa* spp.), *Wallago attu*, *Ompok* spp. and Bagrids catfish (*Mystus* spp.) **(d) Off-farm occupation** • For increasing the chance and efficiency for villagers to work in this project, preparing villagers to have skill and experience to work is needed. Sample of occupation that villagers can occupy are construction worker, carpenter, gardener, guard, light machine repair, trader, driver, food cooking, etc. Activities to prepare PAPs for off-farm occupation are; - To facilitate training by practice - To set up vocational education - To coordinate with contractor for PAPs employment • Woman training for supplementary income. Activities to prepare are; - Food processing/preservation - Promotions of edible fencing/home lots garden

TABLE 8.4-1

IMPACTS DURING OPERATION PHASE AND MITIGATION MEASURES (CONT'D)

Environmental and Social Issue	Impacts	Mitigation Measures
Community Development	The Project Affected People (PAP) are people in the nearby villages of the four land categories whose land will be used by the Project. Most of them would own the land although some may be users of the four types of land requirements.	**(a) Public Health Support** • Provide equipment for health service and sanitary condition improvement in the Hnget Gyi Thaik, Thayet Pin, Ma Gyi Inn, War Net village, Yeywa and Jongywa. • Organize activities to enhance health and sanitation by educating villagers on health care and diseases prevention for people of all ages. **(b) Education Support** • Upgrading of existing facilities and capacity; • Provision of educational materials and equipment; • Scholarships for students; **(c) Provision of Basic Infrastructure** • Water pumping system and groundwater well to alleviate impact from turbidity of water due to construction activities in river bed. • Provision of bus or boat for convenient transportation during construction period • Safety signs installation or barriers provided for community safety

CHAPTER 9

PUBLIC CONSULTATIONS AND DISCLOSURE

CHAPTER 9

PUBLIC CONSULTATIONS AND DISCLOSURE

9.1 INTRODUCTION

The EIA Procedure prescribes requirements for public consultations and disclosure (PCD) in the EIA investigation in Articles 50 and 51 as copied below for ready reference.

50. *The EIA shall consider the views, concerns, and perceptions of stakeholders, communities and individuals that could be affected by the Project or who otherwise have an interest in the Project. The EIA should include the results of public consultations and negotiations with the affected populations on the environmental and social issues. Public concerns should also be taken into account in assessing impacts, designing mitigation measures, and selecting monitoring parameters.*

51. *As part of the EIA investigations, the Project Proponent shall undertake the following consultation process:*

    a) *timely disclosure of all relevant information about the proposed Project and its likely Adverse Impacts to the public and civil society through local and national media, the website of the Project Proponent, at public places such as libraries and community halls and sign boards at the Project site visible to the public.*
    b) *arrange consultation meetings at national, state and local level with PAPs, authorities, community based organizations, and civil society;*
    c) *consultations with concerned government organizations including the Ministry, the concerned sector ministry, regional government authorities, and others; and*
    d) *field visits for the Ministry and concerned government organizations*

The EIA Procedure requires PCD to be conducted three times: (i) during project scoping; (ii) during the preparation of EIA report; (iii) during EIA review.

This chapter presents results of the first three PCD. The first PCD was conducted during the scoping stage from 21 to 30 April, 2015, the second PCD during the preparation of the draft EIA report from 14 to 22 September 2015, and the third PCD during EIA review. The chapter is structured as prescribed in the EIA Procedure.

9.2 METHODOLOGY AND APPROACH

The Consultant planned, organized and conducted the two PCD in consultation with the Mandalay Region Office of the Environmental Conservation Department. It should be noted that PCD is essentially the primary level of public participation in project development and implementation. The approach and methodology adopted in the PCD for this Project follows principles and practices in public participation, and is briefly described as follows;

9.2.1 Identification of Stakeholders and Groups Affected by the Project

Considering the project scope and the legal and institutional framework for environmental and social impact management applicable to the Project, the Project stakeholders could be identified and classified into three categories:

(1) Government Authorities Involved in EIA Administration

The stakeholders in this category are key officials or representatives of the national, state/regional, district and local authorities who have direct responsibilities for the administration of the EIA process for environmental and social clearance and issuing operation permits for proposed development projects particularly power projects.

For this Project, relevant key offices at the national level are: (i) Ministry of Environmental Conservation and Forestry; (ii) Environmental Conservation Department and (iii) Ministry of Electric Power; and (iv) Ministry of Social Welfare, Relief Resettlement.

