

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

June 2018

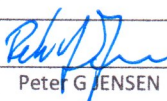
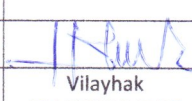
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| A | 30 July 2018 | |  Peter G. JENSEN |  Vilayhak SOMSOU LIVONG | |
| REV | DATE | AUTHOR | CHECKED | APPROVED | MODIFICATION DETAILS |
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BBREVIATIONS / ACRONYMS

| | |
|---------|---|
| AIP | Annual Implementation Plan |
| ADB | Asian Development Bank |
| BBS | Biodiversity Baseline Survey |
| BAC | Biodiversity Advisory Committee |
| BOF | Biodiversity Offset Framework |
| BOMC | Biodiversity Offset Management Committee |
| BOMP | Biodiversity Offset Management Plan |
| CA | Concession Agreement between the NNP1PC and GOL, |
| CAP | Corrective Action Plan |
| COD | Commercial Operation Date |
| CVC | Conventional Vibrated Concrete |
| CWC | Civil Works Contract |
| CTA | Common Terms Agreement |
| DEB | Department of Energy Business, MEM |
| DEPP | Department of Energy Policy and Planning, MEM |
| DEQP | Department of Environment and Quality Promotion, MONRE |
| DESIA | Department of Environmental and Social Impact Assessment, MONRE |
| DFRM | Department of Forest Resources Management, MONRE |
| DLA | Department of Land Administration, MONRE |
| DSRP | Dam Safety Review Panel |
| EC | Electrolytic Conductivity |
| EC OCD | EGAT Construction Obligation Commencement Date |
| EDL | Electricite du Laos |
| EDL PPA | Power Purchase Agreement between NNP1PC and EDL |
| EGAT | Electricity Generating Authority of Thailand |
| EGATi | EGAT International Company Limited |
| EIA | Environmental Impact Assessment |
| EMMR | Environmental Management and Monitoring Reports |
| EMO | Environmental Management Office of ESD within NNP1PC |
| EMU | Environmental Monitoring Unit |
| EMWC | Electrical-Mechanical Works Contract |
| EPF | Environmental Protection Fund |
| ERIC | Environmental Research Institute Chulalongkorn University |

| | |
|--------|---|
| ERM | Environmental Resource Management |
| ESD | Environmental and Social Division of NNP1PC |
| ESMMP | Environmental and Social Monitoring and Management Plan |
| FY | Fiscal Year |
| GOL | Government of Lao PDR |
| GIS | Geographic Information Systems |
| HH | Household |
| HMWC | Hydraulic Metal Works Contract |
| HR | Human Resources |
| IEE | Initial Environmental Examination |
| IMA | Independent Monitoring Agency |
| INRMP | Integrated Natural Resources Management Plan |
| ISP | Intergraded Spatial Planning |
| km | kilometre |
| kV | kilo-Volt |
| LEPTS | Lao Electric Power Technical Standard |
| LHSE | Lao Holding State Enterprise |
| LTA | Lender's Technical Advisor |
| M | million |
| m | metre |
| MAF | Ministry of Agriculture and Forestry |
| MEM | Ministry of Energy and Mines, Lao PDR |
| MOF | Ministry of Finance, Lao PDR |
| MOM | Minutes of Meeting |
| MONRE | Ministry of Natural Resource and Environment, Lao PDR |
| MOU | Memorandum of Understanding |
| NBCA | National Biodiversity Conservation Area |
| NCI | Non-Compliance Issue |
| NCR | Non-Compliance Report |
| NN2 | Nam Ngum 2 Power Company Limited |
| NNP1PC | Nam Ngiep 1 Power Company Limited |
| NPF | National Protection Forest |
| NTFP | Non-Timber Forest Products |
| NT2 | Nam Theun 2 Hydropower Project |
| OC | Obayashi Corporation |
| ONC | Observation of Non-Compliance |
| PAFO | Provincial Department of Agriculture and Forestry |

| | |
|----------|---|
| PAP | Project Affected People |
| PD | Property Damage |
| PONRE | Provincial Department of Natural Resource and Environment, MONRE |
| PvPA | Provincial Protection Area |
| RCC | Roller Compacted Concrete |
| SIR | Site Inspection Report |
| SLBMP | Salvage Logging Biomass Management Plan |
| SOP | Standard Operating Procedure |
| SMO | Social Management Office of ESD within NNP1PC |
| SS-ESMMP | Site Specific Environmental and Social Monitoring and Management Plan |
| TD | Technical Division of NNP1PC |
| TOR | Terms of Reference |
| TSS | Total Suspended Solids |
| UAE | United Analysis and Engineering Consultant Company Ltd. |
| UXO | Unexploded Ordinance |
| WMF | Watershed Management Fund |
| WMP | Watershed Management Plan |
| WRPC | Watershed and Reservoir Protection Committee |
| WRPO | Watershed and Reservoir Protection Office |
| WWTS | Waste Water Treatment System |

EXECUTIVE SUMMARY

Three SS-ESMMPs carried over since February and March 2018 and one Site Decommissioning Plan (2nd revision) for the TCM camp received on 27 June 2018 were under review by the Environment Management Office (EMO) during June 2018.

The Environmental Management Unit (EMU) of the government rescheduled their monthly site inspection to July 2018.

The camps' effluent monitoring results for June 2018 confirmed that BOD5 and COD comply with the relevant effluent standards, except at the HMM Main Camp, IHI and LILAMA10 Camps (for 04 and 18 June 2018). Total coliform is fluctuated in four out of 11 camps (Sino Hydro, V&K, HM Hydro and IHI). Most of the camps except Kenber struggle with compliance with total nitrogen and ammonia nitrogen. With the completion of the RCC placement work at the Man Dam, the production at the Aggregate Crushing Plant and the RCC plant has ended resulting in no water discharge from these plants during June 2018.

Surface water samples were collected and analysed for 10 stations in Nam Ngiep River, four stations in the main tributaries including lower Nam Chian, Nam Phouane, Nam Xao and Houay Soup during the reported month. The surface water quality monitoring for June 2018 indicates that the level of dissolved oxygen (DO) in the station at the main dam has decreased due to the impounding of the main reservoir which was started on 15 May 2018.

In June 2018, a total of 160.4 m³ solid waste was disposed at the NNP1 Project Landfill, a decrease of 44 m³ compared to May 2018; and a total of 1,127.8 kg of recyclable waste was sold to Khounmixay Processing Factory. Only 35.1 m³ of solid waste from Phouhomxay, Thahuea and Hat Gniun villages was disposed at the Houay Soup Landfill.

The Nam Ngiep 1 Watershed Management Plan (WMP) was further updated based on inputs from the workshop with the government held at the end of May 2018. The final review and signing by the chairman of Watershed and Reservoir Protection Committee (WRPC) is expected at the end of July or early August 2018.

The first draft of NNP1 Biodiversity Offset Management Plan was submitted by the consultant on 29 June 2018 and is currently being reviewed by NNP1PC EMO team. The draft provincial regulations for the management of Nam Chouan – Nam Xang (NCNX) biodiversity offset site were discussed at a provincial technical workshop on 12 June 2018 and subsequently consulted with six villages during the period from 18 to 20 June 2018.

A contractor is being procured by NNP1PC for the removal of floating debris in the Nam Ngiep 1 main reservoir. The technical evaluation was concluded on 30 May 2018 and the financial evaluation was concluded on 14 June 2018. NNP1PC is currently undertaking contract negotiations with the prospective winner and the contractor is expected to be appointed sometime in July 2018.

The data from the daily fish catch logbook monitoring indicates that the mean daily fish catch in Nam Ngiep River was 1.7 kg/household/day in May 2018. The estimated total fish catch in Nam Ngiep basin for May 2018 is 33,800 kg. Around 40 % of the catch was sold, 51% was consumed fresh, 6% processed and approximately 3% was used for other purposes.

1. INTRODUCTION

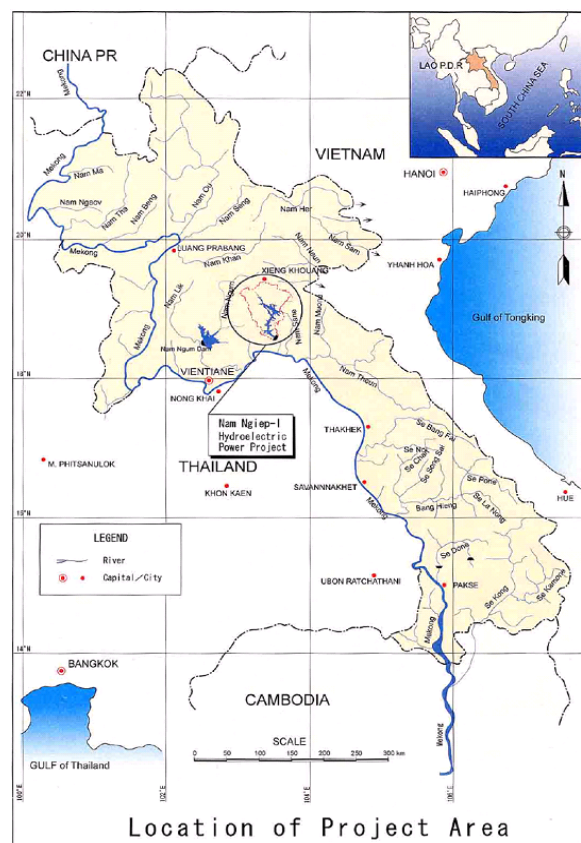
The Nam Ngiep originates in the mountains of Xieng Khouang Province, flowing through Khoun District into Thathom District of Xaysomboun Province, through Hom District and into Bolikham District of Bolikhamxay Province. The Nam Ngiep meets the Mekong River just upstream from Pakxan in Bolikhamxay Province (Fig. 1-1).

Figure 1-1: Location Map

The project will consist of two dams. The main dam which is located 9.0 km upstream of Hat Gnuin Village in Bolikham District, will create a 70-km-long, narrow reservoir that extends up the Ngiep Valley as far as Thathom District. At almost 150 m high, the main dam will be the second largest in Lao PDR. The Power Station at this dam will generate up to 272 MW of electricity for export to Thailand. With a combined capacity of 290 MW, Nam Ngiep 1 will generate around 1,620 GWh of electricity annually. Two transmission lines will be required to transport the electricity generated by the project. From the main power station, a 230-kV line will run for 125 km to the Nabong outside Vientiane Capital. A 115-kV transmission line will be constructed by EDL from the Re-regulation Power Station to Pakxan substation over a distance of 40 km.

This Environmental Monthly Monitoring Report (EMMR) provides a summary of environmental monitoring activities and mitigation actions in January 2017. The EMMR was prepared by the Project's Environmental Management Office (EMO). It has been internally reviewed and cleared by EMO senior technical staff and management prior to submitting the report to the Government of Lao PDR (GoL) related agencies.

The EMMR and other related reports including related construction Site Specific Environmental and Social Monitoring and Management Plans (SS-ESMMPs) are publicly disclosed on the Project website in line with the ADB and GoL Public Disclosure Policies. Hard copies of the final reports will also be available upon requests at the Project's main office in Vientiane Capital and field office in Pakxan, Bolikhamxay Province.



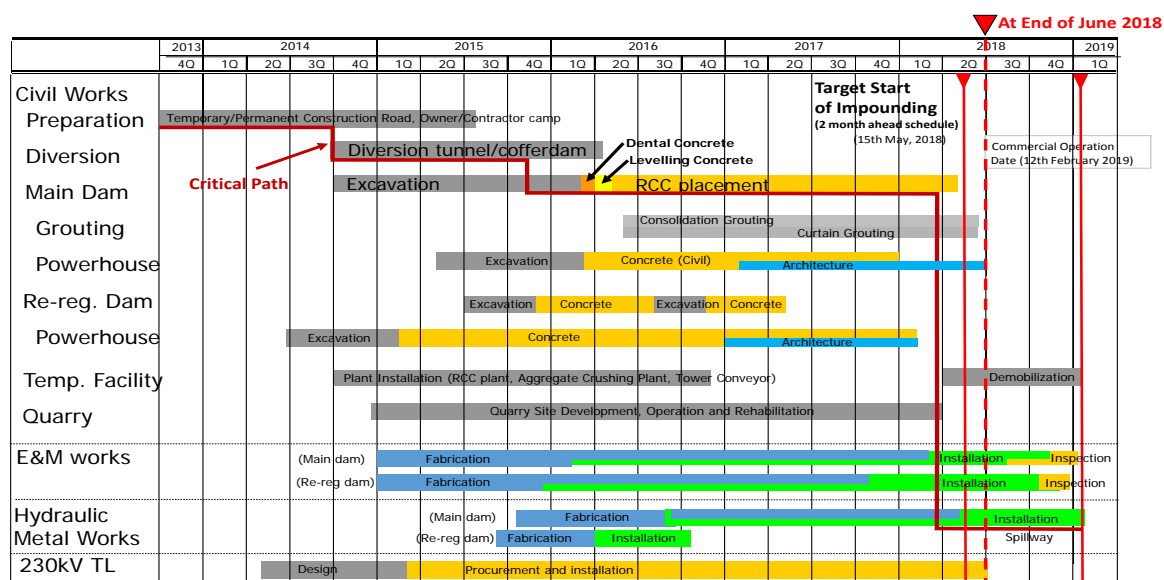
2. WORK PROGRESS OF PRINCIPAL CONTRACTORS

Construction Works for the Project are being carried out through four separate main construction contracts under the supervision of the Technical Division of NNP1PC. The four contracts are the Civil Works, the Electrical and Mechanical Works, the Hydraulic Metal or Hydro-mechanical Works and the 230 kV Transmission Line Works. Actual overall cumulative work progress until the end of June 2018 was 96.2 % (compared to planned progress of 97.5 %), based on achieved Interim Milestone Payments for all Contracts

excluding the value of Advance Payments, varied works and other adjustments allowed under each Contract. In terms of the value of actual work done the percentage is understated since work completed, but not paid, is not included.

The overall construction schedule and progress curve (by achieved Milestone Payments) are shown in *Error! Reference source not found.*

Figure 2-1: Overall Construction Schedule



2.1 Civil Work

The Civil Works Contract was executed between Obayashi Corporation and the Nam Ngiep 1 Power Company on 30 September 2013 and the NTP was issued on 03 October 2014. Excavation works of the main dam, the diversion tunnel and the re-regulation dam were commenced in October 2014 and completed in February 2016, following which the concreting works were commenced.

The cumulative actual work progress of the Civil Works until the end of June 2018 was 97.9 % (compared to planned progress of 98.7 %) calculated in the same manner as described above for the value of achieved Interim Milestone Payments excluding advance payment.

2.1.1 Main dam and power house

After starting the main dam excavation works in October 2014 on the left bank, the works were about one month advanced when diversion of the Nam Ngiep River was achieved at the end of October 2015. However, excavated volumes were 20% greater than expected and part of this additional work is necessary to construct a 'shear key' structure due to the weak layers of rock encountered in the dam foundation. Following the efforts on Site, the additional excavation work was completed at the end of February 2016.

Figure 2-2: Main Dam and Powerhouse from Overhead Looking Upstream

The consolidation drilling and grouting for the main dam started in May 2016 and was completed in June 2018.

Table 2-1: Progress of consolidation and curtain drilling for grouting at the end of June 2018

| Item | Description | Total Drilling (m) | Completed (m) | Progress (%) |
|------------------------|----------------------------|--------------------|---------------|--------------|
| Consolidation Grouting | Anticipated Quantity | 17,769 | 17,769 | 100 |
| Curtain Grouting | Original Design Quantity | 27,945 | 58,400 | 209 |
| | Anticipated Final Quantity | 58,400 | 58,400 | 100 |

*The linear metres 'completed' are drilled and grouted.

Main powerhouse sub-structure excavation works were completed in January 2016 and levelling concrete works were started in coordination with installation of the grounding system and the penstock concrete encasement. Major concrete of the main powerhouse was substantially completed in December 2017 and Progress of the powerhouse concreting works is shown in **Table 2-2** below. Dam control centre works and oil pit works are ongoing in June 2018.

Table 2-2: Progress of Main Powerhouse Sub-Structure Concrete Works to as of the end of June 2018.

| Location | Total Anticipated Volume (m ³) | Completed (m ³) | Progress (%) |
|--------------------|--|-----------------------------|--------------|
| Main Powerhouse | 34,800 | 34,650 | 99 |
| Penstock Embedment | 11,885 | 11,885 | 100 |
| Spillway | 35,500 | 29,500 | 83 |

2.1.2 Re-regulation dam and powerhouse

The re-regulation powerhouse excavation and cofferdam works for river diversion were commenced in early October 2014. The excavation works for the powerhouse on the left bank were fully completed down to El. 146.7 m at the end of February 2015.

Structural concrete works were commenced in March 2015, in coordination with installation of the grounding system. The progress of structural concrete works is shown in **Figure 2-3** below

Figure 2-3: Completed Re-regulation Dam and Powerhouse at the End of June 2018



2.1.3 Temporary work facility

2.1.3.1 DIVERSION TUNNEL INLET AND OUTLET

The diversion tunnel works which is over 600 m in length and 10 m in diameter were commenced in October 2014 by drill and blast techniques and completed in late September

2015. The river diversion took place on 31 October 2015 together with construction of earth-fill cofferdams upstream and downstream.

2.1.3.2 SECONDARY UPSTREAM COFFERDAM

The concrete placement works in both conventional and roller compacted concrete (CVC and RCC respectively) for the secondary upstream cofferdam were started in November 2015 and completed ahead of construction schedule in the middle of February 2016. The grout curtain works were completed on 02 April 2016.

2.1.3.3 PLANT YARDS

These comprise the Aggregate Crushing Plant, the CVC Batching Plant and the RCC Batching Plant.

Foundation work and installation of equipment were completed at all the plant yards and the belt conveyor system from the RCC plant to the main dam was completed in early April 2016.

2.1.3.4 QUARRY

After removal of overburden the excavation of raw materials for aggregate crushing were started in July 2015. The nature and type of the rock being exploited is acceptable though unsuitable soil layers are removed to spoil disposal areas, and good quarry management continues.

2.1.3.5 DISPOSAL AREAS

The disposal area on the right bank has been available for operation since January 2015, as was the adjacent waste disposal area. The Disposal Area No.9 along Road P1 near the entrance of Road T5 started operation in April 2015. Unsuitable material from the quarry continues to be hauled to Disposal Area No.6 and Disposal Area No.9 is being developed by the E&M Contractor as stated above.

2.2 Electrical and Mechanical Works

The EMWC was executed between Hitachi-Mitsubishi Hydro Corporation and NNP1PC on 13 June 2014 and the NTP was issued on 03 October 2014. The cumulative work progress of the Electrical and Mechanical Works by value at the end of June 2018 was 98.3 % (compared to planned progress of 98.3 %).



Figure 4.2-7: Lowering and Installing Lower Cooling Coil for Unit 2

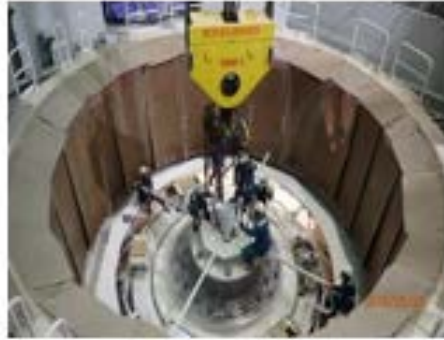


Figure 4.2-8: Run-out Check for Coupling Main Shaft and Lower Shaft for Unit 2



Figure 4.2-9: Commissioning Tests of SCADA System Interface to Remote Control Panels



Figure 4.2-10: Dielectric Strength Test for 16.5 kV Disconnecting Switch for Unit 1 & 2



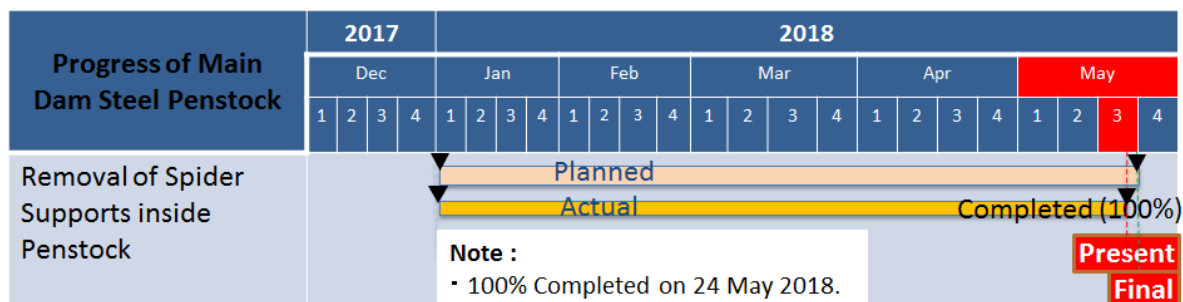
Figure 4.2-11: Installation of Generator Main Lead along Access Shaft



Figure 4.2-12: Inspection of Generator Air Gap between Rotor and Stator

2.3 Hydro-Mechanical Works

The HMWC was executed between IHI Infrastructure Systems (IIS) and NNP1PC on 18 April 2014 and the NTP was issued to the Contractor on 03 October 2014. The actual cumulative work progress of the Hydro-Mechanical Works until the end of June 2018 was 68.8 % (compared to planned progress of 79.1 %). The main activities carried out during this month are described below:



2.4 230kV Transmission Line Works

The TLW Contract was executed between Loxley-Sri Consortium and NNP1PC on 11 July 2014 and the NTP was issued to the 230 kV TL Contractor on 03 October 2014. The cumulative work progress of the Transmission Line Works until the end of June 2018 was 100 % (compared to planned progress of 100 %).