Relevant key offices at the regional level are: (i) Mandalay Region Office of Administrative ; (ii) Mandalay Region Office of the Environmental Conservation Department; (iii) Mandalay Region Office of Social Welfare, Relief and Resettlement; (iv) Mandalay Region Office of Planning and Economic; and (v) Mandalay Region Office of Fisheries and (vi) Department of Hydropower Project Implementation of Mandalay Region (DHPI)

Relevant key offices at the local level are: (i) Pyin Oo Lwin Township Administration; and (ii) Kyaukse Township Administration.

(2) Other Interested Parties

The Project stakeholders in this category are various government departments responsible for development of various sectors, and community based organizations as listed below:

- Department of Health
- Planning Department
- Forestry Department
- Agriculture Department
- Fishery Department
- Electric Power Department
- Land Record Department

(3) Potentially Affected People

The Project stakeholders in this category are village committees and individual villagers in the eight villages in the study area in Pyin Oo Lwin and Kyaukse Townships; namely: Hnget Kyi Thaik village, Ma Gyi Inn village, War Net village, Gwebin village and Pein village in Pyin Oo Lwin Township and Thayet Pin village, Yeywa village and Kyaungywa village in Kyaukse Township. Residents in these villages had concerns on various potential impacts of the Project during construction and operations such as noise, fugitive dust, turbidity, traffic safety, boat transportation, riverbank erosion, and degradation of natural resources.

9.2.2 Conducting Public Consultations

(1) Purposes of Public Consultation and Disclosure

PCD conducted as part of the Scoping Stage and EIA investigation of this Project has three purposes:

(i) informing the stakeholders about the Project, environmental and social issues related to Project construction and operation, and preliminary mitigation measures to minimize environmental and social impacts;

(ii) seeking views of the stakeholders on the Project and mitigation measures; and

(iii) ensuring participation and partnership where the stakeholders and the Project jointly discussed and assessed relevant issues and needs raised by the stakeholders.

Results of the public consultation are useful to the EIA investigation and public consultation during the remaining course of the EIA process, including implementation of the environmental management plan (EMP).

(2) Methods of Consultations

The main method used in the public consultation was public meeting. This method is generally used in EIA. It is most effective in achieving the informing purpose, followed by the seeking views purpose, and the participation and partnership purpose.

The public meeting method was complemented by disclosure of project information through presentation in the meetings. This would serve the informing purpose.

In addition, the public meeting method was also complemented by the household surveys and one- on- one interviews used in collecting socio- economic information on communities in the study area. These two methods would serve the informing and seeking views purposes of the public consultation.

Before the meetings with villagers, announcement poster was posted at the well-known visible places in the communities; e.g. school, temple, tea shop, etc., in order to inform about venue and schedule for public consultation meeting in each village as shown in ***Photo 9.2-1***.

Ma Gyi Inn village

Thayet Pin village

War Net village

PHOTO 9.2-1 : DISCLOSURE OF PUBLIC CONSULTATION MEETING IN EACH VILLAGE

These methods are generally used in EIA. It is most effective in achieving the public consultation and information disclosure purpose. The results would be utilized to formulate environmental and social management plans for the Project.

(1) Approach to the Public Meetings

The following approach to the public meetings was adopted:

- Each meeting was organized with assistance of the Township Administration Department and village headmen in identifying participants to be invited, in making arrangements for the meeting venue, and in issuing the invitations.

- Representatives of the Project Proponent and the Consultant jointly conducted the meeting. The Project Proponent's representatives were responsible for briefing on Project information including Project development plan, and answering questions from the meeting or clarifying points raised in the meeting regarding the Project development plan. The Consultant was responsible for providing information on the EIA, and clarifications on issues related to impacts of the Project. The two parties worked as a Project team.

- Each meeting was chaired by a district chief and village headman. The meeting began by informing the participants of the objectives of the meeting and expected outcome. After that the Project Proponent team gave information on the Project and the EIA.

- Each meeting provided an open forum for the participants to express their concerns, offer their views and suggestions, and raise questions or points that they needed response from the Project team. The Project team responded to their concerns, views and suggestions as appropriate. The meeting was interactive, i.e. the Project team and the participants engaged in constructive and relevant discussions.

9.2.3 Disclosure

Project information was disclosed to the government authorities though slide presentation and brochures in the meetings. Project information was provided in the meetings with local villagers in handouts in Burmese language including supporting maps.