In respect of the delay to commencement of most works the Contractor is studying its programme to ensure that sufficient resources are committed as the works progress to ensure that completion is achieved in good time. Onset of daily rains has made access to all areas difficult but the Contractor follows its revised acceleration schedule, after the progress for the construction of tower foundations slowed after May, 2016 (See **Figure 2-4** below)

Figure 2-4: Cumulative Work Progress of Tower Foundation (Original, Revised Planned and Actual)

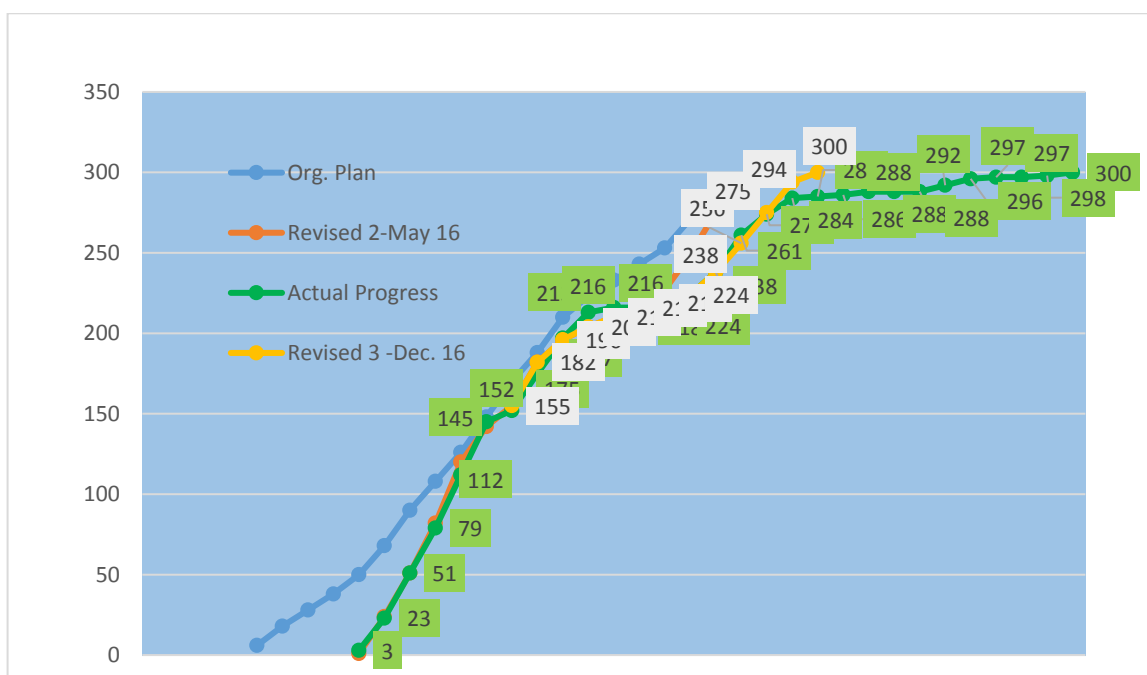


Figure 2-5: Revised Cumulative Work Progress of Tower Erection (Planned and Actual)

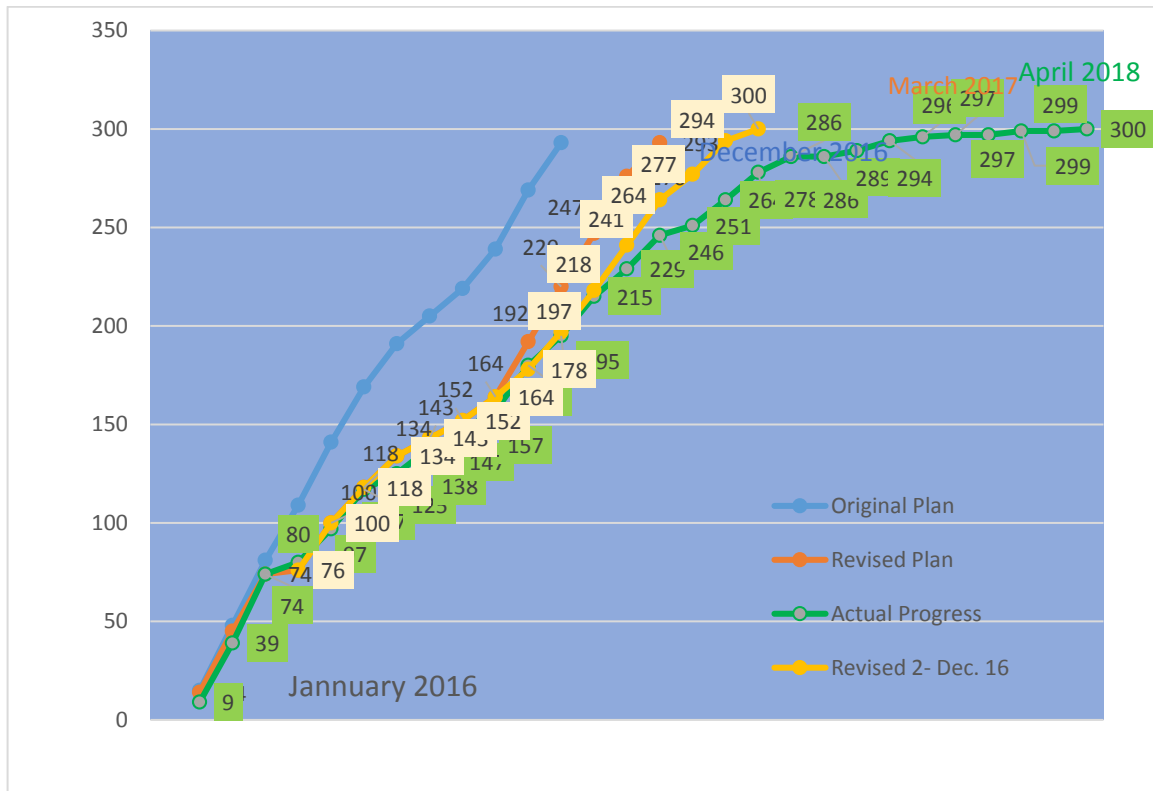


Figure 2-6: Cumulative Progress of Stringing Works (Planned & Actual)



3. ENVIRONMENTAL MANAGEMENT MONITORING

3.1 Compliance Management

3.1.1 Site Specific Environmental and Social Management and Monitoring Plans

Three SS-ESMMPs carried over since February and March 2018 and one Site Decommissioning Plan (2nd revision) for the TCM camp received on 26 June 2018 were active for Environment Management Office (EMO) review.

Table 3-1: SS-ESMMP review status in June 2018

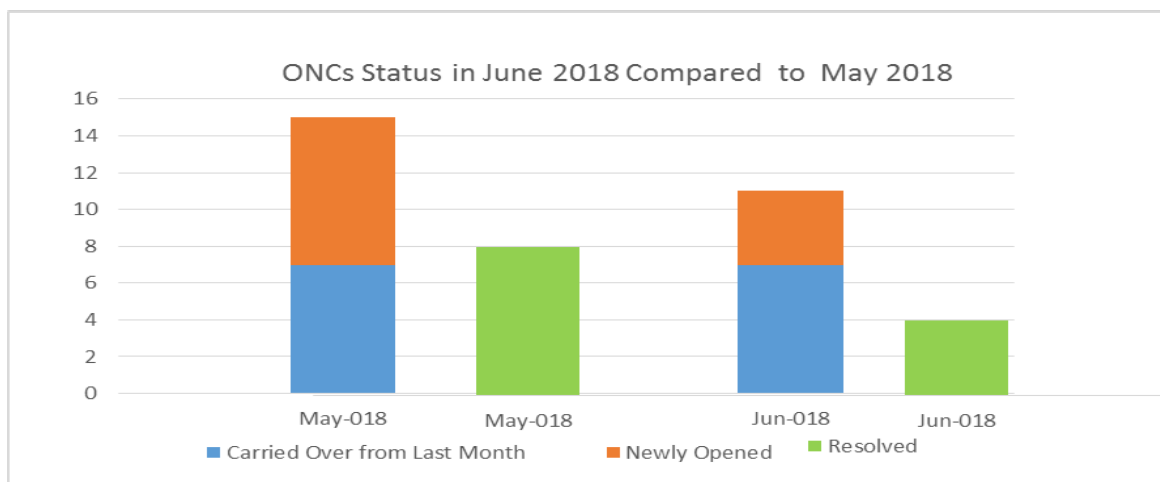
| Title | Date Received | Status |
|--|--|---------------------------------------|
| TCM Camp _ Site Decommissioning Plan | 27 June 2018 (2 nd submission) | Under review |
| SS-ESMMP for Closing of the Dyke at Borrow Pit No.7 | 03 February 2018 (Reply to Owner's comment) | Under review |
| SS-ESMMP–RRPS for Closing of Borrow Pit at the Corner of Road P1 & P1A | 03 February 2018 (Reply to Owner's comment) | Under review |
| SS-ESMMP for Construction of Quarry Site | 17 March 2018 (Version A6) | Under review |
| SS-ESMMP for Preparation and Monitoring Works for Main Dam Impounding | 07 May 2018 (1 st submission) | Returned with comments on 12 May 2018 |

3.1.2 Compliance Report

The Observation of Non-Compliance (ONC) and Non-Compliance Report (NCR) are summarized in **Table 3-2**, **Table 3-3** and **Table 3-3** below.

Table 3-2: Summary of ONC and NCR

| Items | ONC | NCR-1 | NCR-2 | NCR-3 |
|------------------------------|-----------|----------|----------|----------|
| Carried over from May 2018 | 07 | 0 | 0 | 0 |
| Newly Opened in June 2018 | 04 | 0 | 01 | 0 |
| Total in June 2018 | 11 | 0 | 1 | 0 |
| Resolved in June 2018 | 04 | 0 | 0 | 0 |
| Carried over into July 2018 | 07 | 0 | 1 | 0 |
| Unsolved Exceeding Deadlines | 04 | 0 | 0 | 0 |

Figure 3-1: Summary of ONC and NCR**Table 3-3: Carried-Over ONC and NCR from June 2018 into July 2018**

| Site ID | Issues | Reporting | Actions |
|---|---|-----------------------|---|
| Re-regulation Dam (Borrow Pit Area at Corner of P1 & P1A Road) | The borrow pit slopes had no berm and cut-off drains. Lack of closure plan for the borrow pit (ONC_OC-0232). First inspection: 30 August 2016 Latest inspection: 15 February 2018 | ONC (Closure Pending) | A response to Owner's comments submitted on 03 March 2018 is under review. The issue is expected to be resolved in July 2018. |
| Main Quarry Site | <ul style="list-style-type: none"> - Waste rock had been pushed down the slope towards Nam Ngiep. The operation has damaged riparian vegetation; - The revised DWP & SSES MMP submitted on 16 March 2018 did not fully address EMO's comments on erosion control and site decommissioning (ONC_OC-0273). First inspection: 13 February 2018 Latest inspection: 05 May 2018 | ONC (Closure Pending) | The revised DWP & SSES MMP submitted on 16 March 2018 is under review. It is expected to be cleared in July 2018. |

| Site ID | Issues | Reporting | Actions |
|---|--|--------------------------|---|
| HM Hydro Worker Camp No.2 (LILAMA10 Camp) | A food waste trap/ oil trap at the canteen was damaged. As a result, food waste was flushed and accumulated at the wetland pond (ONC_HM-0015). First inspection: 15 May 2018 Latest inspection: 26 June 2018 | ONC (Closure Pending) | Further improvements of the waste water treatment system are required by 10 July 2018: <ul style="list-style-type: none">- Improve the oil trap;- Clean-up the food waste regularly and disposed at NNP1 Project Landfill. |
| Aggregate Crushing Plant Yard | Indicative timeframe of site removal and rehabilitation provided by CWC's contractors (<i>Camps and Facilities Decommissioning ref: rev.0, 16th March 2018</i>) was behind the actual work on site, some decommissioning of conveyor belts, crusher has started, but some facilities were not included in the site removal list (ONC_OC-0279). First inspection: 29 May 2018 Latest Inspection: 28 June 2018 | ONC (Closure Pending) | The following actions shall be taken by 15 July 2018 <ul style="list-style-type: none">- Revise the indicative dates of decommissioning and rehabilitation to be consistent with the actual work on site;- Sino Hydro main camp & office and Sino hydro magazine (at Spoil Disposal Area No.6), need to be added to the list. |
| HM Hydro Worker Camp No. 2 (LILAMA10 Camp) | The following findings were identified during EMU, IAP-ABD and several joint inspections: <ul style="list-style-type: none">- Hazardous material (oil drums) was stored in unsecure storage (no proper bund, floor). Some oil drums and containers were stored on the bare ground;- Poultry was raised in the LILAMA10 camp (NCR_HM-0004). First inspection: 27 April 2018 Latest Inspection: | NCR-2 (New) | The contractor is required to take the following actions by 30 June 2018: <ul style="list-style-type: none">- Improve the existing oil storage facility and provide spill response kit;- Display procedures and poster for the correct oil handling practice at the storage facility;- Clean-up and dispose oil contaminated soil/waste as per hazardous waste management procedures;- Provide training on hazardous material and |

| Site ID | Issues | Reporting | Actions |
|----------------------------|--|--------------|---|
| | 26 June 2018 | | <p>waste handling to LILAMA10's workers;</p> <ul style="list-style-type: none"> - Stop raising any poultry and dismantle chicken coop; and - HM Hydro shall follow-up the corrective action implemented by their subcontractor, then report the progress to NNP1PC in a timely manner. |
| Song Da 5 Camp No.1 | <p>Improper operation of WWTS:</p> <ul style="list-style-type: none"> - No operation of water pump causing a nearly overflowing of waste water from the pond prior to chlorination; - Wastewater releases from unfit pipe line connection points (ONC_OC-0282). <p>First inspection: 26 June 2018 Latest Inspection: Not available</p> | ONC (New) | <p>The contractor is required to take the following action by the end of June 2018:</p> <ul style="list-style-type: none"> - Re-install the water pump and ensure wastewater is pumped to the chlorination tank for treatment prior to discharging; - Repair and properly connect the wastewater pipe line to ensure no release and leakage of wastewater to the outside environment. |
| Song Da 5 Camp No.1 | <p>Poor operation of workshop and hazardous storage area, oily equipment and machines were stored on the bare ground without spillage protection facilities/devices (ONC_OC-0283).</p> <p>First inspection: 26 June 2018 Latest Inspection: Not available</p> | ONC (New) | <p>The contractor is required to take the following action by end of June 2018:</p> <ul style="list-style-type: none"> - Provide steel trays to collect oil dripping from the old machine; - Provide plastic sheet cover for oily equipment and machines to prevent from rain wash. |
| RCC Plant Yard | <p>Septic tanks next to the RCC plant's laboratory was full causing black water releasing to outside (ONC_OC-0285).</p> <p>First inspection:</p> | ONC (New) | <ul style="list-style-type: none"> - Immediately block the septic tank hole to stop black water leakage; |

| Site ID | Issues | Reporting | Actions |
|---------|---|-----------|--|
| | 26 June 2018 Latest Inspection: Not available | | <ul style="list-style-type: none"> - Empty the septic tank and dispose black water by following NNP1PC's Standard Operating Procedure (SOP) for black water/sewage sludge disposal. <p>The corrective action will be verified on 5 July 2018.</p> |

Figure 3-2: Site Inspection Locations

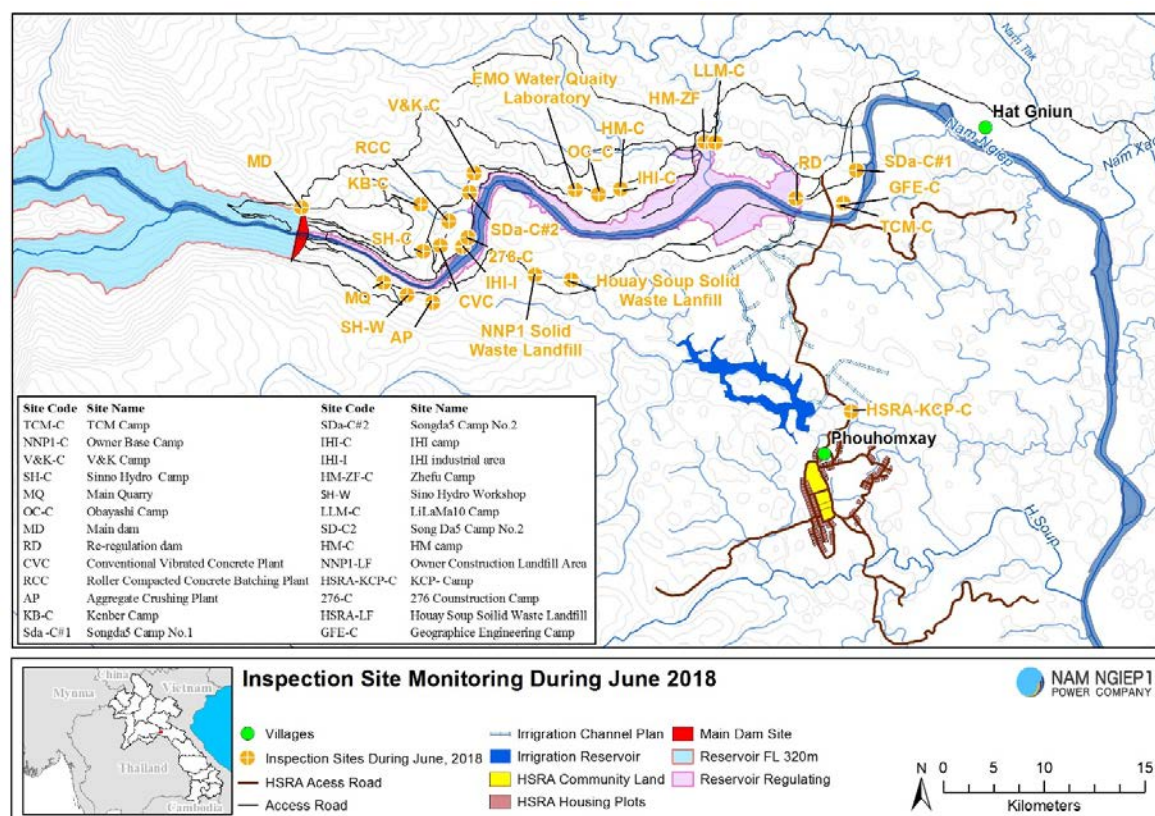
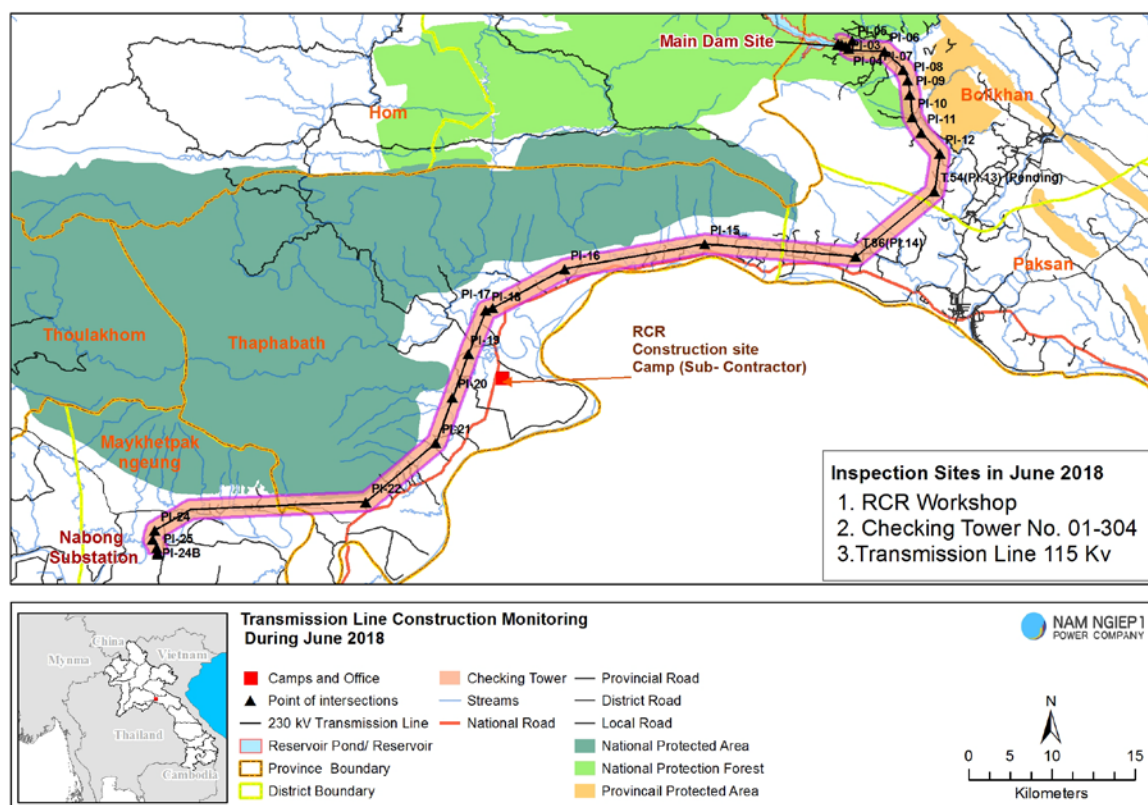


Figure 3-3: 230 kV Transmission Line Construction Monitoring

3.1.3 Inspection by Environment Management Unit

The Environmental Management Unit (EMU) of the government rescheduled their monthly inspection to July 2018.

3.2 Environmental Quality Monitoring

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD5), faecal coliform, E. Coli bacteria and total coliform have been carried out by NNP1PC Environmental Laboratory since August 2017.

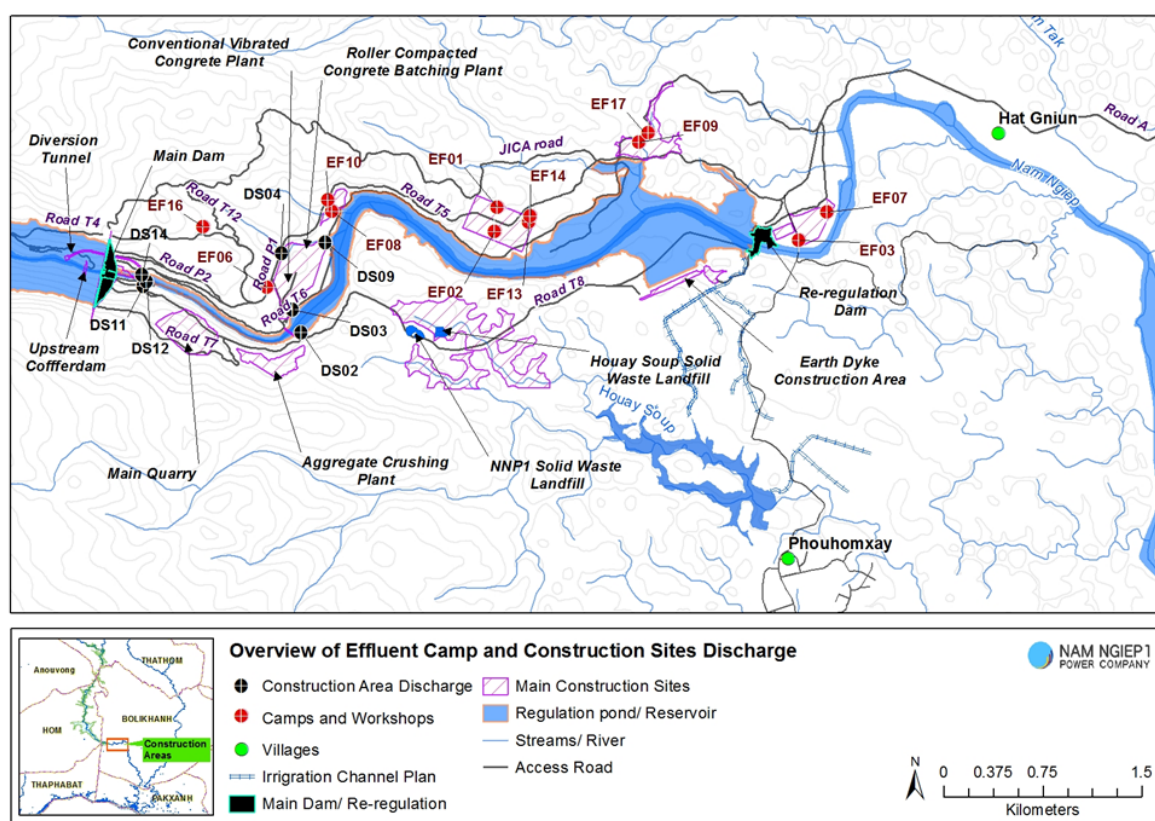
All data are reported to the Ministry of Natural Resources and Environment (MONRE) and the Project Lenders on a monthly and quarterly basis and published on the Company website <https://namngiep1.com/resources/monitoring-reports/>.

3.2.1 Effluent Discharge from Camps and Construction Sites

During June 2018, all camp effluents were monitored. Results of effluent monitoring from the camps and construction sites are presented and the monitoring locations are displayed in

Figure 3-4.

Figure 3-4: Map of Effluent Discharge Monitoring Locations



Detailed monitoring results are provided in **Annex 1** of this Report. The camps' effluent monitoring results for June 2018 indicate that BOD5 and COD comply with the relevant effluent standards, except at HMH Main camp, IHI and LILAMA10 camps (for 04 and 18 June 2018), Total coliform has fluctuated in four out of 11 camps (Sino Hydro, V&K, HM Hydro and IHI). Most of the camps except Kenber struggle with compliance with total nitrogen and ammonia nitrogen.

Following the completion of the RCC placement work at the Man Dam, the production at the aggregate crushing plant and the RCC plant has stopped resulting in to no water discharge from the sedimentation retention ponds during June 2018.

Table 3-4: Status of Corrective Actions at Camps and Construction Sites

| Site | Sampling ID | Status | Corrective Actions |
|--|-------------|------------------------------------|--|
| Owner's Site Office and Village (OSOV) | EF01 | Non-compliance for total nitrogen. | The effluent monitoring result is being shared with TD to improve the operation of the WWTS. |

| Site | Sampling ID | Status | Corrective Actions |
|--|-------------|--|--|
| Obayashi Corporation Camp | EF02 | Non-compliance for ammonia nitrogen (NH ₃ -N) and total nitrogen. | The effluent monitoring result is being shared with TD and the contractors to improve the operation of the WWTS. |
| Sino Hydro Camp | EF06 | Non-compliance for ammonia nitrogen (NH ₃ -N) and total coliform on 18 June 2018. | As above. |
| Song Da 5 Camp No. 1 | EF07 | Non-compliance for ammonia nitrogen (NH ₃ -N) and total nitrogen. | As above. |
| Song Da 5 Camp No. 2 | EF08 | Non-compliance for ammonia nitrogen and total nitrogen. | As above. |
| Zhefu Camp (Subcontractor of Hitachi-Mitsubishi Hydro) | EF09 | Non-compliance for TSS, NH ₃ -N and total nitrogen. | As above. |
| V&K Camp | EF10 | Non-compliances for ammonia nitrogen (NH ₃ -N) and total coliform on 18 June 2018. | As above. |
| HMH Main Camp (WWTS) | EF13 | Non-compliance for BOD ₅ , COD, NH ₃ -N, total nitrogen and total coliform. However, total coliform was back in compliance on 18 June 2018. | As above. |
| IHI Main Camp | EF14 | Non-compliance for BOD ₅ , COD, NH ₃ -N, total nitrogen and total coliform. However, total coliform on 18 June 2018 was back to compliant with the standard. | As above. |
| Kenber Camp | EF16 | Non-compliance for TSS on 18 June 2018. | As above. |
| Lilama10 Camp | EF17 | Non-compliances for BOD ₅ and total nitrogen. However, the BOD ₅ was back in compliance on 18 June 2018. | As above. |
| Main Dam Construction Area (Waste Water Treatment Plant No.1) | DS11 | No discharge during the missions. | |
| Main Dam Construction Area (Waste Water | DS12 | No discharge during the missions. | |

| Site | Sampling ID | Status | Corrective Actions |
|---|-------------|--|--|
| Treatment Plant No.2) | | | |
| Main Dam Construction Area (Waste Water Treatment Plant No.3) | DS14 | Non-compliance for TSS on 08 and 14 June 2018. | As above. The contractor was instructed to improve the WWTS operation. |
| Spoil Disposal Area No.2 (Song Da 5 Workshop) | DS04 | Non-compliance for TSS on 14 June 2018. | As above. |
| CVC Plant | DS03 | No discharge during the missions. | |
| RCC Plant (discharge point at the weirs) | DS09 | No discharge during the missions. | |
| Aggregate Crushing Plant | DS02 | No discharge during the missions. | |

3.2.2 Ambient Surface Water Quality Monitoring

The surface water quality monitoring programme comprises 14 monitoring stations. The May 2018 programme is summarized in **Table 3-5** and the location of the monitoring stations are shown in **Table 3-5: Monitoring Frequency for Surface Water Quality Parameters**

| Frequency of Monitoring | Parameters (Unit) | Monitoring Sites |
|-------------------------|---|--|
| Tuesdays and Saturdays | pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C) and Turbidity (NTU) | <ul style="list-style-type: none"> - NNG09, Nam Ngiep Upstream Main Dam (NNG09); - NNG05, Nam Ngiep Downstream the Re-regulation Dam at Ban Hat Gniun |
| Weekly | pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU), TSS (mg/l), BOD5 (mg/l), Faecal coliform (MPN/100 ml) and Total coliform (MPN/100 ml) | <ul style="list-style-type: none"> - NPH01, Lower Nam Phouan (Physical parameters only); - NNG02, (Physical parameters only); - NNG03, (Physical parameters only); - NNG09, Nam Ngiep Upstream Main Dam (NNG09); - R6, Re-regulation Reservoir; |

| Frequency of Monitoring | Parameters (Unit) | Monitoring Sites |
|-----------------------------------|--|--|
| | | <ul style="list-style-type: none"> - R7, Re-regulation Reservoir 0.3 km Upstream the Re-Regulation Dam; - NNG05, Nam Ngiep Downstream the Re-regulation Dam at Ban Hat Gniun |
| Fortnightly | pH, DO (%), DO (mg/l), Conductivity (μ s/cm), TDS (mg/l), Temperature ($^{\circ}$ C), Turbidity (NTU) | All 14 stations |
| Monthly | TSS (mg/l), BOD5 (mg/l), COD (mg/l), NH3-N (mg/l), NO3-N (mg/l), total coliform (MPN/100 ml), faecal coliform (MPN/100 ml) | All 14 stations |
| Quarterly | Total iron (mg/l), Manganese (mg/l), total phosphorus (mg/l), TOC (mg/l) Total Kjeldahl Nitrogen (mg/l), Chloride (mg/l), Sulphate (mg/l), Alkalinity (mg/l), Lead (mg/l), Arsenic (mg/l), Mercury (mg/l), Calcium (mg/l), Magnesium (mg/l), Potassium (mg/l), Sodium (mg/l) | All 14 stations |
| Once when water level at 312 masl | Total dissolved phosphorus (mg/l), phytoplankton biomass (g dry weight/m ³) | NNG09 |

Figure 3-5 below.

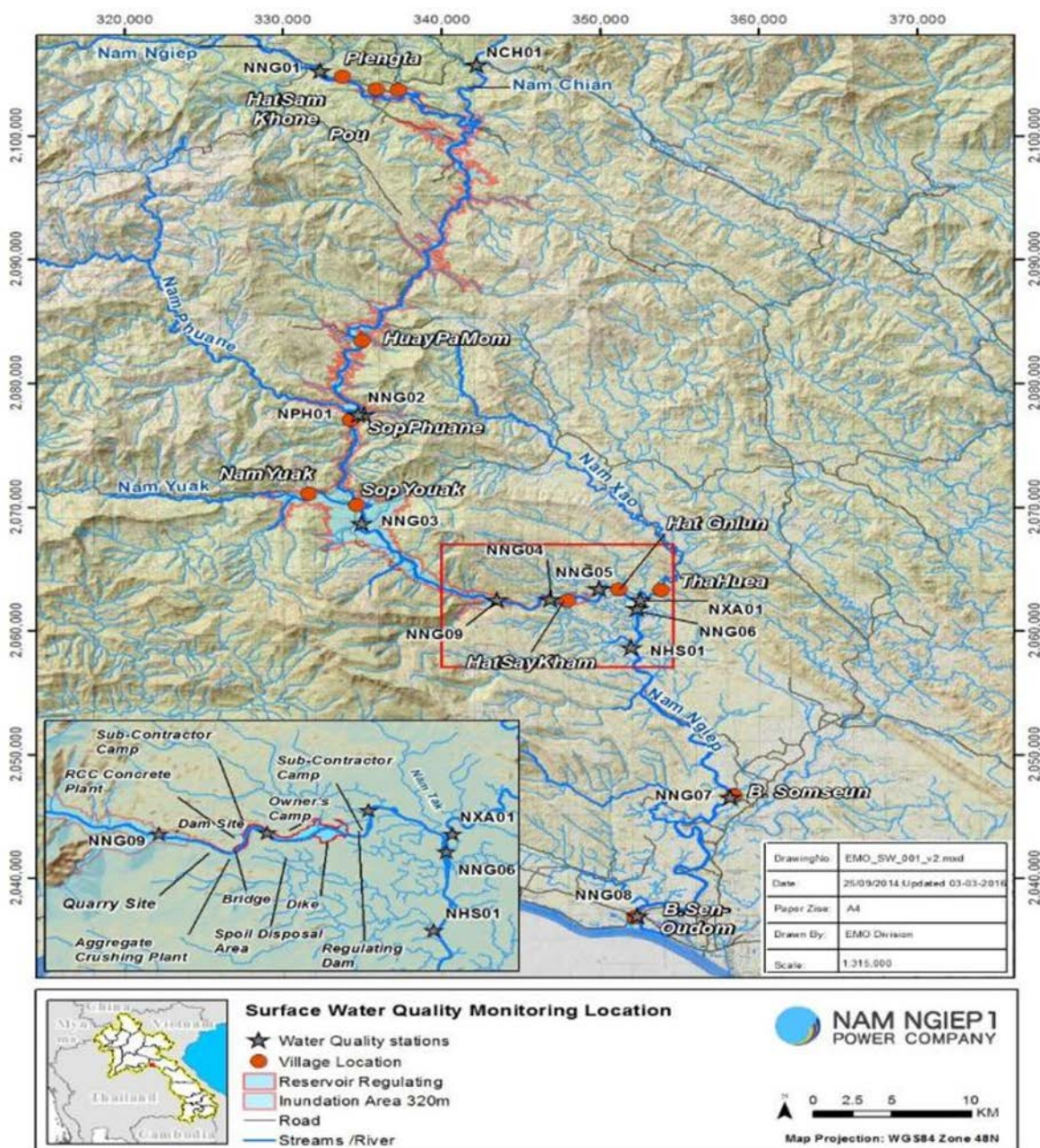
In addition, the monitoring frequency for two surface water stations (NNG09 and NNG05) has been increased from a weekly basis to three times/week since 29 May 2018 to monitor water quality at these stations during the impounding of the main reservoir.

Table 3-5: Monitoring Frequency for Surface Water Quality Parameters

| Frequency of Monitoring | Parameters (Unit) | Monitoring Sites |
|-------------------------|---|--|
| Tuesdays and Saturdays | pH, DO (%), DO (mg/l), Conductivity ($\mu\text{S}/\text{cm}$), TDS (mg/l), Temperature ($^{\circ}\text{C}$) and Turbidity (NTU) | <ul style="list-style-type: none"> - NNG09, Nam Ngiep Upstream Main Dam (NNG09); - NNG05, Nam Ngiep Downstream the Re-regulation Dam at Ban Hat Gniun |
| Weekly | pH, DO (%), DO (mg/l), Conductivity ($\mu\text{S}/\text{cm}$), TDS (mg/l), Temperature ($^{\circ}\text{C}$), Turbidity (NTU), TSS (mg/l), BOD ₅ (mg/l), Faecal coliform (MPN/100 ml) and Total coliform (MPN/100 ml) | <ul style="list-style-type: none"> - NPH01, Lower Nam Phouan (Physical parameters only); - NNG02, (Physical parameters only); - NNG03, (Physical parameters only); - NNG09, Nam Ngiep Upstream Main Dam (NNG09); - R6, Re-regulation Reservoir; - R7, Re-regulation Reservoir 0.3 km Upstream the Re-Regulation Dam; - NNG05, Nam Ngiep Downstream the Re-regulation Dam at Ban Hat Gniun |
| Fortnightly | pH, DO (%), DO (mg/l), Conductivity ($\mu\text{S}/\text{cm}$), TDS (mg/l), Temperature ($^{\circ}\text{C}$), Turbidity (NTU) | All 14 stations |
| Monthly | TSS (mg/l), BOD ₅ (mg/l), COD (mg/l), NH ₃ -N (mg/l), NO ₃ -N (mg/l), total coliform (MPN/100 ml), faecal coliform (MPN/100 ml) | All 14 stations |
| Quarterly | Total iron (mg/l), Manganese (mg/l), total phosphorus (mg/l), TOC (mg/l) Total Kjeldahl Nitrogen (mg/l), Chloride (mg/l), Sulphate | All 14 stations |

| Frequency of Monitoring | Parameters (Unit) | Monitoring Sites |
|-----------------------------------|---|------------------|
| | (mg/l), Alkalinity (mg/l), Lead (mg/l), Arsenic (mg/l), Mercury (mg/l), Calcium (mg/l), Magnesium (mg/l), Potassium (mg/l), Sodium (mg/l) | |
| Once when water level at 312 masl | Total dissolved phosphorus (mg/l), phytoplankton biomass (g dry weight/m ³) | NNG09 |

Figure 3-5: Surface Water and Re-Regulation Reservoir Water Quality Monitoring Stations



The surface water quality data for June 2018 indicates that the levels of dissolved oxygen (DO) at the NNG09 may be affected by the impounding of the main reservoir, which started on 15 May 2018. Following the start of impounding, the DO levels in NNG09 immediately upstream the main dam have fluctuated between 3.85 mg/L and 7.83 mg/L. The DO measurements in R6 and R7 (re-regulation reservoir) have shown values from 6.19 mg/L to 8.74 mg/L and the DO in NNG05 downstream the re-regulation dam has remained above 7.26 mg/L.

Similarly, to the previous months, the levels of ammonia nitrogen are elevated and slightly exceeding the water quality standard at all stations during the first week of June 2018.

Table 3-6: Results of the Physical and Chemical Parameters of Nam Ngiep Surface Water Quality Monitoring

| | Station Code | NNG 01 | NNG0 2 | NNG0 3 | NNG0 9 | NNG0 4 / R6 | R7 | NNG0 5 | NNG0 6 | NNG0 7 | NNG0 8 |
|------------------------------|--------------|-----------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-----------|
| | Date | 05-Jun-18 | 12-Jun-18 | 12-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | | | | |
| pH | 5.0 - 9.0 | 7.99 | 6.43 | 6.39 | 7.97 | 7.59 | 7.57 | 7.97 | 6.63 | 7.38 | 7.16 |
| Sat. DO (%) | | 94 | 98 | 109.2 | 91.9 | 97.2 | 97.2 | 99.1 | 90.1 | 85.4 | 88.2 |
| DO (mg/l) | >6.0 | 7.35 | 7.43 | 8.45 | 6.79 | 7.54 | 7.53 | 7.54 | 6.86 | 6.65 | 6.67 |
| Conductivity (µs/cm) | | 77.9 | 68 | 69.2 | 70.4 | 68 | 70.2 | 54.6 | 69.7 | 42.9 | 43.3 |
| TDS (mg/l) | | 38.5 | 34 | 34 | 35.2 | 34 | 35 | 27.3 | 34.8 | 21.4 | 21.5 |
| Temperature (°C) | | 25.6 | 27.4 | 26.9 | 28.2 | 27.5 | 27.3 | 28.1 | 28 | 26.8 | 28.5 |
| Turbidity (NTU) | | 40.8 | 51.8 | 5.2 | 1.05 | 5.78 | 6.86 | 7.79 | 7.02 | 12.9 | 9 |
| TSS (mg/l) | | 242.48 | 102.78 | 10.34 | <5.0 | 6.36 | 7.52 | 14.2 | 12.2 | 43.03 | 18.43 |
| BOD ₅ (mg/l) | <1.5 | <1.0 | <1.0 | 3.64 | 1.75 | 1.02 | 1.08 | <1.0 | 1.07 | 1.06 | <1.0 |
| COD (mg/l) | <5 | 12.9 | 6.6 | 13.3 | 8.9 | 6.7 | 6.1 | 12.8 | 11.5 | 14.2 | 12.2 |
| NH ₃ -N (mg/l) | <0.2 | 1.68 | 0.39 | 2.5 | 0.99 | 3.4 | 0.83 | 4.97 | 1.6 | 1.57 | 2.96 |
| NO ₃ -N (mg/l) | <5 | 0.1 | 0.07 | <0.02 | 0.18 | 0.41 | 0.28 | 0.49 | 0.1 | 0.11 | 0.12 |
| Faecal coliform (MPN/100 ml) | <1,000 | 410 | 1,600 | 23 | 350 | 49 | 33 | 920 | 49 | 1,600 | 920 |
| Total Coliform (MPN/100 ml) | <5,000 | 480 | 1,600 | 240 | 1,600 | 130 | 79 | 1,600 | 1,600 | 1,600 | 1,600 |
| TKN | | <1.5 | <2.0 | <2.0 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 |
| Chloride (mg/l) | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| Sulphate (mg/l) | <500 | 8.2 | 8.5 | 11.5 | 10.7 | 12.4 | 7.8 | 27.6 | 20.5 | 16.6 | 11.7 |
| Alkalinity (mg/l) | | 65.3 | 50.4 | 57.2 | 51.5 | 53.8 | 59.5 | 41.2 | 66.4 | 44.7 | 36.6 |
| Arsenic (mg/l) | <0.01 | 0.0015 | 0.0009 | 0.0008 | <0.0003 | 0.0006 | 0.0004 | 0.0005 | 0.001 | 0.0009 | 0.0007 |
| Calcium (mg/l) | | 8.1 | 8.43 | 7.6 | 6.37 | 6.27 | 7.11 | 5.33 | 6.48 | 3.96 | 3.67 |
| Manganese (mg/l) | <1.0 | 0.188 | 0.117 | 0.018 | 0.017 | 0.105 | 0.079 | 0.126 | 0.099 | 0.056 | 0.032 |
| Mercury (mg/l) | <0.002 | 0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Potassium (mg/l) | | 1.16 | 0.794 | 1.49 | 1.31 | 0.713 | 0.75 | 0.783 | 0.781 | 0.747 | 0.57 |
| Sodium (mg/l) | | 2.3 | 1.09 | 1.09 | 1.29 | 0.928 | 1.06 | 0.915 | 1.35 | 0.929 | 1.01 |
| Total Iron (mg/l) | | 7.08 | 2.85 | 0.057 | 0.064 | 0.792 | 0.665 | 1.07 | 1.02 | 0.721 | 1.75 |
| Phytoplankton | | 99.1 | 46.2 | 3 | 0.82 | | | 11.4 | | | |

| | Station Code | NNG 01 | NNG0 2 | NNG0 3 | NNG0 9 | NNG0 4 / R6 | R7 | NNG0 5 | NNG0 6 | NNG0 7 | NNG0 8 |
|-----------------------------------|--------------|-----------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-----------|
| | Date | 05-Jun-18 | 12-Jun-18 | 12-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 | 07-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | | | | |
| Biomass (g dry wt/m3) | | | | | | | | | | | |
| Total Phosphorus (mg/l) | | 0.01 | <0.01 | <0.01 | <0.01 | | | <0.01 | | | |
| Total Dissolved Phosphorus (mg/l) | | <0.01 | <0.01 | <0.01 | <0.01 | | | <0.01 | | | |
| TOC (mg/l) | | 2.82 | 2.39 | 3.21 | 2.63 | | | 4.19 | | | |
| α-BHC | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| β-BHC | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| γ-BHC | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Heptachlor | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Aldrin | <0.1 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Heptachlor Epoxide | <0.2 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Endosulfan I | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| p,p-DDE | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Dieldrin | <0.1 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Endrin | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Endosulfan li | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| p,p-DDD | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Endrin Aldehyde | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Endosulfan Sulfate | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| p,p-DDT | <1 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Methoxychlor | | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 | NNG06 | NNG07 | NNG08 |
|----------------------|--------------|-------|-------|-------|-----------|------------|-----------|-----------|-----------|-----------|-----------|
| | Date | | | | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | | | | |
| pH | 5.0 - 9.0 | | | | 7.38 | 7.32 | 6.94 | 7.48 | 7.13 | 6.21 | 7.1 |
| Sat. DO (%) | | | | | 79.8 | 90.9 | 93.8 | 97.7 | 94 | 77.9 | 86.7 |
| DO (mg/l) | >6.0 | | | | 6.14 | 7.21 | 7.18 | 7.57 | 7.37 | 6.21 | 6.98 |
| Conductivity (µs/cm) | | | | | 66.5 | 38.7 | 41.1 | 27.4 | 48.9 | 19.33 | 24.8 |
| TDS (mg/l) | | | | | 33 | 19.35 | 20.1 | 14 | 24 | 10 | 12.4 |
| Temperature (°C) | | | | | 26.6 | 25.9 | 28.2 | 27.1 | 26.4 | 25.6 | 25.1 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 | NNG06 | NNG07 | NNG08 |
|-----------------------------|--------------|-------|-------|-------|-----------|------------|-----------|-----------|-----------|-----------|-----------|
| | Date | | | | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 | 21-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | | | | |
| Turbidity (NTU) | | | | | 2.27 | 74.75 | 85.45 | 230 | 61.8 | 64.88 | 78.66 |
| TSS (mg/l) | | | | | <5.0 | 127.32 | 68.27 | 143.5 | | | |
| BOD ₅ (mg/l) | <1.5 | | | | 1.89 | <1.0 | 1.27 | <1.0 | | | |
| Faecal coliform (MPN/100ml) | <1,000 | | | | 11 | 170 | 1,600 | 170 | | | |
| Total Coliform (MPN/100ml) | <5,000 | | | | 1,600 | 1,600 | 1,600 | 1,600 | | | |