9.3 SUMMARY OF CONSULTATION ACTIVITIES UNDERTAKEN

9.3.1 PCD during the Scoping Stage

9.3.1.1 Overview of Consultation Activities

(1) Persons Met and Meeting Dates

Public consultations with the three identified categories of stakeholders were held on several occasions between 21 to 30 April, 2015. The meeting dates, group of agencies, and number of participants are given in ***Table 9.3-1***. Minutes of meeting and list of participants in each meeting are shown in ***Appendix 9A***.

(2) Project Information Disclosure

Slides used in the presentations and the brochures provided to the government authorities are shown in ***Appendix 9B***.

The project information disclosed in the meetings can be summarized as follows:-

- Project location will be located about 12 miles downstream of Yeywa HPP
- Two alternative sites of project location are Site 44C Thayet Pin village and Site 54 Hnget Gyi Thaik village;
- Generation capacity is about 66 MW;
- Consortium Stucky Ltd-Gruner GmbH conduct detailed feasibility design for the project;

- TEAM (Thailand) and TBS (Myanmar company) conduct EIA study for the project;
- EIA study will be finished within November 2015;
- Transmission line will be connected to the existing Shwesaya Sub-station;
- Water level will be raised up about 8 m from normal condition;
- Flooded level will be within riverbank only
- No residential area will be flooded.
- Major affected areas are project construction site and communities nearby quarry.

TABLE 9.3-1

MEETINGS WITH PROJECTS STAKEHOLDERS

Meeting Dates	Organization/Name	Number of Participants
23 April 2015	**Kyaukse Township**	
	1. Government officials	24
	2. Project Proponent's representatives (HTCT)	3
	3. EIA Consultant (TEAM)	4
27 April 2015	**Pyin Oo Lwin Township**	
	1. Government officials	18
	2. Project Proponent's representatives (HTCT)	3
	3. EIA Consultant (TEAM)	5
29 April 2015	**ECD of Mandalay Region**	
	1. ECD officials	3
	2. Project Proponent's representatives (HTCT)	1
	3. EIA Consultant (TEAM)	4
	The General Public : Local Community Groups	
25 April 2015	1.Thayet Pin village	Village headman, village committee, community leaders and villagers (total of 84 persons)
26 April 2015	2.Hnget Gyi Thaik village	Village headman, village committee, community leaders and villagers (total of 72 persons)
28 April 2015, a.m.	3.Ma Gyi Inn village	Village headman, village committee, community leaders and villagers (total of 35 persons)
28 April 2015, p.m.	4.War Net village	Village headman, village committee, community leaders and villagers (total of 73 persons)

9.3.1.2 Summary of the Opinions of the Persons Consulted

(see details in ***Appendix 9A***)

Opinion of the persons consulted can be summarized by category as follows:

(1) Government Authorities

- **Kyaukse Township**

- Government officials have no objection against the project but they have some concerns about environmental and health impacts on students and villagers in communities nearby the project site.

- They also have concern about pH level of water in Myitnge River which is currently high and may increase during the project operation period.

- They hope that the project would support community development, road improvement, and electricity supply and tourism promotion.

- In case it is necessary to use private land for construction purpose, the land owners should be properly informed in advance.

- **Pyin Oo Lwin Township**

- Government officials have no objection against the project.

- Compensation for land is a big problem in Myanmar. The project should put special care and have proper arrangement for fair and transparent compensation for the project affected persons.

(2) Local Communities

- The meeting participants from the project related villages have positive views on the project.

- They have concerns on the following environmental and social impacts that may be created from the project construction and operation:-
  - Impact on farmland (flooding and land acquisition)
  - Impact from dust, noise and vibration
  - Impact on water quality and turbidity
  - Impact from dam failure

- They hope for proper impact mitigation measures and fair compensation.

- They expect job opportunity for local people and project support on infrastructure (electricity and water supply system).

9.3.2 PCD during the EIA Preparation

9.3.2.1 Overview of Consultation Activities

(1) Persons Met and Meeting Dates

Public consultations during the EIA investigation were held on several occasions between 1 to 7 October, 2015. The meeting dates, group of agencies, and number of participants are given in ***Table 9.3-2***. Minutes of meeting and list of participants in each meeting are shown in ***Appendix 9C.***

(2) Project Information Disclosure

Slides used in the presentations and the brochures provided to the government authorities are shown in ***Appendix 9D***.