Table 3-7: Results of Nam Ngiep Surface Water Quality Monitoring

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|----------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 02-Jun-18 | | | 02-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 7.68 | | | 7.72 |
| Sat. DO (%) | | | | | 104.2 | | | 103 |
| DO (mg/l) | >6.0 | | | | 7.41 | | | 7.52 |
| Conductivity (µs/cm) | | | | | 72.9 | | | 48.6 |
| TDS (mg/l) | | | | | 36.4 | | | 24.3 |
| Temperature (°C) | | | | | 31 | | | 30.2 |
| Turbidity (NTU) | | | | | 2.74 | | | 12.6 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|----------------------|--------------|-----------|-----------|-----------|-----------|------------|----|-----------|
| | Date | 19-Jun-18 | 19-Jun-18 | 19-Jun-18 | 19-Jun-18 | | | 19-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | 7.17 | 7.38 | 7.82 | 7.3 | | | 6.82 |
| Sat. DO (%) | | 91.9 | 94.8 | 131.5 | 83.2 | | | 95.9 |
| DO (mg/l) | >6.0 | 7.21 | 7.22 | 9.75 | 6.28 | | | 7.63 |
| Conductivity (µs/cm) | | 77.3 | 56 | 67.5 | 65.7 | | | 45.2 |
| TDS (mg/l) | | 38.65 | 28 | 33.75 | 32.85 | | | 22.6 |
| Temperature (°C) | | 25.2 | 27.1 | 28.7 | 23.9 | | | 25.4 |
| Turbidity (NTU) | | 45.68 | 69.82 | 4.4 | 1.52 | | | 121.64 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|-------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 09-Jun-18 | | | 09-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 7.76 | | | 7.19 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|----------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 09-Jun-18 | | | 09-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| Sat. DO (%) | | | | | 92.8 | | | 102.5 |
| DO (mg/l) | >6.0 | | | | 7.01 | | | 7.85 |
| Conductivity (µs/cm) | | | | | 86.8 | | | 51.9 |
| TDS (mg/l) | | | | | 43.4 | | | 26 |
| Temperature (°C) | | | | | 27.9 | | | 27.6 |
| Turbidity (NTU) | | | | | 2.23 | | | 18.11 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|-----------------------------|--------------|-------|-------|-------|-----------|------------|-----------|-----------|
| | Date | | | | 14-Jun-18 | 14-Jun-18 | 14-Jun-18 | 14-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 7.17 | 7.01 | 6.29 | 6.98 |
| Sat. DO (%) | | | | | 90.8 | 87.7 | 82 | 96.4 |
| DO (mg/l) | >6.0 | | | | 6.97 | 6.6 | 6.19 | 7.35 |
| Conductivity (µs/cm) | | | | | 71.8 | 56.1 | 57.4 | 47.1 |
| TDS (mg/l) | | | | | 36 | 28 | 28.5 | 23.5 |
| Temperature (°C) | | | | | 26.6 | 28.5 | 28.3 | 27.7 |
| Turbidity (NTU) | | | | | 2.48 | 27.74 | 41.16 | 76.31 |
| TSS (mg/l) | | | | | 6.08 | 20.13 | 29.05 | 49.32 |
| BOD ₅ (mg/l) | <1.5 | | | | 2.03 | 1.01 | <1.0 | <1.0 |
| Faecal coliform (MPN/100ml) | <1,000 | | | | 920 | 49 | 33 | 280 |
| Total Coliform (MPN/100ml) | <5,000 | | | | 1,600 | 79 | 79 | 920 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|----------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 16-Jun-18 | | | 16-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 6.73 | | | 6.79 |
| Sat. DO (%) | | | | | 62.1 | | | 97.9 |
| DO (mg/l) | >6.0 | | | | 5.39 | | | 7.44 |
| Conductivity (µs/cm) | | | | | 84.7 | | | 48.7 |
| TDS (mg/l) | | | | | 42.35 | | | 24.35 |
| Temperature (°C) | | | | | 27.1 | | | 27.7 |
| Turbidity (NTU) | | | | | 4.18 | | | 29.53 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|-------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 23-Jun-18 | | | 23-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 6.85 | | | 7 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|----------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 23-Jun-18 | | | 23-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| Sat. DO (%) | | | | | 94.9 | | | 101.9 |
| DO (mg/l) | >6.0 | | | | 6.91 | | | 7.49 |
| Conductivity (µs/cm) | | | | | 67.3 | | | 47.4 |
| TDS (mg/l) | | | | | 33.65 | | | 23.7 |
| Temperature (°C) | | | | | 30.2 | | | 29.5 |
| Turbidity (NTU) | | | | | 1.46 | | | 54.95 |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|-----------------------------|--------------|-------|-------|-------|-----------|------------|-----------|-----------|
| | Date | | | | 29-Jun-18 | 29-Jun-18 | 29-Jun-18 | 29-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 7.85 | 7.96 | 6.93 | 7.98 |
| Sat. DO (%) | | | | | 83.2 | 94.2 | 117.3 | 95 |
| DO (mg/l) | >6.0 | | | | 6.31 | 7.24 | 8.74 | 7.26 |
| Conductivity (µs/cm) | | | | | 66.4 | 39.3 | 40.3 | 33.2 |
| TDS (mg/l) | | | | | 33.2 | 19.1 | 20.1 | 16.5 |
| Temperature (°C) | | | | | 27.3 | 27.5 | 29 | 27.3 |
| Turbidity (NTU) | | | | | 1.23 | 22.88 | 36.14 | 42.68 |
| TSS (mg/l) | | | | | <5.0 | 15.48 | 23.44 | 36.1 |
| BOD ₅ (mg/l) | <1.5 | | | | Pending | Pending | Pending | Pending |
| Faecal coliform (MPN/100ml) | <1,000 | | | | Pending | Pending | Pending | Pending |
| Total Coliform (MPN/100ml) | <5,000 | | | | Pending | Pending | Pending | Pending |

| | Station Code | NNG01 | NNG02 | NNG03 | NNG09 | NNG04 / R6 | R7 | NNG05 |
|----------------------|--------------|-------|-------|-------|-----------|------------|----|-----------|
| | Date | | | | 30-Jun-18 | | | 30-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | | |
| pH | 5.0 - 9.0 | | | | 7.45 | | | 7.74 |
| Sat. DO (%) | | | | | 54.6 | | | 94.5 |
| DO (mg/l) | >6.0 | | | | 4.13 | | | 7.35 |
| Conductivity (µs/cm) | | | | | 66.6 | | | 33.8 |
| TDS (mg/l) | | | | | 33 | | | 17 |
| Temperature (°C) | | | | | 27.7 | | | 27.7 |
| Turbidity (NTU) | | | | | 1.33 | | | 31.7 |

Table 3-8 *Results of Physical and Chemical Parameters of Nam Chian, Nam Phouan, Nam Xao and Nam Houay Soup*

| | Station Code | NCH01 | NPH01 | NXA01 | NHS01 |
|--|--------------|-----------|-----------|-----------|-----------|
| | Date | 05-Jun-18 | 12-Jun-18 | 07-Jun-18 | 07-Jun-18 |
| Parameters (Unit) | Guideline | | | | |
| pH | 5.0 - 9.0 | 8.05 | 6.63 | 6.53 | 6.76 |
| Sat. DO (%) | | 101 | 99 | 92.2 | 92.9 |
| DO (mg/l) | >6.0 | 8.11 | 7.74 | 6.82 | 7.18 |
| Conductivity (µs/cm) | | 30.1 | 44.4 | 109.5 | 17.62 |
| TDS (mg/l) | | 15 | 22 | 54.5 | 8.8 |
| Temperature (°C) | | 24 | 25.7 | 29.3 | 27.2 |
| Turbidity (NTU) | | 8.61 | 207 | 4.02 | 5.58 |
| TSS (mg/l) | | 26.72 | 282.26 | 7.14 | 14.14 |
| BOD ₅ (mg/l) | <1.5 | <1.0 | <1.0 | 1.01 | 1.8 |
| COD (mg/l) | <5 | 5.3 | 25.2 | 4.9 | 19 |
| NH ₃ -N (mg/l) | <0.2 | 2.13 | 0.74 | 1.59 | 0.73 |
| NO ₃ -N (mg/l) | <5 | 0.14 | 0.09 | 0.11 | 0.07 |
| Faecal coliform (MPN/100ml) | <1,000 | 1,600 | 1,600 | 790 | 170 |
| Total Coliform (MPN/100ml) | <5,000 | 1,600 | 1,600 | 3,500 | 1,600 |
| TKN | | <1.5 | <2.0 | <1.5 | <1.5 |
| Chloride (mg/l) | | <2.0 | <2.0 | 3.9 | <2.0 |
| Sulphate(mg/l) | <500 | 6 | 13.9 | 7.5 | 1.7 |
| Alkalinity (mg/l) | | 25.2 | 36.6 | 82.4 | 13.7 |
| Arsenic (mg/l) | <0.01 | 0.0005 | 0.0015 | 0.0006 | <0.0003 |
| Calcium (mg/l) | | 2.32 | 6.18 | 8.84 | 8.03 |
| Manganese (mg/l) | <1.0 | 0.056 | 0.25 | 0.062 | 0.046 |
| Mercury (mg/l) | <0.002 | 0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Potassium (mg/l) | | 0.725 | 1.52 | 0.821 | 0.369 |
| Sodium (mg/l) | | 0.826 | 0.751 | 2.55 | 0.38 |
| Total Iron (mg/l) | | 1.38 | 5.38 | 0.712 | 1.41 |
| Phytoplankton Biomass (g dry wt/m ³) | | 21 | 118 | | |
| Total Phosphorus (mg/l) | | 0.01 | <0.01 | | |
| Total Dissolved Phosphorus (mg/l) | | <0.01 | <0.01 | | |
| TOC (mg/l) | | 1.94 | 3.7 | | |
| α-BHC | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| β-BHC | | <0.02 | <0.02 | <0.02 | <0.02 |
| γ-BHC | | <0.02 | <0.02 | <0.02 | <0.02 |
| Heptachlor | | <0.02 | <0.02 | <0.02 | <0.02 |
| Aldrin | <0.1 | <0.02 | <0.02 | <0.02 | <0.02 |
| Heptachlor Epoxide | <0.2 | <0.02 | <0.02 | <0.02 | <0.02 |
| Endosulfan I | | <0.02 | <0.02 | <0.02 | <0.02 |
| p,p-DDE | | <0.04 | <0.04 | <0.04 | <0.04 |

| | Station Code | NCH01 | NPH01 | NXA01 | NHS01 |
|--------------------|--------------|-----------|-----------|-----------|-----------|
| | Date | 05-Jun-18 | 12-Jun-18 | 07-Jun-18 | 07-Jun-18 |
| Parameters (Unit) | Guideline | | | | |
| Dieldrin | <0.1 | <0.04 | <0.04 | <0.04 | <0.04 |
| Endrin | | <0.04 | <0.04 | <0.04 | <0.04 |
| Endosulfan li | | <0.04 | <0.04 | <0.04 | <0.04 |
| p,p -DDD | | <0.04 | <0.04 | <0.04 | <0.04 |
| Endrin Aldehyde | | <0.04 | <0.04 | <0.04 | <0.04 |
| Endosulfan Sulfate | | <0.04 | <0.04 | <0.04 | <0.04 |
| p,p -DDT | <1 | <0.04 | <0.04 | <0.04 | <0.04 |
| Methoxychlor | | <0.04 | <0.04 | <0.04 | <0.04 |

Table 3-9: Physical Parameters Results of Surface Water Quality – Nam Chian, Nam Phouan, Nam Xao and Nam Houay Soup (measured Every Fortnight)

| | Station Code | NCH01 | NPH01 | NXA01 | NHS01 |
|----------------------|--------------|-----------|-----------|-----------|-----------|
| | Date | 19-Jun-18 | 19-Jun-18 | 21-Jun-18 | 21-Jun-18 |
| Parameters (Unit) | Guideline | | | | |
| pH | 5.0 - 9.0 | 7.93 | 7.69 | 7.07 | 7.51 |
| Sat. DO (%) | | 101.1 | 99.9 | 95.2 | 91.5 |
| DO (mg/l) | >6.0 | 8.07 | 7.87 | 7.42 | 7.22 |
| Conductivity (µs/cm) | | 25.8 | 68.4 | 59.1 | 10.25 |
| TDS (mg/l) | | 12.9 | 34.2 | 30 | 5 |
| Temperature (°C) | | 24.1 | 25.3 | 26.7 | 26.1 |
| Turbidity (NTU) | | 53.24 | 76.55 | 37.65 | 10.53 |

3.2.3 Groundwater Quality Monitoring

During June 2018, groundwater quality analyses were carried out for four newly constructed boreholes, one at Somseun village, one at Nam Pa village, one at Thong Noi village and one at Pou village. Six community boreholes at Phouhomxay village have been permanently replaced with gravity fed water supply system. In addition, monitoring of four boreholes at NNP1 Landfill and one borehole at Houaysoup Landfill were continued.

All results complied with the community groundwater quality standards for water supply purposes, except two boreholes (GTHN01 in Thong Noi Village and GNPA01 in NamPa Village) for faecal coliform and Ecoli bacteria. The monitoring results were shared with ESD-SMO as part of NNP1PC public health programme and communicated to the villagers and the local health authorities.

Figure 3-6: Groundwater Quality Monitoring Locations

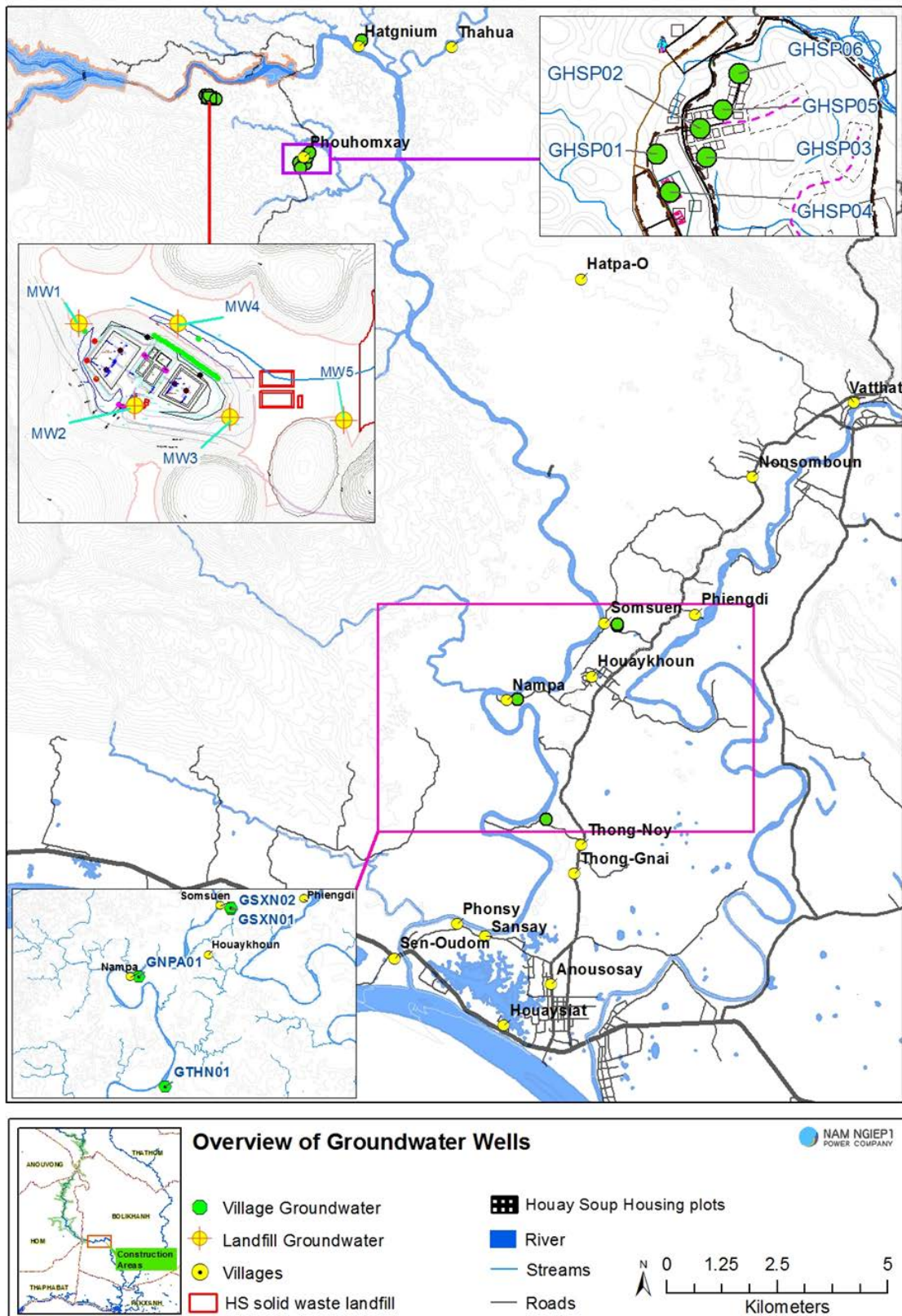


Table 3-10: Groundwater Quality Monitoring Results, Somsuen, Nam Pa, Thongnoi and Pou Villages

| | Site Name | Somseun Village | | NamPa Village | ThongNoy Village | Pou Village |
|-----------------------------|-----------|-----------------|---|---------------|------------------|-------------|
| | Station | GSXN01 | GSXN02 | GNPA01 | GTHN01 | GPOU01 |
| Parameter (Unit) | Guideline | | | | | |
| pH | 6.5 - 9.2 | 7.36 | This borehole was connected with GSXN01 since June 2018 | 7.15 | 7.14 | 6.23 |
| Sat. DO (%) | | 82.4 | | 92.6 | 83.4 | 88.3 |
| DO (mg/l) | | 6.37 | | 7.11 | 6.27 | 6.71 |
| Conductivity (µS/cm) | | 304 | | 303 | 312 | 22.2 |
| TDS (mg/l) | | 152 | | 151.5 | 156 | 11.1 |
| Temperature (°C) | | 27.3 | | 27.6 | 28.8 | 27.1 |
| Turbidity (NTU) | <20 | 2.41 | | 0.95 | 3.53 | 3.48 |
| Fecal coliform (MPN/100ml) | 0 | 0 | | 350 | 280 | 0 |
| E.coli Bacteria (MPN/100ml) | 0 | 0 | | 350 | 280 | 0 |
| Arsenic (mg/) | <0.05 | <0.0003 | | <0.0003 | <0.0003 | |
| Total Iron (mg/l) | | <0.010 | | <0.010 | 0.104 | |
| Magnesium (mg/l) | | 3.14 | | 2.28 | 3.23 | |
| Manganese (mg/l) | <0.5 | <0.005 | | <0.005 | <0.005 | |
| Fluoride (mg/l) | <1 | <0.02 | | <0.02 | 0.06 | |
| Total hardness (mg/l) | <500 | 184 | | 163 | 179 | |
| Nitrate (mg/l) | <45 | 0.93 | | 0.84 | 1.15 | |
| Nitrite (mg/l) | <3 | <0.02 | | <0.02 | <0.02 | |
| Lead (mg/l) | <0.05 | <0.008 | | <0.008 | <0.008 | |

3.2.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

The groundwater quality in the monitoring wells located at the NNP1 Project Landfill and the Houay Soup Landfill was monitored on 15 June 2018. Similar to previous monitoring results, the concentration of lead in the monitoring wells MW1, MW4 and MW5 exceeded the relevant groundwater quality standard.

Table 3-11: Groundwater Quality Monitoring Results at NNP1 Project Landfill and Houay Soup Solid Waste Landfill

| | Site Name | NNP1 Project Landfill | | | | Houay Soup Landfill |
|----------------------|-----------|-----------------------|-----------|-----------|-----------|---------------------|
| | Station | MW1 | MW2 | MW3 | MW4 | MW5 |
| | Date | 15-Jun-18 | 15-Jun-18 | 15-Jun-18 | 15-Jun-18 | 15-Jun-18 |
| Parameter (Unit) | Guideline | | | | | |
| pH | | 5.63 | 6.47 | 6.19 | 5.22 | 6.14 |
| Sat. DO (%) | | 23.5 | 47.1 | 14.3 | 25.8 | 48.4 |
| DO (mg/l) | | 1.82 | 3.55 | 1.11 | 2.03 | 3.74 |
| Conductivity (µS/cm) | | 107 | 126.3 | 156.9 | 28.2 | 68.4 |
| TDS (mg/l) | | 53.5 | 63 | 78.4 | 41.1 | 34.2 |

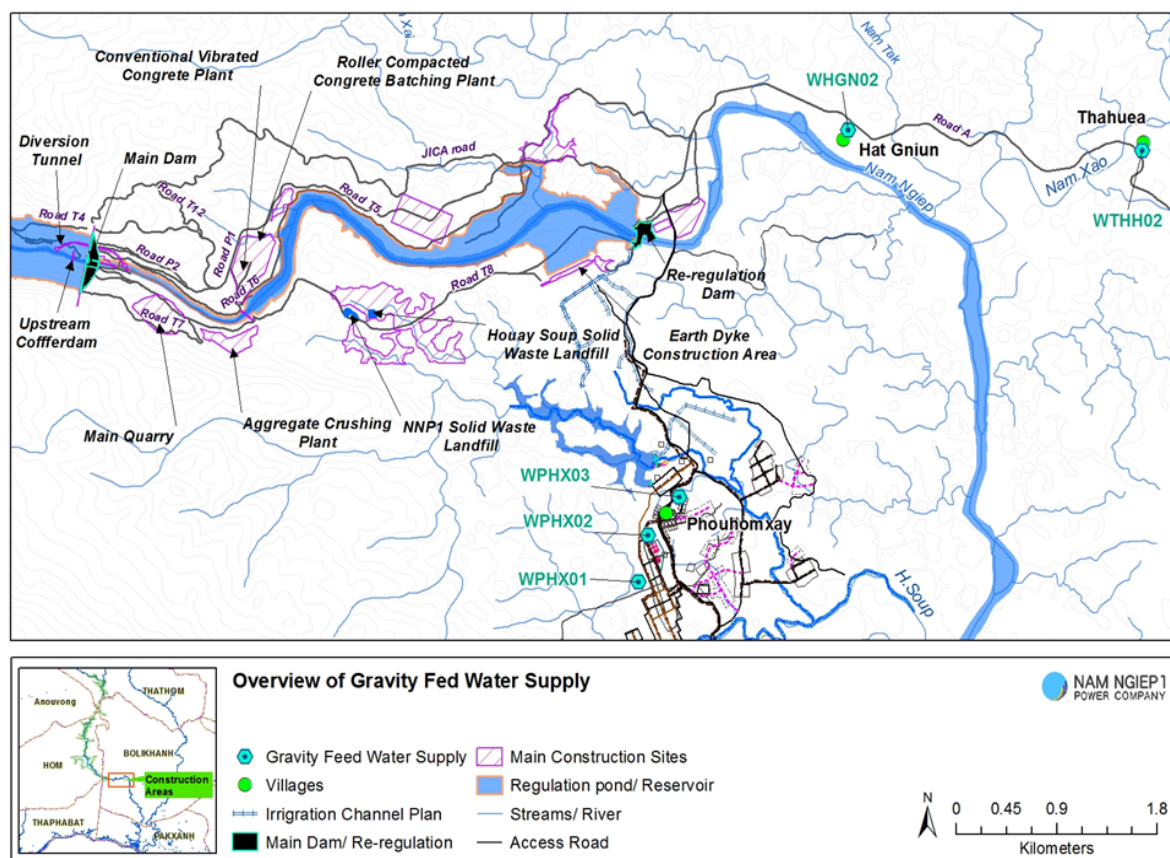
| Parameter (Unit) | Site Name | NNP1 Project Landfill | | | | Houay Soup Landfill |
|-----------------------------|-----------|-----------------------|-----------|-----------|-----------|---------------------|
| | Station | MW1 | MW2 | MW3 | MW4 | MW5 |
| | Date | 15-Jun-18 | 15-Jun-18 | 15-Jun-18 | 15-Jun-18 | 15-Jun-18 |
| | Guideline | | | | | |
| Temperature (°C) | | 26.5 | 28.5 | 26.6 | 25.9 | 26.9 |
| Turbidity (NTU) | | 6.7 | 5.59 | 2.90 | 20.12 | 14.64 |
| Total Nitrogen (mg/l) | | 3.06 | 1.87 | 2.66 | 4.56 | 1.68 |
| Lead (mg/l) | <0.01 | 0.226 | 0.062 | 0.072 | 0.118 | 0.190 |
| Total Phosphorus (mg/l) | | 0.02 | 0.03 | 0.10 | 0.02 | 0.03 |
| Faecal Coliform (MPN/100ml) | | 0 | 0 | 2 | 0 | 0 |
| Total Coliform (MPN/100ml) | | 0 | 0 | 2 | 0 | 0 |
| NH ₃ -N (mg/l) | | 2.90 | 1.76 | 2.52 | 4.34 | 1.43 |
| Copper (mg/l) | | 0.005 | 0.008 | 0.006 | <0.003 | <0.003 |
| Total Petroleum (mg/l) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Water level (m) | | 28 | 30 | 18 | 15 | 15 |

3.2.5 Gravity Fed Monitoring

During June 2018, water samples were taken from water taps at Thahuea, Hat Gniun and Phouhomxay villages.

The results indicated all parameters monitored at NNP1 Landfill were complied with the Standard.

Figure 3-7 Gravity Fed Monitoring Locations



All parameters complied with the National Drinking Water Standards for Thahuea, Hat Gniun and Phouhomxay villages except for faecal coliforms and E.Coli. According to the Law on Hygiene, Disease Prevention and Health Promotion No 01/NA of 10 April 2001, "Presence of E.Coli in the Gravity Feed Water Supply System is a common and seasonal situation, domestic water supply for daily use is not readily drinkable, but should be boil or treated before drinking". The local villagers were informed about the results and encouraged to boil water before drinking.

Table 3-12: Result Gravity Fed Water Supply (GFWS) Quality Monitoring

| | | Site Name | Thahe u Village | Hat Gnuin Village | Phouhomxay Village | | |
|-----------|--------------------------------|-----------|-----------------------|-------------------------|--------------------|------------|------------|
| | | Station | WTHH0 2 | WHGN0 2 | WPHX0 1 | WPHX0 2 | WPHX0 3 |
| Date | Parameter (Unit) | Guideline | | | | | |
| 20-Jun-18 | pH | 6.5 - 8.6 | 6.78 | 7.32 | 7.31 | 7.04 | 7.5 |
| 20-Jun-18 | Sat. DO (%) | | 90.1 | 95.3 | 99.5 | 89.4 | 84.9 |
| 20-Jun-18 | DO (mg/l) | | 7.00 | 7.45 | 7.84 | 7.08 | 6.69 |
| 20-Jun-18 | Conductivity (μ S/cm) | <1,000 | 30.8 | 44.9 | 17.24 | 33.3 | 11.28 |
| 20-Jun-18 | TDS (mg/l) | <600 | 15 | 22 | 9 | 17 | 6 |
| 20-Jun-18 | Temperature (°C) | <35 | 27 | 26.6 | 26.1 | 25.8 | 26.2 |
| 20-Jun-18 | Turbidity (NTU) | <10 | 9.94 | 14 | 1.46 | 5.52 | 6.17 |
| 20-Jun-18 | Faecal Coliform (MPN/100ml) | 0 | 240 | 1,600 | 39 | 1,600 | 1,600 |
| 20-Jun-18 | E.coli Bacteria (MPN/100ml) | 0 | 240 | 1,600 | 39 | 1,600 | 1,600 |
| 20-Jun-18 | Arsenic (mg/l) | <0.05 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 |
| 20-Jun-18 | Cadmium (mg/l) | <0.003 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| 20-Jun-18 | Iron (mg/l) | | 0.161 | 0.127 | 0.0565 | 0.183 | 0.137 |
| 20-Jun-18 | Lead (mg/l) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| 20-Jun-18 | Magnesium (mg/l) | | 0.756 | 1.09 | 0.271 | 0.394 | 0.372 |
| 20-Jun-18 | Manganese (mg/l) | <0.5 | 0.0661 | <0.005 | <0.005 | <0.005 | <0.005 |
| 20-Jun-18 | Fluoride (mg/l) | <1.5 | <0.02 | 0.18 | 0.04 | 0.04 | <0.02 |
| 20-Jun-18 | Nitrate (mg/l) | <50 | 0.49 | 0.18 | 0.35 | 0.53 | 0.44 |

| | | Site Name | Thaheau Village | Hat Gnuin Village | Phouhomxay Village | | |
|-----------|-----------------------|-----------|-----------------|-------------------|--------------------|---------|---------|
| | | Station | WTHH02 | WHGN02 | WPHX01 | WPHX02 | WPHX03 |
| Date | Parameter (Unit) | Guideline | | | | | |
| 20-Jun-18 | Nitrite (mg/l) | <3 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 20-Jun-18 | Total hardness (mg/l) | <300 | 32.5 | 36.6 | 22.8 | 21.1 | 19.4 |
| 20-Jun-18 | Selenium (mg/l) | <0.01 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| 20-Jun-18 | Mercury (mg/l) | <0.001 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |

3.2.6 Landfill Leachate Monitoring

During June 2018, the landfill leachate monitoring was conducted for NNP1 (last pond – LL4) and Houay Soup Solid Waste Landfills (discharge point – LL7).

The results indicate that the treated leachate comply with the relevant effluent standards.

Figure 3-8 Landfill Leachate Monitoring Location

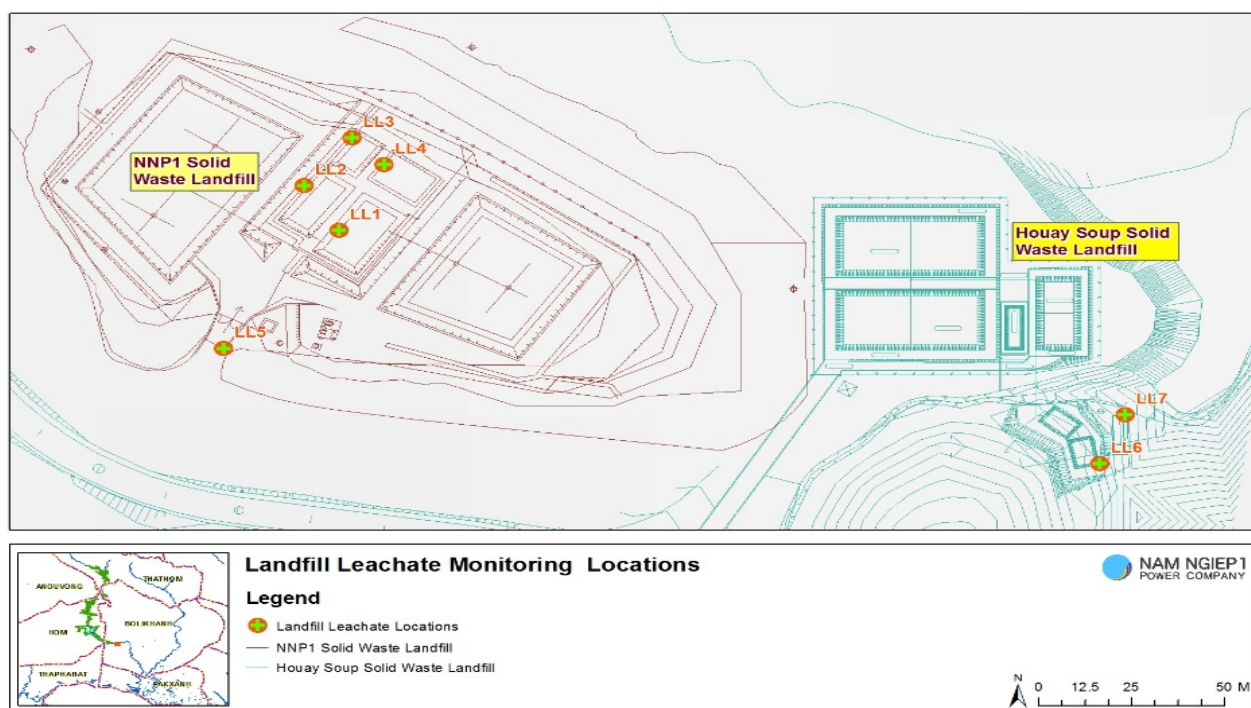


Table 3-13: *Landfill Leachate Monitoring Results*

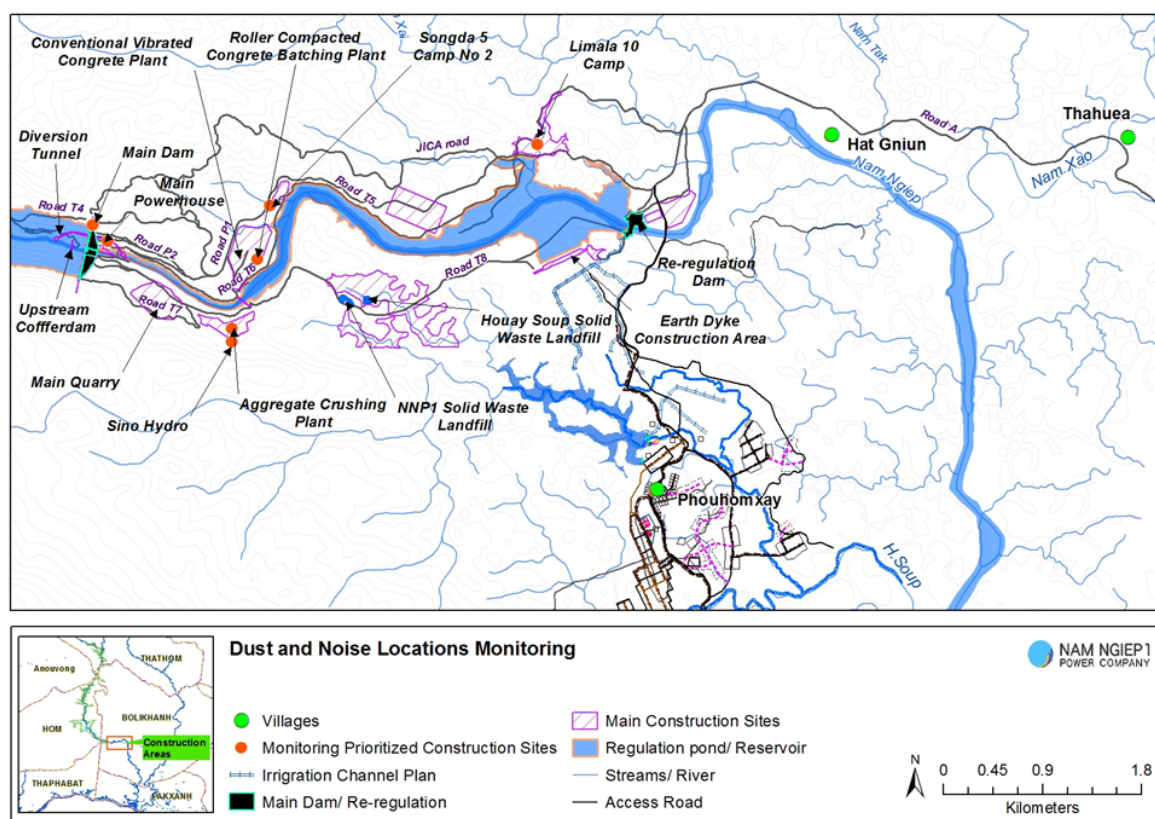
| | Site Name | NNP1 Landfill Leachate | Houay Soup Landfill |
|-------------------------------------|-----------|------------------------|---------------------|
| | Location | Pond No.04 | Discharged Point |
| | Station | LL4 | LL7 |
| | Date | 15-June-18 | 15-June-18 |
| Parameter (Unit) | Guideline | | |
| pH | 6.0-9.0 | 7.34 | 6.81 |
| Sat. DO (%) | | 118 | 65 |
| DO (mg/l) | | 8.74 | 4.85 |
| Conductivity (µS/cm) | | 218.2 | 83.3 |
| TDS (mg/l) | | 109 | 41.5 |
| Temperature (°C) | | 29 | 28.8 |
| Turbidity (NTU) | | 12.14 | 1.39 |
| BOD (mg/l) | <30 | 4.29 | 1.54 |
| COD (mg/l) | <125 | 66 | <25 |
| Faecal Coliform (MPN/100ml) | | 79 | 33 |
| Total Coliform (MPN/100ml) | <400 | 350 | 49 |
| Mercury (mg/l) | | <0.0005 | <0.0005 |
| Total nitrogen (mg/l) | <10 | 3.65 | 0.71 |
| Arsenic (mg/l) | | 0.0016 | <0.0003 |
| Manganese (mg/l) | | 0.252 | 0.142 |
| Lead (mg/l) | <0.2 | <0.010 | <0.010 |
| Iron (mg/l) | | 0.524 | 0.166 |
| Total Petroleum Hydrocarbons (mg/l) | | <1 | <1 |

3.2.7 Dust Monitoring

The results indicated non-compliance with the National Standard at the main powerhouse. The results were shared with EMO-compliance and TD-safety teams as a reference for inspection to ensure proper establishment of health & safety procedures (traffic access restriction, wear proper personal protective equipment including masks, eye protection).

3.2.8 Noise Monitoring

During June 2018, noise monitoring was conducted for 72 consecutive hours at Hat Gniun and Phouhomxay villages, and 24 consecutive hours at the Aggregate Crushing Plant, RCC Plant, Sino Hydro Main Camp, Sino Hydro Temporary Worker Camp, Main Dam, Lilama10 Camp, and the main powerhouse.

Figure 3-9: Noise and Dust Emission Monitoring Locations

The results indicate compliance with National Standard at all stations for the monitored period, except the Phouhomxay Village during 22:01-06:00 on 26-27 June 2018. The exceedance of noise level at Phouhomxay was likely caused by a rain event.

3.3 PROJECT WASTE MANAGEMENT

3.3.1 Solid Waste Management

In June 2018, a total of 160.4 m³ solid waste was disposed at the NNP1 Project Landfill, a decrease of 44 m³ compared to May 2018. During June 2018, NNP1PC-EMO conducted two waste spot checks at the landfill. Waste from Kenber, Sino-Hydro and GFE contractor was not separate properly before transporting to the landfill. NNP1PC returned the waste and provided first warning to the contractor for proper segregation of waste before disposing.

A total of 1,127.8 kg of recyclable waste was sold to Khounmixay Processing Factory by the Contractors.

Table 3-14: Amounts of Recyclable Waste Sold

| Source and Type of Recycled Waste | | Unit | Sold | Cumulative Total by 30 June 2018 |
|-----------------------------------|-----------------|-----------|--------------|----------------------------------|
| Construction activity | | | | |
| 1 | Scrap metal | kg | 1,005 | 42,412 |
| Sub-Total 1 | | kg | 1,005 | 42,412 |
| Operation camp | | | | |
| 2 | Glass bottles | kg | 0 | 1,472 |
| 3 | Plastic bottles | kg | 24 | 193 |

| Source and Type of Recycled Waste | | Unit | Sold | Cumulative Total by 30 June 2018 |
|-----------------------------------|-----------------|-----------|----------------|----------------------------------|
| 4 | Paper/Cardboard | kg | 74 | 136 |
| 5 | Aluminium can | kg | 24.8 | 36.2 |
| Sub-Total 2 | | kg | 122.8 | 1,837.2 |
| Grand Total 1+2 | | kg | 1,127.8 | 44,249.2 |

A total of 4,450 kg (increased 2,679 kg compared to May 2018) food waste was collected in June 2018 from selected camps by villagers of Phouhomxay for animal feeding.

Table 3-15 Amounts of Food Waste Collected by Villagers

| NO. | SITE NAME | UNIT | TOTAL |
|--------------|---|-----------|--------------|
| 1 | Song Da 5 Camp No. 2 | kg | 1,376 |
| 2 | Song Da 5 Camp No. 1 | kg | 707 |
| 3 | Obayashi Corporation Camp | kg | 724 |
| 4 | Owner's Village and Site Office (OSOVI) | kg | 563 |
| 5 | LILAMA 10 Camp | kg | 871 |
| 6 | Kenber Camp | kg | 209 |
| Total | | kg | 4,450 |

3.3.2 Hazardous Materials and Waste Management

The hazardous waste was collected and transported for offsite treatment and final disposed at Khounmixay processing factory for the reported period.