The project information disclosed in the meetings can be summarized as follows:-

- Project location will be located about 12 miles downstream of Yeywa HPP
- Sites of project location is Site 54 Hnget Gyi Thaik village;
- Generation capacity is about 338 GWh;
- Consortium Stucky Ltd-Gruner GmbH conduct detailed feasibility design for the project;
- TEAM (Thailand) and TBS (Myanmar company) conduct EIA study for the project;
- EIA study will be finished within November 2015;
- Transmission line will be connected to the Yeywa Sub-station;
- Water level will be raised up about 8 m from normal condition;
- Environmental and social investigation during April and July 2015
- Environmental and Social impact assessment
  - Flooded level will be within riverbank only;
  - No residential area will be flooded;
  - Major affected areas are project construction site and communities nearby quarry;
- Environmental and mitigation measures

TABLE 9.3-2

MEETINGS WITH PROJECT STAKEHOLDERS

Meeting Dates	Organization/Name	Number of Participants
1 October 2015	**Kyaukse Township**	
	1. Government officials	20
	2. Project Proponent's representatives (DHPI and HTCT)	5
	3. EIA Consultant (TEAM)	3
5 October 2015	**Pyin Oo Lwin Township**	
	1. Government officials	14
	2. Project Proponent's representatives (DHPI and HTCT)	5
	3. EIA Consultant (TEAM)	5
7 October 2015	**ECD of Mandalay Region**	
	1. ECD officials	6
	2. Project Proponent's representatives (DHPI and HTCT)	2
	3. EIA Consultant (TEAM)	5
	The General Public : Local Community Groups	
3 October 2015, am.	1.Thayet Pin village	Village headman, village committee, community leaders and villagers (total of 102 persons)
3 October 2015, pm.	3.Ma Gyi Inn village	Village headman, village committee, community leaders and villagers (total of 22 persons)
4 October 2015, am.	2.Hnget Gyi Thaik village	Village headman, village committee, community leaders and villagers (total of 56 persons)
4 October 2015, pm.	4.War Net village	Village headman, village committee, community leaders and villagers (total of 60 persons)

9.3.2.2 Summary of the Opinions of the Persons Consulted

(see details in ***Appendix 9*****C)**

Opinion of the persons consulted can be summarized by category as follows:

(1) Government Authorities

- **Kyaukse Township**
  - When will the project construction begin ?
  - Compensation rate for affected people.
  - Impact on water use of local people.
  - Impact on water quality on downstream area.
  - The exactly flooded area due to project implementation.
  - How to control about salinity in river water ?
  - How to manage about boat traffic ?

- **Pyin Oo Lwin Township**
  - Mitigation measures should be strictly implemented by construction contractor.
  - The construction contractor should contact closely with local people.
  - There should be consultation and negotiation on compensation issues among government administration office, developer and local people.
  - Local people do not actually own the land, they have only right to use it. Land belong to the country, if the government need to use the land for project development, the land holder will be compensated.
  - There should be long term mitigation measures during operation period.
  - There should be detailed inventory survey on project affected land and properties.

(2) Local Communities

- **Hnget Gyi Thaik village**
  - How about compensation rate for project affected area and properties ?
  - The Project Proponent should be support the infrastructure development e.g. library construction, teacher and doctor accommodation.
  - Job opportunity for local people and local vehicle for project construction activities.
  - There are 3 people whose all piece of farmland will be flooded and another 3 people will affected some part of farmland only.

- **Thayet Pin village**
  - How about flooded level due to project implementation ?
  - Compensation rate on both bank of Myitnge River should be equal.
  - They would like to use the weir crest for crossing river.
  - Villagers had bad experience from Yeywa Dam activities e.g. impact from quarry site, vibration from blasting and water turbidity.

- **Ma Gyi Inn village**
  - Some of villagers do not agree with project development.
  - There should be demarcation of the area to be flooded.
  - They are worried about flooded area along both bank of Myitnge River.

- **War Net village**
  - How about compensation rate for project affected area and properties?
  - Job opportunity for local people.
  - Villagers had bad experience from Yeywa Dam activities e.g. impact from quarry site and impact from water fluctuation.