Table 3-16: Results of Hazardous Material Inventory

| No. | Hazardous Waste Type | Unit | Total in Jun 2018 (A) | Disposed (B) | Remainder (A - B) |
|-----|---|------------------|-----------------------|--------------|-------------------|
| 1 | Used hydraulic and engine oil | litre (l) | 9,770 | 600 | 9,170 |
| 2 | Contaminated soil, sawdust and concrete | kg | 775 | 0 | 775 |
| 3 | Used oil filters | No. | 329 | 0 | 329 |
| 4 | Used tire | No. | 324 | 0 | 324 |
| 5 | Empty used chemical drum/container | Drum (20 litter) | 180 | 0 | 180 |
| 6 | Empty paint and spray cans | can | 180 | 0 | 180 |
| 7 | Halogen/fluorescent bulbs | No. | 162 | 0 | 162 |
| 8 | Ink cartridge | No. | 130 | 0 | 130 |
| 9 | Empty used chemical drum/container | drum (200 l) | 122 | 31 | 91 |
| 10 | Empty used oil drum/container | drum (20 l) | 91 | 13 | 78 |
| 11 | Empty used oil drum/container | drum (200 l) | 45 | 5 | 40 |
| 12 | Contaminated textile and material | kg | 31 | 0 | 31 |
| 13 | Lead acid batteries | No. | 22 | 0 | 22 |

| No. | Hazardous Waste Type | Unit | Total in Jun 2018 (A) | Disposed (B) | Remainder (A - B) |
|-----|---|--------------|-----------------------|--------------|-------------------|
| 14 | Empty contaminated bitumen drum/container | drum (200 l) | 17 | 2 | 15 |
| 15 | Lithium-ion batteries | No. | 7 | 0 | 7 |
| 16 | Clinical waste | kg | 40.6 | 40.6 | 0 |
| 17 | Acid and caustic cleaners | Bottle | 0 | 0 | 0 |
| 18 | Cement bag | bag | 0 | 0 | 0 |
| 19 | Used oil mixed with water | litre (l) | 0 | 0 | 0 |

In addition, a total of 300 kg compost was produced from grass, cow dung, rice husks, molasses, bio-effect (BE) and leftover vegetables and fruits from the canteens and used by villagers who served as workers at the landfill and OSOV, and a total of 40.6 kg of clinical waste from NNP1PC, OC contractor, Song Da 5 and Sino-Hydro sub-contractors was incinerated at the Vientiane landfill, as well as a total of 8 m³ of sewage sludge from OC contractor was transported and disposed at Disposal area #6 as following NNP1PC's SOP.

3.4 Community Waste Management

3.4.1 Community Recycling Programme

In June 2018, a total of 612 kg of recyclable waste was recorded at the Community Waste Bank, a decrease of 67 kg compared to May 2018.

Table 3-17: Types and Amounts of Recyclable Waste Traded at the Community Waste Bank

| Types of Waste | Unit | Remaining in May 2018 | Additions in Jun 2018 | Sold | Remaining in Jun 2018 |
|-----------------|-----------|-----------------------|-----------------------|------------|-----------------------|
| Scrap metal | kg | 16 | 0 | 0 | 16 |
| Glass bottles | kg | 1,153.5 | 248 | 0 | 1,401.5 |
| Paper/cardboard | kg | 529.5 | 240.5 | 0 | 770 |
| Aluminium cans | kg | 52.5 | 2 | 41 | 13.5 |
| Plastic bottles | kg | 225 | 121.5 | 195 | 151.5 |
| Total | kg | 1,976.5 | 612 | 236 | 2,352.5 |

3.4.2 Community Solid Waste Management

In June 2018, approximate of 35.1 m³ of solid waste was collected from Phouhomxay, Thahuea and Hat Gniun villages. The solid waste was collected and transported from Phouhomxay, Thahuea, Hat Gniun villages to Houay Soup Landfill three days/week (Mondays, Wednesdays and Fridays), and segregated before disposing at the Houay Soup Landfill.

3.5 Watershed and Biodiversity Management

3.5.1 Watershed Management

3.5.1.1 Preparation of the Watershed Management Plan

NNP1 Watershed and Reservoir Protection Office (WRPO) in coordination with NNP1PC and relevant GOL offices improved the NNP1 Watershed Management Plan based on the workshop at the end of May 2018. The focus of the improvements included institutional arrangements, achievement indicators, budget, monitoring framework, and refining the Lao translation. The improved plan was ready at the end of June 2018 for submission and review by ADB. The final review and signing of the plan is expected at the end of July or early of August 2018.

In parallel with plan improvement, NNP1PC initiated further discussions with the relevant provincial authorities and the WRPO on the new structure of WRPO and reached the following conclusions:

- WRPO will act as the lead agency and implementer in collaboration with relevant sectors at provincial, district and village level to develop plans, implement activities, and undertake monitoring and evaluation.
- The Xaysomboun WRPO will comprise two main implementing units namely administration and technical that will work under the direct supervision of the head of WRPO. The administrative unit will be responsible for financial management and logistics, planning and reporting, and capacity and awareness; while the technical unit will be responsible for reservoir and land use planning and management, watershed and reservoir patrolling and law enforcement, field survey and monitoring, and community development. The new structure of Xaysomboun WRPO will be authorized by the Provincial Governor.
- The structure of Bolikhamxay WRPO will be simpler to reflect the smaller area and management activities of the watershed within Bolikhamxay Province. The team members of Bolikhamxay WRPO will be nominated based on the identified activities from the approved NNP1 WMP, the recent official notification from Minister of Agriculture and Forestry (Agreement No.1371/MAF, dated 11 June 2018), and the agreement of Bolikhamxay Provincial Governor.
- The new organization structure of the WRPOs will be incorporated into the improved plan that is expected to be approved at the end of July or early August 2018.

The preparation of the annual implementation plan for NNP1 watershed management for the period of 2018 – 2019 will - as agreed on the workshop at the end of May 2018 - have to wait until the new structure of the WRPO is established. However, it was also agreed that pre-WMP activities, particularly for operation of check points within Xaysomboun and Bolikhamxay Province during impounding should continue as planned until the plan is approved.

NNP1PC in collaboration with the WRPOs have established three check points. The checkpoints started operations in May and June 2018. The first check point is located at Ban Houaxay (lower reservoir area), Hom District, Xaysomboun Province, the second check point is located at Ban Pou (upper reservoir area), Tathom District, Xayomboun Province, and the third check point is located at Ban Nahan (eastern part of reservoir), Bolikhan District, Bolikhamxay Province. The primary objectives of check point operation could be summarized as follow:

- 1) To ensure the safety of people living in and adjacent to main reservoir particularly the upstream and downstream communities who may access into the reservoir during the impounding;

- 2) To control extraction of wildlife and biodiversity from the areas especially within and surrounding the identified Totally Protected Zones (TPZs) within the NNP1 Watershed.
- 3) To monitor the use of roads built for salvage logging activities in the areas;
- 4) To monitor and control access to the reservoir and immediately stopping activities that may cause adverse impacts on biodiversity or otherwise pose a threat to habitats, water resources or water quality.

The key findings from the checkpoint operations including monitoring within the nearby areas include:

- 1) People are still accessing the reservoir and NNP1 watershed area for fishing, livestock raising/grazing, and agriculture plantation/harvesting despite the safety concerns related to reservoir impounding.
- 2) Fishing are mostly done by villagers from villages in Hom District and nearby.
- 3) The logging contractors that were contracted by the Government for salvage logging in November 2017 continue to move the cut logs out of the lower reservoir area. A new log yard at the Vangkhiaw's area, Houayxay Village to pile logs removed from log yard in Ban Sopphouan. The company planned to remove the remaining logs during/after impounding.

Further discussions between NNP1PC and Xaysomboun Provincial Governor at the end of June 2018 concluded that the current checkpoints will only able to effectively stop people accessing NNP1 watershed area once the TPZs area are legally proclaimed. The future enforcement should be based on this legal status and managed by GOL. The GOL and NNP1PC are progressing on the issuance of the legal status of NNP1 watershed and its TPZs.

3.5.1.2 PREPARATION OF PROVINCIAL REGULATION FOR THE WATERSHED MANAGEMENT

The final draft regulation has been re-submitted to the Department of Justice. Xaysomboun PONRE will present the regulations at the Provincial Assembly Meeting which is scheduled in the middle of July 2018.

As a temporary measure, the Head of Xaysomboun Provincial Governor's Office has issued a notification on 19 June 2018 to prohibit access into the reservoir. The notification letter was distributed to three districts and some villages within NNP1 watershed on 22 June 2018. At the same date, a similar notification to prohibiting access to the reservoir was also issued by Bolikhamxay Provincial Governor.

3.5.2 Biodiversity Offset Management

3.5.2.1 PREPARATION OF BIODIVERSITY OFFSET MANAGEMENT PLAN

The initial first draft of the NNP1 Biodiversity Offset Management Plan for NCNX was submitted to NNP1PC on 29 June 2018 for internal review. The draft plan will be submitted to ADB for further review, translated to Lao language, and internally discussed with BOMC in July 2018.

3.5.2.2 PREPARATION OF PROVINCIAL REGULATION FOR BIODIVERSITY OFFSET MANAGEMENT IN NC-NX

The draft provincial regulations for biodiversity offset management in Nam Chouan – Nam Xang was discussed at a provincial technical workshop on 12 June 2018 and consulted at six

NCNX villages from 18 to 20 June 2018. The key comments and conclusions from the district and village level consultations include:

1. The Secretariat of Provincial Regulation Development Committee should continue to improve the draft regulations based on comments from the stakeholders and the committee should keep the content short, practical, and consistent with the law for legislations development, focus on rearranging the chapters, articles, and contents as well as clearly define the scope for the enforcement.
2. Most of the participants in the six consulted villages agreed on content of the regulations and requested clarification on the tools which are allowed or prohibited for hunting.
3. There is existing land use and expectation of further expansion of land use within the proposed TPZ. Villagers proposed that TPZ boundary to be further away from the land use and its expansion particularly for Na Gngang Village.
4. Land zoning should be started together with villagers as soon as possible. In case of Sopkhone Village, villagers are now accessing the area of Chamhang River for the purpose of fishing and some area along this river is being prepared for rice plantation.
5. Livelihood development activities are strongly required and should be one of the prioritized activities of the Biodiversity Offset Management Plan.
6. Approval for customary use activities such as collecting honey inside the proposed TPZ in Vangphieng Village should be further discussed and considered.
7. The TOR for the implementation unit should be described in the first section in details to make it clear on roles and responsibilities to deal with violator especially the Government employee.

Following the consultations, the Provincial Regulation Development Committee has further improved the draft regulations elaborating the comments from village level consultations, and the committee has submitted the regulations to the Provincial Justice Department for further reviews and feedback at the end of June 2018. Further comments from the Provincial Justice Department and improvements are expected in August 2018. Submission to Provincial Assembly with further comments, improvement, and final approval are expected to be sometime during September / October 2018.

3.5.2.3 Implementation of pre-Biodiversity Offset Management Plan

NNP1PC has disbursed funds on 16 March 2018 for the implementation of the second pre-BOMP. Patrolling activities have continued in June 2018. Two patrolling teams with a total of 18 people conducted forest patrolling for 20 days. The patrolling covered nine key areas within the NCNX offset site: Nam San, Nam Sangar, Nam Houng, Nam Sik in Viengthong zone and Nam Hung, Kayi, Nam Luck, Nam Chan Thuy and Nam Chamhung in Xaychamphone zone. The main threats found in the areas are hunting camps and upland crop plantations. The detailed information are being recorded into the SMART database and will be presented to BOMC Secretariat early next month.

It was recommended by IAP and ADB mission in May 2018 that the pre-BOMP activities need to be continued until the BOMP is ready. The implementation period was advised to be for another six months from September 2018 to February 2019. ADB provided feedback on 16 June 2018 on the second half of pre-BOMP2 proposal for further clarification. The proposal is expected to be re-submitted for ADB approval in July 2018.

4. FISHERY MONITORING

The fishery monitoring programme is progressing in June as planned with the daily catch logbook, gillnet survey, and sampling household interview. The gathered information is being put into the database system.

The data from the daily fish catch logbook monitoring indicates that the mean daily fish catch in Nam Ngiep River was 1.7 kg/household/day in May 2018. The estimated total fish catch in Nam Ngiep basin for May 2018 is 33,800 kg. Around 40 % of the catch was sold, 51% was consumed fresh, 6% processed and approximately 3% was used for other purposes.

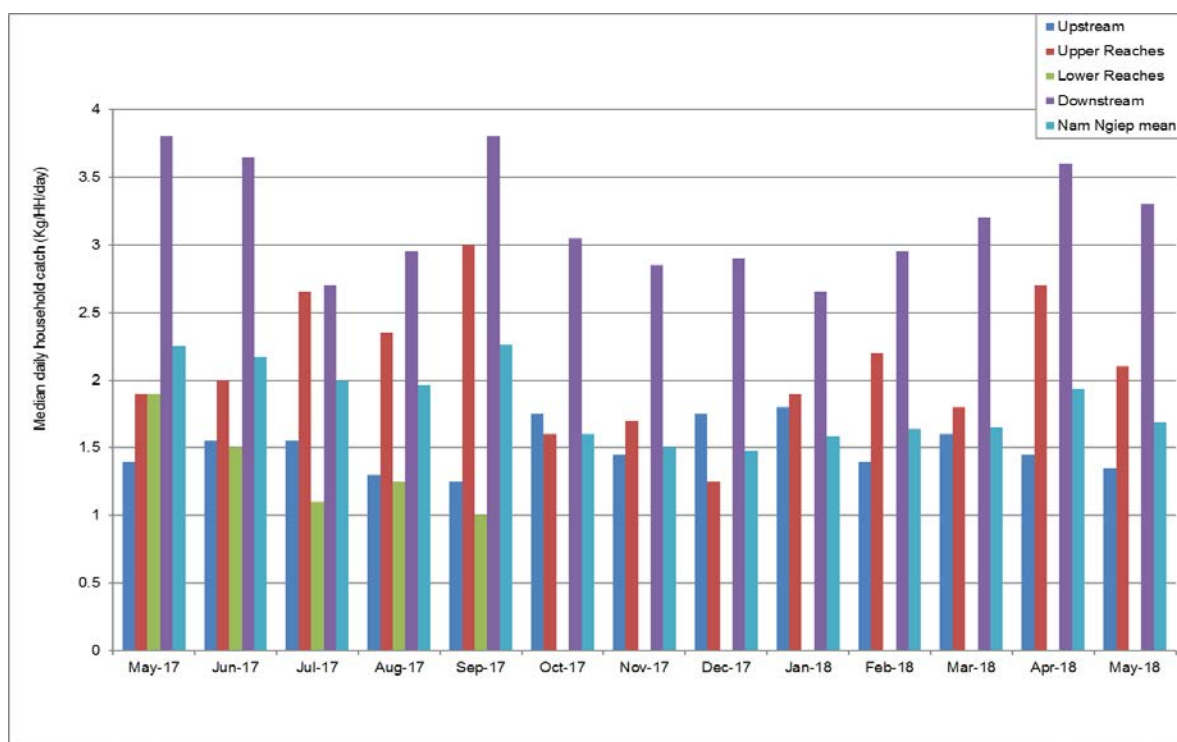
Detail activity of fishery monitoring program comprises of daily fish catch monitoring, re-sampling HH, gillnet survey, and fish monitoring during reservoir impoundment could be summarized as below table.

Table 4-1: Summary of Fishery Monitoring Program in June 2018

| Activities in June 2018 | Results |
|---------------------------------------|--|
| Daily Catch Logbook survey | <ul style="list-style-type: none"> Completed daily catch logbook survey in 93 households out of the total target of 93 households. Re-sampling new target households for daily catch survey in Lower Reservoir Area with a target of 32 households in Bolikhan District of Bolikhamxay Province and 28 households in Hom District of Xaysomboun Province. The average daily household catch for Nam Ngiep in May 2018 is 1.7 kg/household/day. The estimated total catch for Nam Ngiep in May 2018 is approximately 33,800 kg. |
| Gillnet Survey | <ul style="list-style-type: none"> Completed the second round of data collection for 2018 at 12 stations in May 2018. Fish species identified by fisheries experts in June 2018. There are 68 fish species identified and recorded belongs to 17 different families and among those are 42 dominant species of Cyprinid. Total fish species composition from October 2015 to May 2018 is 137 species. |
| Fish Monitoring for Impounding period | <ul style="list-style-type: none"> No dead fish observed in the Upper Reservoir, Lower Reservoir and Downstream during the impounding period (May-June 2018). |

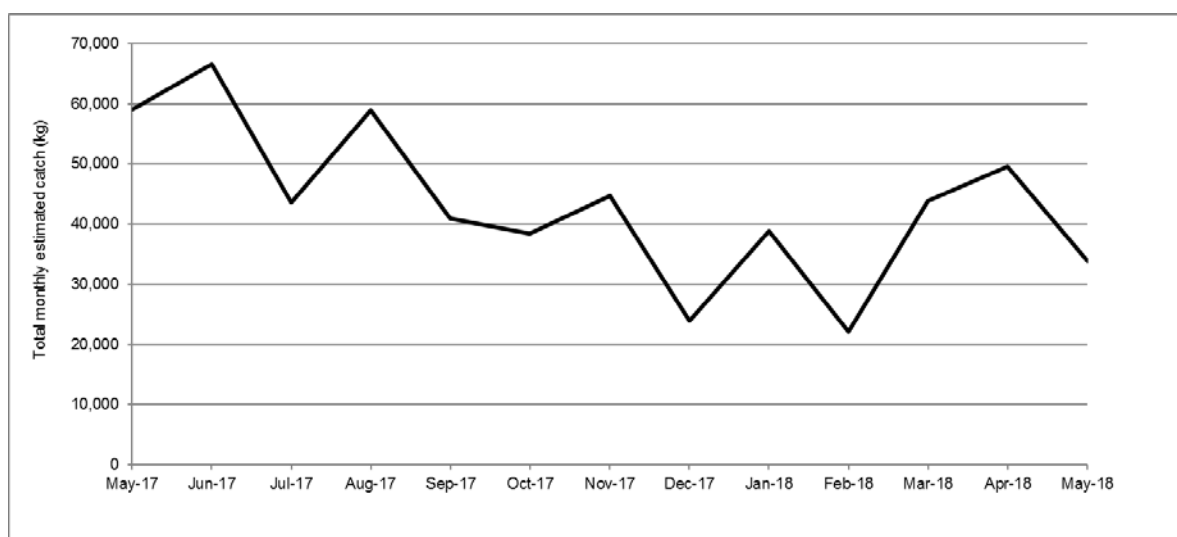
Median daily household catch by fishing zone and the mean value of household catch in Nam Ngiep for all combined fishing zones (Kg/HH/day) during May 2017 to May 2018. The trend shows the increase of median daily household catch at all fishing zones during the dry season in the first quarter of 2018. This situation is expected during dry season that indicates the higher fishing effort in which households preferred more fishing than other livelihood activities such as agriculture. In May 2018, the median household catch is lower than the previous month that indicates the transition period where people are getting ready for other livelihood activities prior to wet season.

Figure 4-1: Median Daily Household Catch (Kg/HH/day)



The total estimated fish catch in Nam Ngiep by month could be seen in figure above. Please note that this figure refers to the estimated number of total fish catch from the total households doing the fishing in certain days within a month multiply with the mean daily household catch for all sampling area (upstream, upper reach, lower reach, and downstream). The total fish catch in May 2018 is lower than previous month due to fewer households doing fishing as well as less number of days spent for fishing.

Figure 4-2: Total Estimated Catch in Nam Ngiep by Month (Kg)



ANNEXES

ANNEX A: RESULTS OF EFFLUENT ANALYSES

Table A- 1: Results of Camp Effluents in June 2018

| | Site Name | Owner's Site Office and Village | | Obayashi Camp | | Sino Hydro Camp | |
|----------------------------------|--------------|---------------------------------|-----------|---------------|-----------|-----------------|-----------|
| | Station Code | EF01 | | EF02 | | EF06 | |
| | Date | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | |
| pH | 6.0 - 9.0 | 7.15 | 6.91 | 7.71 | 7.15 | 7.7 | 7.05 |
| Sat. DO (%) | | 70.1 | 39.1 | 91.2 | 71.2 | 90 | 56.5 |
| DO (mg/l) | | 5.05 | 2.98 | 6.45 | 5.31 | 6.5 | 4.21 |
| Conductivity (µs/cm) | | 366 | 235 | 563 | 307 | 344 | 216.3 |
| TDS (mg/l) | | 183 | 118 | 281 | 158 | 172 | 108 |
| Temperature (°C) | | 30.6 | 27.5 | 31 | 28.6 | 30.6 | 28.6 |
| Turbidity (NTU) | | 0.66 | 1.45 | 17 | 19.19 | 7.08 | 51.82 |
| TSS (mg/l) | <50 | <5 | <5 | 7.96 | 5.85 | 27.61 | 38.72 |
| BOD (mg/l) | <30 | 8.61 | <6 | 7.68 | <6 | 15.18 | 11.94 |
| COD (mg/l) | <125 | <25 | <25 | 39 | <25 | 38.2 | <25 |
| NH3-N (mg/l) | <10.0 | 5.7 | 5.2 | 16.9 | 13.6 | 7.7 | 5.5 |
| Total Nitrogen (mg/l) | <10.0 | 12.7 | 14.1 | 17 | 17.3 | 8.89 | 11.8 |
| Total Phosphorus (mg/l) | <2 | 0.77 | 0.54 | 0.96 | 0.62 | 0.74 | 0.57 |
| Oil & Grease (mg/l) | <10.0 | <1 | | <1 | | <1 | |
| Total coliform (MPN/100ml) | <400 | 94 | 350 | 4 | 0 | 14 | 1,600 |
| Faecal Coliform (MPN/100ml) | | 33 | 33 | 0 | 0 | 4 | 920 |
| Effluent Discharge Volume (L/mn) | | 25 | 30 | 12 | 12 | 0 | 6 |
| Chlorination Dosing Rate (ml/mn) | | | | 280 | 555 | 290 | 183 |
| Residual Chlorine (mg/l) | <1.0 | | | 0.18 | 0.61 | 0.07 | 0.07 |

| | Site Name | Song Da 5 Camp No.1 | | Song Da 5 Camp No.2 | | Zhefu Camp | |
|----------------------|--------------|---------------------|-----------|---------------------|-----------|------------|-----------|
| | Station Code | EF07 | | EF08 | | EF09 | |
| | Date | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | |
| pH | 6.0 - 9.0 | 7.46 | 6.87 | 7.48 | 6.92 | 7.32 | 7.23 |
| Sat. DO (%) | | 57.5 | 49.9 | 38.9 | 33.4 | 43.7 | 30.2 |
| DO (mg/l) | | 3.66 | 3.67 | 2.85 | 2.53 | 2.93 | 2.24 |
| Conductivity (µs/cm) | | 1278 | 503 | 779 | 302 | 451 | 662 |
| TDS (mg/l) | | 638 | 251 | 389 | 151 | 225 | 331 |
| Temperature (°C) | | 31.8 | 28.4 | 29.9 | 28 | 35 | 29 |

| | Site Name | Song Da 5 Camp No.1 | | Song Da 5 Camp No.2 | | Zhefu Camp | |
|----------------------------------|--------------|---------------------|-----------|---------------------|-----------|------------|-----------|
| | Station Code | EF07 | | EF08 | | EF09 | |
| | Date | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 |
| | Guideline | | | | | | |
| Parameters (Unit) | Guideline | | | | | | |
| Turbidity (NTU) | | 22.6 | 35.79 | 30.9 | 30.74 | 8.56 | 35.9 |
| TSS (mg/l) | <50 | 31.4 | 33.53 | 29.14 | 20.23 | 26.54 | 54.49 |
| BOD (mg/l) | <30 | <6 | <6 | <6 | <6 | <6 | <6 |
| COD (mg/l) | <125 | 76 | 49.8 | 95.2 | 46.2 | 62.4 | 95.2 |
| NH3-N (mg/l) | <10.0 | 18.3 | 7.4 | 32.9 | 11.5 | 20 | 14.7 |
| Total Nitrogen (mg/l) | <10.0 | 22.6 | 16.3 | 33.8 | 21 | 35.1 | 15.2 |
| Total Phosphorus (mg/l) | <2 | 0.68 | 0.27 | 1.28 | 0.47 | 0.81 | 0.66 |
| Oil & Grease (mg/l) | <10.0 | <1 | | <1 | | <1 | |
| Total coliform (MPN/100ml) | <400 | 0 | 0 | 0 | 0 | 0 | 0 |
| Faecal Coliform (MPN/100ml) | | 0 | 0 | 0 | 0 | 0 | 0 |
| Effluent Discharge Volume (L/mn) | | 30 | 20 | 30 | 12 | 4.2 | 4.2 |
| Chlorination Dosing Rate (ml/mn) | | 180 | 83 | 70 | 1000 | 3.1 | 3.1 |
| Residual Chlorine (mg/l) | <1.0 | 1.06 | 0.4 | 0.76 | 1.7 | 1.06 | 2.1 |

| | Site Name | V & K Camp | | HM Main Camp | | IHI Camp | |
|-------------------------|--------------|------------|-----------|--------------|-----------|-----------|-----------|
| | Station Code | EF10 | | EF13 | | EF14 | |
| | Date | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 |
| | Guideline | | | | | | |
| Parameters (Unit) | Guideline | | | | | | |
| pH | 6.0 - 9.0 | 7.63 | 7.16 | 7.08 | 6.93 | 6.78 | 6.97 |
| Sat. DO (%) | | 79 | 55.8 | 29.3 | 33 | 17.6 | 26.1 |
| DO (mg/l) | | 5.7 | 4.22 | 2.1 | 2.5 | 1.26 | 1.95 |
| Conductivity (µs/cm) | | 372 | 216.7 | 609 | 490 | 496 | 796 |
| TDS (mg/l) | | 186 | 108 | 305 | 295 | 248 | 398 |
| Temperature (°C) | | 30.8 | 27.9 | 30.8 | 27.7 | 30.9 | 28.5 |
| Turbidity (NTU) | | 3.59 | 9.86 | 22 | 36.41 | 18.3 | 66 |
| TSS (mg/l) | <50 | 10.66 | 6.96 | 46.02 | 23.48 | 31.51 | 35.19 |
| BOD (mg/l) | <30 | <6 | 6.57 | 112.35 | 94.28 | 112.95 | 111.75 |
| COD (mg/l) | <125 | 31.4 | <25 | 263 | 180 | 177 | 171 |
| NH3-N (mg/l) | <10.0 | 5.8 | 11.4 | 20.8 | 16.6 | 10.5 | 11.6 |
| Total Nitrogen (mg/l) | <10.0 | 8.37 | 12.1 | 21.1 | 30.8 | 10.8 | 19.5 |
| Total Phosphorus (mg/l) | <2 | 0.65 | 0.39 | 1.05 | 0.8 | 0.78 | 0.69 |

| | Site Name | V & K Camp | | HM Main Camp | | IHI Camp | |
|----------------------------------|--------------|------------|-----------|--------------|-----------|-----------|-----------|
| | Station Code | EF10 | | EF13 | | EF14 | |
| | Date | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 |
| Parameters (Unit) | Guideline | | | | | | |
| Oil & Grease (mg/l) | <10.0 | <1 | | 5 | | 5 | |
| Total coliform (MPN/100ml) | <400 | 0 | 1,600 | 5,400 | 0 | 9,200 | 23 |
| Faecal Coliform (MPN/100ml) | | 0 | 920 | 5,400 | 0 | 3,500 | 23 |
| Effluent Discharge Volume (L/mn) | | 0 | 6 | 4.2 | 4.2 | 3 | 7.5 |
| Chlorination Dosing Rate (ml/mn) | | 47 | 60 | 3.1 | 3.1 | 2 | 23 |
| Residual Chlorine (mg/l) | <1.0 | 0.28 | 0.11 | 0 | 0.12 | 0 | 0.5 |

| | Site Name | Kenber Camp | | Lilama10 Camp | |
|----------------------------------|--------------|-------------|-----------|---------------|-----------|
| | Station Code | EF16 | | EF17 | |
| | Date | 04-Jun-18 | 18-Jun-18 | 04-Jun-18 | 18-Jun-18 |
| Parameters (Unit) | Guideline | | | | |
| pH | 6.0 - 9.0 | 7.55 | 6.9 | 6.72 | 6.67 |
| Sat. DO (%) | | 100.6 | 89.6 | 22.1 | 26.6 |
| DO (mg/l) | | 7.26 | 6.7 | 1.5 | 1.98 |
| Conductivity (µs/cm) | | 190.6 | 105.1 | 456 | 340 |
| TDS (mg/l) | | 95.3 | 52 | 228 | 170 |
| Temperature (°C) | | 30.2 | 28 | 34.9 | 29 |
| Turbidity (NTU) | | 11.7 | 58.98 | 12.7 | 29.14 |
| TSS (mg/l) | <50 | 20.81 | 67.37 | 21.26 | 25.0 |
| BOD (mg/l) | <30 | <6 | <6 | 34.44 | 26.16 |
| COD (mg/l) | <125 | <25 | 25.2 | 25.6 | <25 |
| NH3-N (mg/l) | <10.0 | 5.1 | 1.4 | 9.2 | 9.4 |
| Total Nitrogen (mg/l) | <10.0 | 8.28 | 7.12 | 25.2 | 24 |
| Total Phosphorus (mg/l) | <2 | 0.44 | 0.21 | 0.14 | 0.14 |
| Oil & Grease (mg/l) | <10.0 | <1 | | <1 | |
| Total coliform (MPN/100ml) | <400 | 0 | 9.3 | 170 | 9.2 |
| Faecal Coliform (MPN/100ml) | | 0 | 4.5 | 130 | 0 |
| Effluent Discharge Volume (L/mn) | | 0 | 3 | 4.2 | 4.2 |
| Chlorination Dosing Rate (ml/mn) | | 20 | 70 | 3.1 | 3.1 |
| Residual Chlorine (mg/l) | <1.0 | 0.32 | 0.31 | 0.08 | 0.07 |

Table A- 2: Results of the Construction Area Discharge in June 2018

| | Site Name | Spoil Disposal No.2 | | | |
|----------------------|--------------|---------------------|-----------|-----------|-----------|
| | Station Code | DS04 | | | |
| | Date | 08-Jun-18 | 14-Jun-18 | 21-Jun-18 | 29-Jun-18 |
| | Guideline | | | | |
| Parameter (Unit) | | | | | |
| pH | 6.0 - 9.0 | 6.63 | 6.7 | 7.51 | 7.85 |
| Sat. DO (%) | | 64.3 | 100.5 | 86.9 | 80.3 |
| DO (mg/l) | | 4.9 | 7.42 | 6.55 | 6.2 |
| Conductivity (µs/cm) | | 29.4 | 226 | 18.34 | 17.96 |
| TDS (mg/l) | | 14 | 113 | 9 | 8.5 |
| Temperature (°C) | | 27.6 | 29.1 | 28.1 | 27 |
| Turbidity (NTU) | | 19.1 | 105.12 | 34.17 | 64.6 |
| TSS (mg/l) | <50 | 42.09 | 74.73 | 19.36 | 40 |
| Oil & Grease (mg/l) | <10 | <1 | | | |

| | Site Name | RCC Plant Discharge at lower ponds | | | |
|----------------------|--------------|------------------------------------|-----------|-----------|-----------|
| | Station Code | DS09 | | | |
| | Date | 08-Jun-18 | 14-Jun-18 | 21-Jun-18 | 29-Jun-18 |
| | Guideline | | | | |
| Parameter (Unit) | | | | | |
| pH | 6.0 - 9.0 | No water discharge | | | |
| Sat. DO (%) | | | | | |
| DO (mg/l) | | | | | |
| Conductivity (µs/cm) | | | | | |
| TDS (mg/l) | | | | | |
| Temperature (°C) | | | | | |
| Turbidity (NTU) | | | | | |
| TSS (mg/l) | <50 | | | | |
| Oil & Grease (mg/l) | <10 | | | | |

| | Site Name | Aggregate Crushing Plant | | | |
|----------------------|--------------|--------------------------|-----------|-----------|-----------|
| | Station Code | DS02 | | | |
| | Date | 08-Jun-18 | 14-Jun-18 | 21-Jun-18 | 29-Jun-18 |
| | Guideline | | | | |
| Parameter (Unit) | | | | | |
| pH | 6.0 - 9.0 | No water discharge | | | |
| Sat. DO (%) | | | | | |
| DO (mg/l) | | | | | |
| Conductivity (µs/cm) | | | | | |
| TDS (mg/l) | | | | | |
| Temperature (°C) | | | | | |
| Turbidity (NTU) | | | | | |
| TSS (mg/l) | <50 | | | | |
| Oil & Grease (mg/l) | <10 | | | | |

| | Site Name | Main Dam Treatment Plant No.2 (DS12) | | | |
|----------------------|--------------|--------------------------------------|-----------|-----------|-----------|
| | Station Code | DS12 | | | |
| | Date | 08-Jun-18 | 14-Jun-18 | 21-Jun-18 | 29-Jun-18 |
| | Guideline | | | | |
| Parameter (Unit) | | | | | |
| pH | 6.0 - 9.0 | No water discharge | | | |
| Sat. DO (%) | | | | | |
| DO (mg/l) | | | | | |
| Conductivity (µs/cm) | | | | | |
| TDS (mg/l) | | | | | |
| Temperature (°C) | | | | | |
| Turbidity (NTU) | | | | | |
| TSS (mg/l) | <50 | | | | |
| Oil & Grease (mg/l) | <10 | | | | |

| | Site Name | Main Dam's Waste Water Treatment Plant No.3 | | | |
|----------------------|--------------|---|-----------|-----------|-----------|
| | Station Code | DS14 | | | |
| | Date | 08-Jun-18 | 14-Jun-18 | 21-Jun-18 | 29-Jun-18 |
| | Guideline | | | | |
| Parameter (Unit) | | | | | |
| pH | 6.0 - 9.0 | 8.97 | 6.7 | 6.61 | 7.9 |
| Sat. DO (%) | | 102.6 | 80.4 | 100.9 | 99.4 |
| DO (mg/l) | | 7.81 | 6.49 | 7.13 | 7.77 |
| Conductivity (µs/cm) | | 157.9 | 29.9 | 140.6 | 36.7 |
| TDS (mg/l) | | 79 | 15 | 70 | 18.3 |
| Temperature (°C) | | 27.8 | 26.4 | 32 | 26.4 |
| Turbidity (NTU) | | 31.7 | 78.55 | 29.4 | 10.42 |
| TSS (mg/l) | <50 | 97 | 127.37 | 34.5 | 9.51 |
| Oil & Grease (mg/l) | <10 | <1 | | | |

ANNEX B: AMBIENT DUST QUALITY

Table B- 1: 24-hour Average Dust Concentrations Measured in Hat Gnuin Village

| Hat Gnuin Village - 24 Hours Average Particulate Matter (PM10) Concentration | | | |
|--|-----------------|-----------------|-----------------|
| Period | 00 to 24 Hours | 24 to 48 Hours | 48 to 72 Hours |
| Start Time | 04-Jun-18 18:00 | 05-Jun-18 18:01 | 06-Jun-18 18:01 |
| End Time | 05-Jun-18 18:00 | 06-Jun-18 18:00 | 07-Jun-18 18:00 |
| Average Data Record in 24h (mg/m ³) | 0.023 | 0.020 | 0.021 |
| Guideline Average in 24h (mg/m ³) | 0.12 | 0.12 | 0.12 |

Figure B- 1: Dust Monitoring Results at Ban Hat Gnuin in June 2018

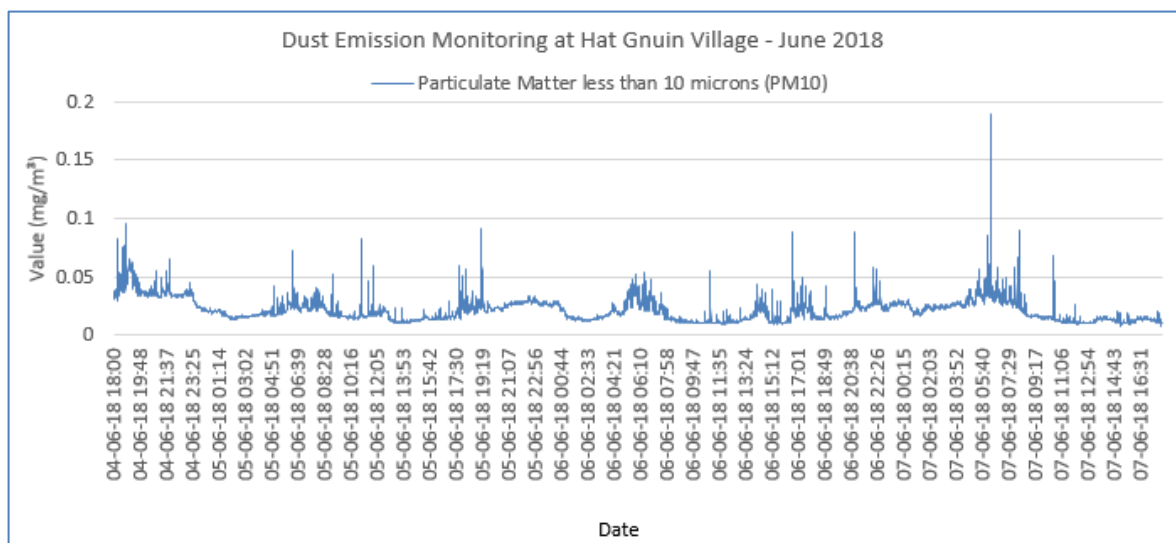


Table B- 2: 24-hour Average Dust Concentrations Measured in Phouhomxay Village

| Phouhomxay Village - 24 Hours Average Particulate Matter (PM10) Concentration | | | |
|---|-----------------|-----------------|-----------------|
| Period | 00 to 24 Hours | 24 to 48 Hours | 48 to 72 Hours |
| Start Time | 25-Jun-18 18:00 | 26-Jun-18 18:00 | 27-Jun-18 18:01 |
| End Time | 26-Jun-18 18:00 | 27-Jun-18 18:01 | 28-Jun-18 18:00 |
| Average Data Record in 24h (mg/m ³) | 0.019 | 0.018 | 0.036 |
| Guideline Average in 24h (mg/m ³) | 0.12 | 0.12 | 0.12 |

Figure B- 2: Dust Monitoring at Phouhomxay Village in June 2018

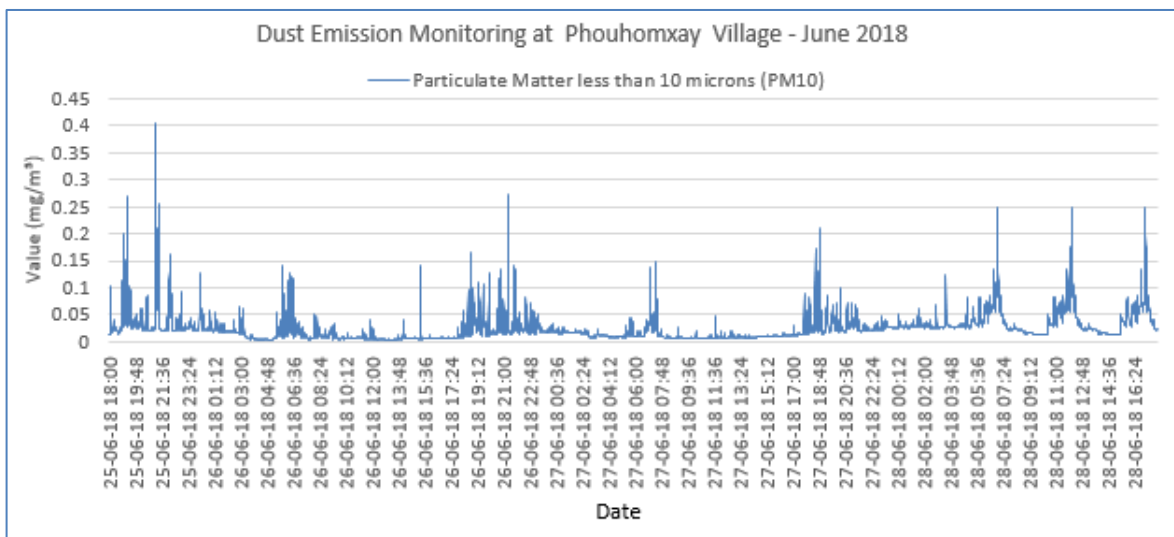


Figure B- 3: Dust Monitoring Results at the Aggregate Crushing Plant in June 2018

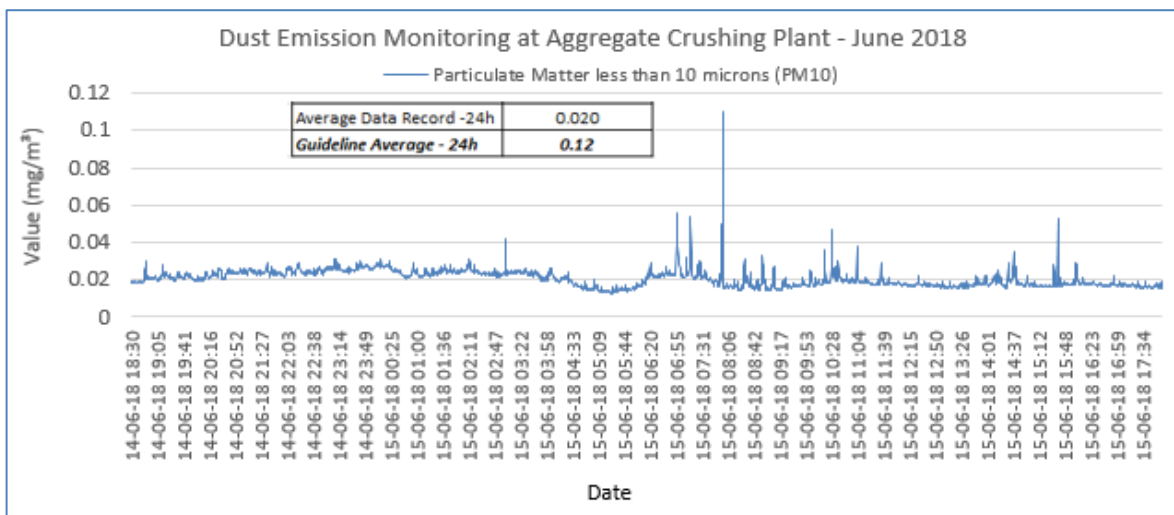


Figure B- 4: Dust Monitoring Results at the RCC Plant in June 2018

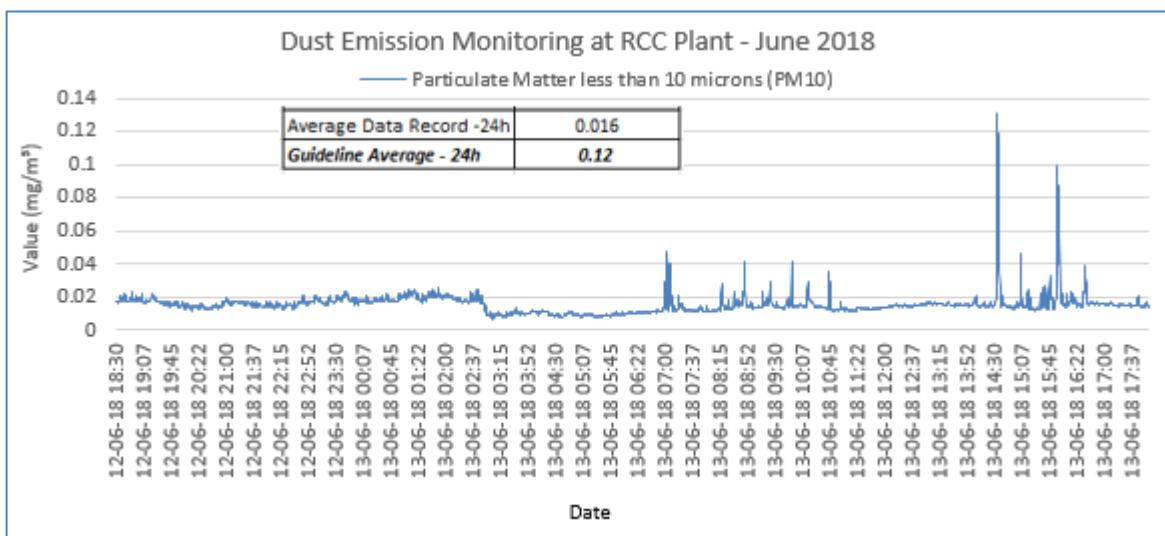


Figure B- 5: Dust Monitoring Results at the Sino Hydro Temporary Camp in June 2018