9.4 RESULTS OF CONSULTATION DURING PROJECT SCOPING

9.4.1 Issues Identified by Stakeholders and Groups Affected by the Project

Issues identified by the stakeholders during the public consultation meetings can be summarized by group as follows:

Issues	Clarifications by the Consultant
(1) Government Authorities	
- Environmental impact e.g. dust, noise and river water quality.	- EIA study covers air, noise, water quality and aquatic ecology. The environmental sampling will be conducted in two seasons in order to compile baseline information for assessment of impact due to project implementation. Furthermore, the Consultant will propose mitigation measures to alleviation expected impacts.
- Concern about pH level of water in Myitnge River which is currently high and tends to increase during the project operation period	- For water quality study, pH level is included in this study. The result of pH level in river water will be presented in the second meeting. In case that pH level tends to increase and may cause any impacts, the Consultant will propose mitigation measures to alleviation expected impacts.
- Health impact on villagers	- EIA study will cover assessment of health impact due to project implementation.
- Land acquisition for project construction area.	- The project will inform and discuss with land owner before project construction.
- Anxiety on dam failure	- EIA study will cover earthquake issue and project design will comply with international standard.

Issues	Clarifications by the Consultant
- Would the raised water level flood the concrete road ?	- Water level will be raised up about 8 m and will be confined within the river channel. However, if the project site is located at site 44C (Thayet Pin village), some part of concrete road will be relocated for project construction area.
- How about the compensation process ?	- A compensation committee will be organized consisting of Project Proponent, government authorities and land owners in order to discuss about compensation rates. - The compensation process will be fair and transparent for project affected persons according to applicable Myanmar laws.
- How about the project affected area in case of project site 54 ?	- The project affected area would be about 5 ha consisting of 2 ha of farmland and 3 ha of uncultivated land. These areas cover project construction area and area to be flooded during the operation period.
- Would the project allow local people to pass through the project area ?	- During project construction phase, the project would not allow local people to pass through the project area for safety reasons. For the operation phase, the project will respond to this issue later.
- If there is any damage on road due to materials and equipment transportation, how about the responsibility of the project ?	- The project will promptly repair the damaged road.
(2) Local Community Groups	
- How about the compensation process ?	- A compensation committee will be organized consisting of project proponent, government authorities and land owners in order to discuss about compensation rates. - The compensation process will be fair and transparent for project affected persons according to applicable Myanmar laws.
- Employment priority for local people nearby project area.	- The consultant will recommend about local worker recruitment for the project as a social impact mitigation measure in EIA report.
- How about the impacts on vibration and noise due to project construction activities?	- EIA study covers noise, vibration issues. Existing noise and vibration level will be measured in order to get baseline information for assessment of impact due to project implementation. Furthermore, the Consultant will propose mitigation measures to alleviate these impacts.
- Community development should be supported by the project e.g. electricity and water supply system.	- The consultant will recommend these issues in EIA report.
- Possibility in using dam crest as access road linking the two banks of Myitnge River.	- The consultant will inform about the response on this issue during the second meeting when the detailed feasibility study was finalized.
- Dissemination of clear project information.	- During this Scoping stage, the detailed feasibility study has not yet been completed, therefore the exact project information will be presented in the second public consultation meeting along with identified major impacts and mitigation measures.

9.4.2 How These Issues are taken into Account

The EIA team and the technical study team will give due consideration of the issues and requirements expressed by the stakeholders in the conduct of the EIA and further works on project designs.

9.5 RESULTS OF CONSULTATIONS DURING THE PREPARATION OF EIA REPORT

9.5.1 Issues Identified by Stakeholders and Groups Affected by the Project

Issues identified by the stakeholders during the public consultation meetings can be summarized by group as follows:

Issues	Clarifications by the Consultant
(1) Government Authorities	
- **Compensation**	
- Compensation rate for affected people. - There should be consultation and negotiation on compensation issues among government administration office, developer and local people.	- A compensation committee will be organized consisting of Project Proponent, government authorities and land owners in order to discuss about compensation rates. - The compensation process will be fair and transparent for project affected persons according to applicable Myanmar laws.
- There should be detailed inventory survey on project affected land and properties.	- The project will conduct detailed inventory survey before project construction.
- **Water use and water Quality**	
- Impact on water quality on downstream area. - How to control about salinity in river water ? - Impact on water use of local people.	- For water quality study, pH level, turbidity, BOD, COD and salinity are included in this study. The result of water quality in river water will be presented in the EIA report. In case that project construction activities and project operation to cause any impacts on water quality, the Consultant will propose mitigation measures to alleviation expected impacts such as water supply system,
- **Water level and flood area**	
- The exactly flooded area due to project implementation.	- Water level will be raised up about 8 m and will be confined within the river channel.
- **Mitigation measures**	
- Mitigation measures should be strictly implemented by construction contractor.	- The consultant will present about local suggestion in EIA report
- The construction contractor should contact closely with local people.	- The consultant will present about local suggestion in EIA report
- There should be long term mitigation measures during operation period.	- The consultant will present about mitigation measures during construction period and operation period in EIA report.
(2) Local Community Groups	
- **Compensation**	
- How about compensation rate for project affected area and properties?	- A compensation committee will be organized consisting of Project Proponent, government authorities and land owners in order to discuss about compensation rates.

Issues	Clarifications by the Consultant
- Compensation rate on both bank of Myitnge River should be equal.	- The compensation process will be fair and transparent for project affected persons according to applicable Myanmar laws.
- **Water level and flood area**	
- How about flooded level due to project implementation ?	- Water level will be raised up about 8 m and will be confined within the river channel.
- They should be demarcation of the area to be flooded. - They are worried about flooded area along both bank of Myitnge River.	- The project will demarcate the area to be flooded and conduct detailed inventory survey before project construction.
- **Transportation**	
- They would like to use the weir crest for crossing river.	- The consultant will present about local suggestion in EIA report and co-operate with feasibility study team.
- **Socio-economic**	
- The Project Proponent should support the infrastructure development e.g. library construction, teacher and doctor accommodation. - Job opportunity for local people and local vehicle for project construction activities.	- The consultant will recommend about local worker recruitment for the project as a social impact mitigation measure in EIA report.
- **Opinion about the project**	
- Some of participants of Ma Gyi Inn village not agree with project development.	- The consultant will present about local opinion for the project in EIA report.
- **Other**	
- The participants of Thayet Pin village and War Net village had bad experience from Yeywa Dam activities e.g. impact from quarry site, vibration from blasting, water turbidity and water fluctuation.	- The consultant will present about mitigation measures during construction period and operation period in EIA report.

9.5.2 How These Issues are taken into Account

The EIA team and the technical study team will give due consideration of the issues and requirements expressed by the stakeholders in the conduct of the EIA and further works on project designs.

9.6 RESULTS OF CONSULTATIONS DURING EIA REVIEW

During the EIA review the Project Proponent organized another public consultation meeting on 23 April 2018. The stake holders involved in the consultation meeting consisted of :-

- Local, regional and township government ministries and departments.
- NGOs, CSOs, and academic/research institutes.
- Villagers in project affected areas.

The purpose of this consultation meeting is to :-

- Update of project design, timeframe and reasons for updates ESIA.
- Information sharing on ESIA methodology, government roles, communication mechanisms in place, and additional stakeholder identification.

The consultation meeting was held in form of stakeholder workshop. This allowed the project team to document concerns, issues and recommendations from the stakeholders, and also to gain insight on government roles, potential government collaboration, existing government communication mechanisms and committees that are already in place and may be relevant to Deedoke Project.

Questions during the April Stakeholder Workshop included:

- Land acquisition impacts;
- Impacts to water quality, including cumulative impacts taking into account Yeywa dam;
- Whether there will be benefit sharing programs;
- Disaster Management Plan / Dam Safety Plan;
- Social and environmental impacts as a result of construction (dust, health, noise, etc.);
- Health surveys being conducted and potential health impacts, and
- Impact of worker influx.

9.7 RECOMMENDATIONS FOR ONGOING CONSULTATIONS

In order to gain full understanding and support from PAPs and stakeholders and interested parties in project implementation, it is vital to have full participation from them at the beginning through the entire process of project development. The program activities are to;

(1) Dissemination of information

The information dissemination for PAPs are as follows;

- Project components.
- Schedule for start-up of the project.
- Detailed information on project policies and implementation procedures.
- Compensation Plan and Entitlements.
- The grievance mechanism and the appeals process.
- Rights to participate and be consulted.
- Program for the improve quality of life and social development plan.
- Organizational responsibilities.

(2) Consultation with PAPs

(a) Informing PAPs about Compensation Payment with letter of notification. The PAPs should also be informed in advance on the relevant documents (e.g. identification card, land title, etc.) that they are required to bring with them for compensation payment purpose.

(b) Consultation with PAPs to confirm preferences for rehabilitation assistances measures.

(c) Informing PAPs about site clearance prior to start-up to civil works.

(d) Informing PAPs about the beginning and ongoing schedule for physical works.

(e) Consultation and confirmation with PAPs on their participation in Income Restoration measures.

(f) Consultation with PAPs on Community/Social Development program.

(g) Informing PAPs on monitoring and supervision activities to be conducted during project implementation.