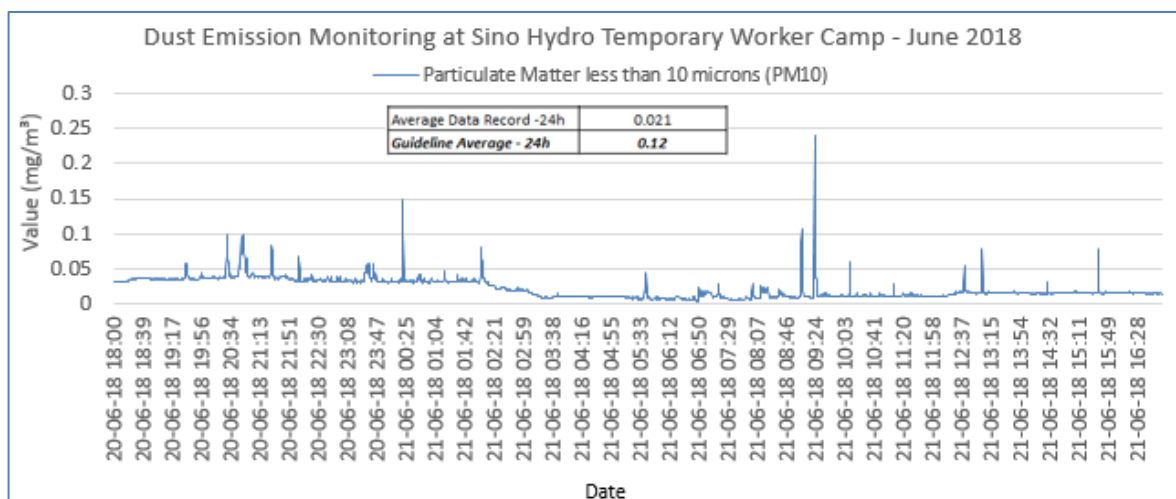


Figure B- 6: Dust Monitoring Results at the SongDa5 No.2 Camp in June 2018

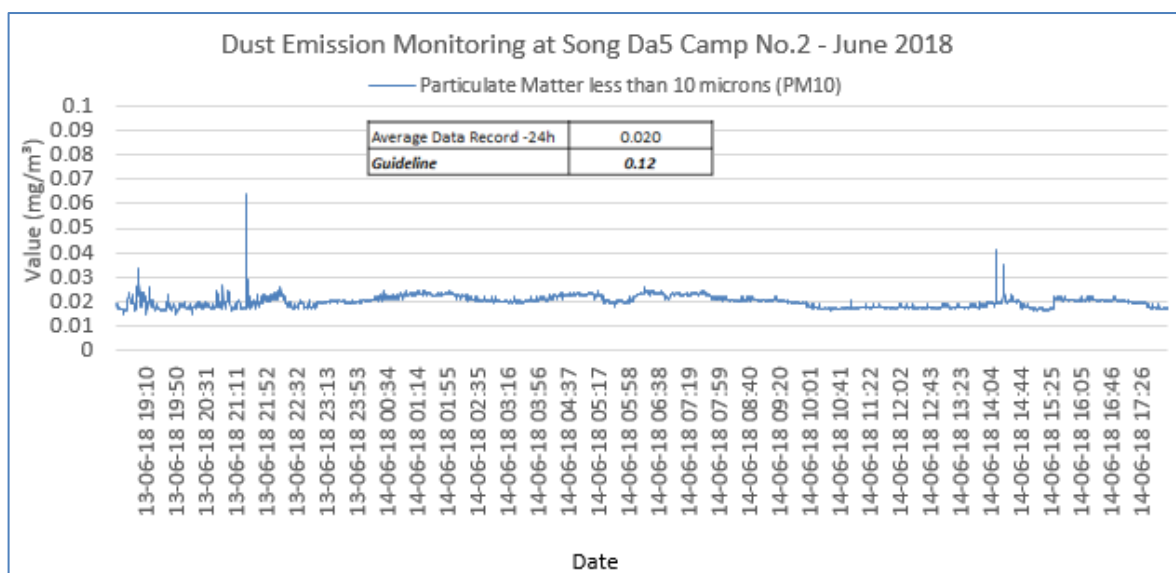


Figure B- 7: Dust Monitoring Results at Main Dam (Top View Left Bank) in June 2018

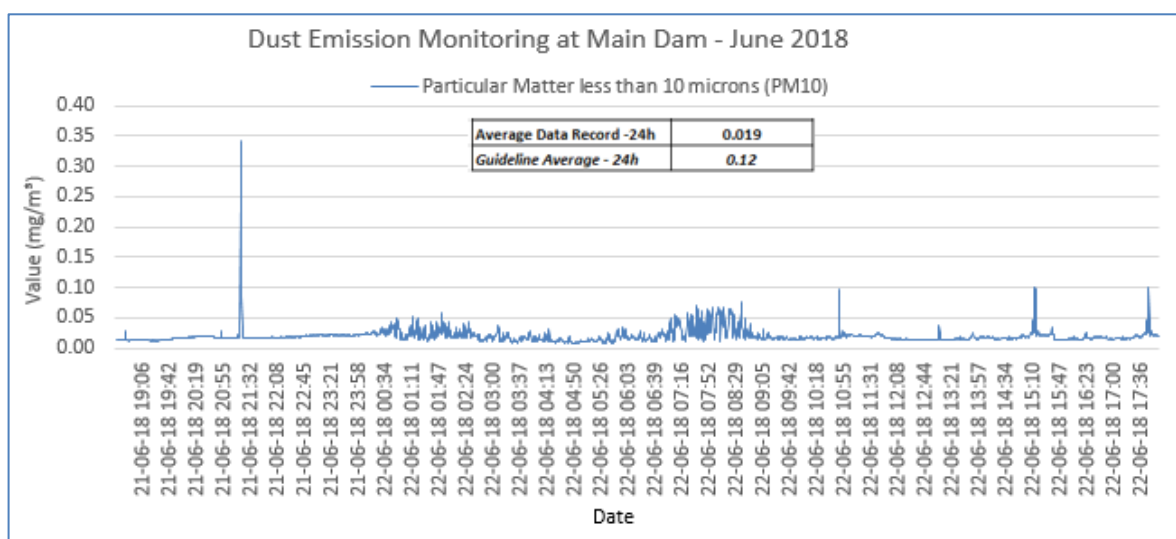


Figure B-8: Dust Monitoring Results at the Lilama10 Camp in June 2018

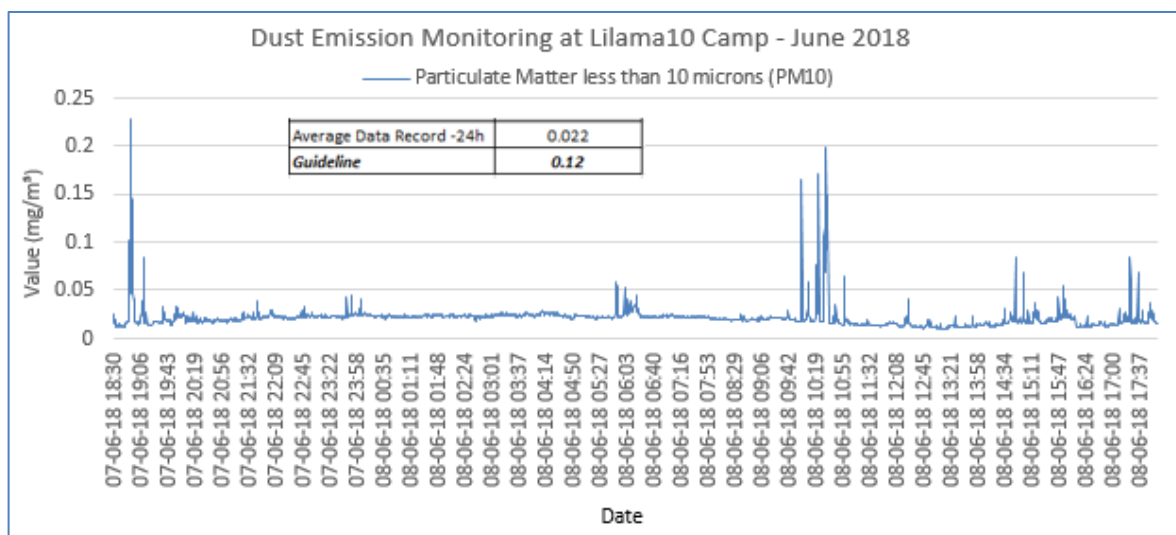


Figure B- 9: Dust Monitoring Results at the Main Powerhouse in June 2018

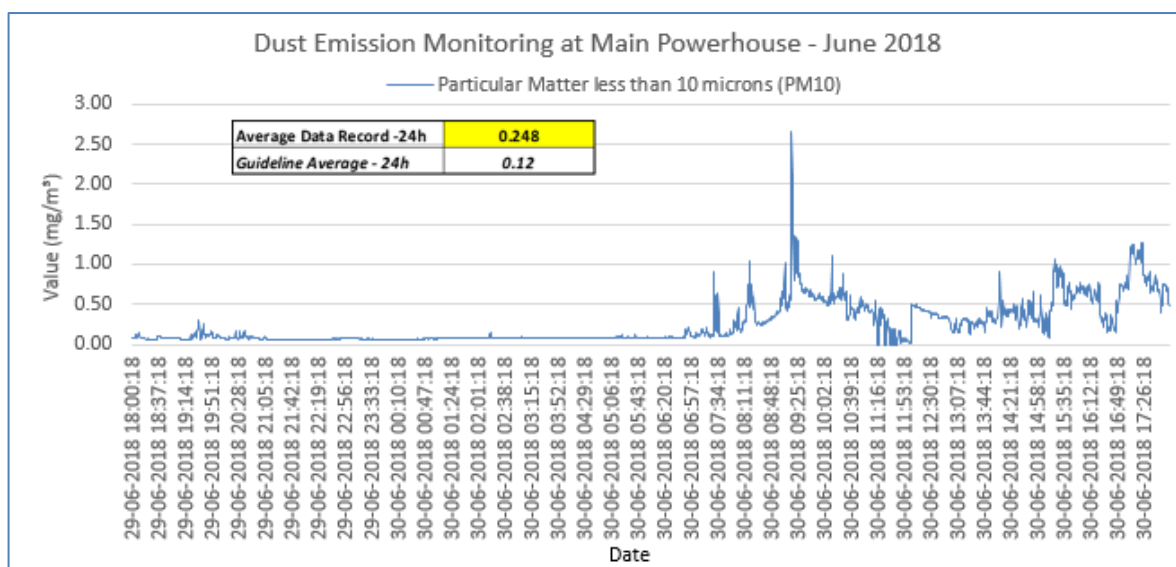
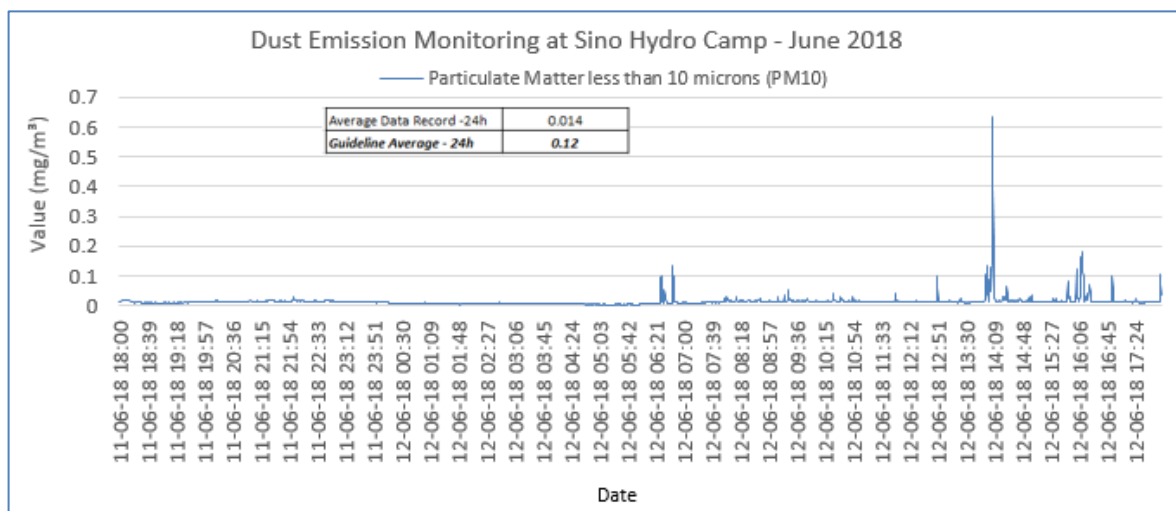


Figure B-10: Dust Monitoring Results at the Sino Hydro Camp in June 2018



ANNEX C: AMBIENT NOISE DATA

Table C- 1: Average Results of Noise Monitoring at Ban Hat Gniun in June 2018

| Noise Level (dB) | 04-05/June/18 | | | 05-06/June/18 | | | 06-07/June/18 | | |
|---------------------------|---------------|-------------|-------------|---------------|-------------|-------------|---------------|-------------|-------------|
| | 18:00-22:00 | 22:01-06:00 | 06:01-18:00 | 18:00-22:00 | 22:01-06:00 | 06:01-18:00 | 18:00-22:00 | 22:01-06:00 | 06:01-18:00 |
| Maximum Value Recorded | 66.10 | 64.30 | 71.00 | 64.60 | 68.70 | 71.20 | 68.50 | 52.70 | 71.70 |
| Guideline Max | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |
| Average Data Recorded | 44.09 | 43.06 | 46.45 | 43.68 | 42.62 | 45.21 | 44.07 | 40.40 | 48.17 |
| Guideline Averaged | 55 | 45 | 55 | 55 | 45 | 55 | 55 | 45 | 55 |

Figure C- 1: Result of Noise Level Monitoring at Ban Hat Gniun in June 2018

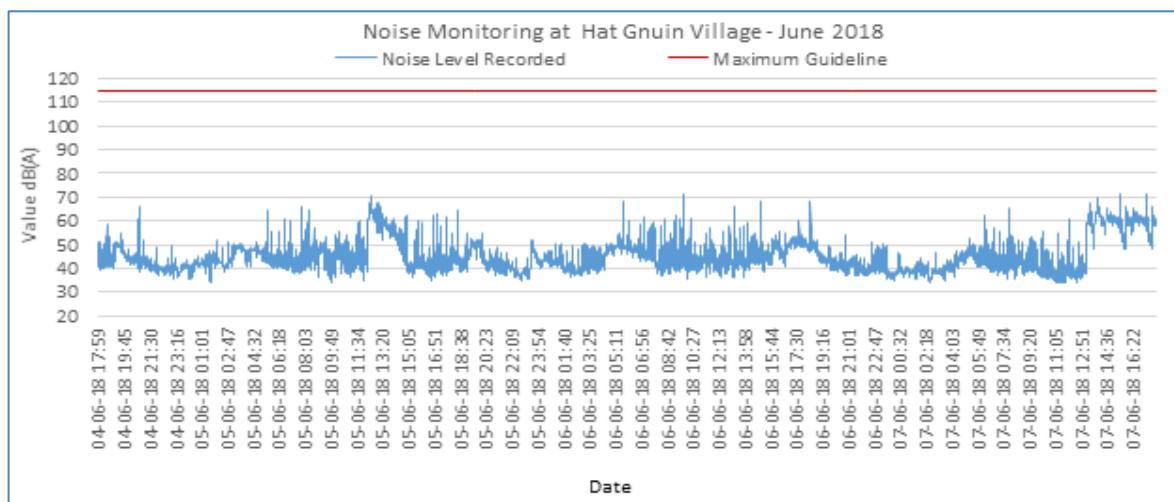
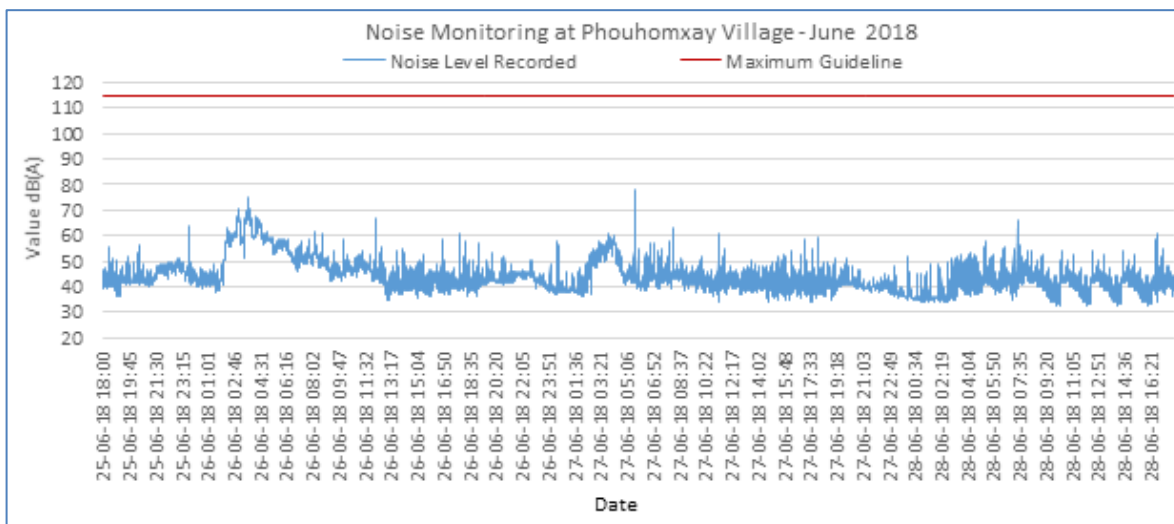


Table C- 2 Average Results of Noise Monitoring at Phouhomxay Village in June 2018

| Noise Level (dB) | 25-26/June/18 | | | 26-27/June/18 | | | 27-28/June/18 | | |
|---------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 18:00-22:00 | 22:01 – 06:00 | 06:01 – 18:00 | 18:00-22:00 | 22:01 – 06:00 | 06:01 – 18:00 | 18:00-22:00 | 22:01 – 06:00 | 06:01 – 18:00 |
| Maximum Value Recorded | 56.20 | 74.90 | 66.60 | 58.10 | 77.90 | 62.80 | 59.60 | 59.60 | 66.30 |
| Guideline Max | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |
| Average Data Recorded | 42.80 | 52.31 | 45.65 | 42.67 | 45.07 | 41.92 | 40.80 | 39.91 | 40.50 |
| Guideline Averaged | 55 | 45 | 55 | 55 | 45 | 55 | 55 | 45 | 55 |

Figure C- 2: Result of Noise Level Monitoring at Phouhomxay Village in June 2018**Table C-3 and Table C-4: Average Results of Noise Monitoring at Aggregate Crushing Plant and RCC Plant in June 2018****Aggregate Crushing Plant**

| Noise Level (dB) | 14-15/June/18 | | 15/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:30 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Maximum Value Recorded | 52.5 | 52.6 | 72.6 |
| Guideline Max | 115 | 115 | 115 |
| Average Data Recorded | 40.47 | 38.90 | 43.85 |
| Guideline Averaged | 70 | 70 | 70 |

RCC Plant

| Noise Level (dB) | 12-13/June/18 | | 13/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:30 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Maximum Value Recorded | 60.1 | 73.9 | 69.1 |
| Guideline Max | 115 | 115 | 115 |
| Average Data Recorded | 42.97 | 46.75 | 45.49 |
| Guideline Averaged | 70 | 70 | 70 |

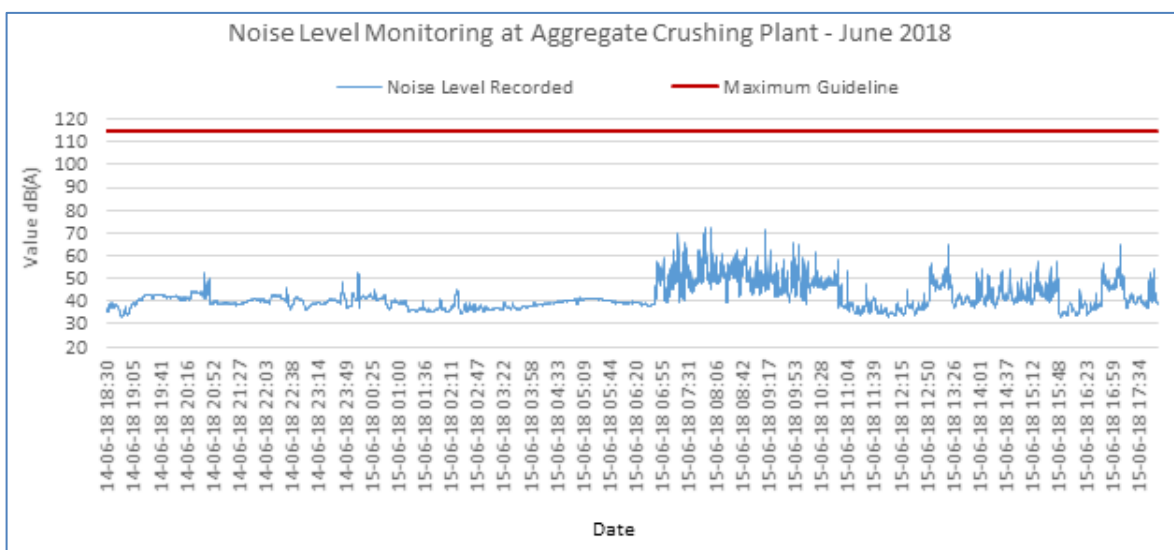
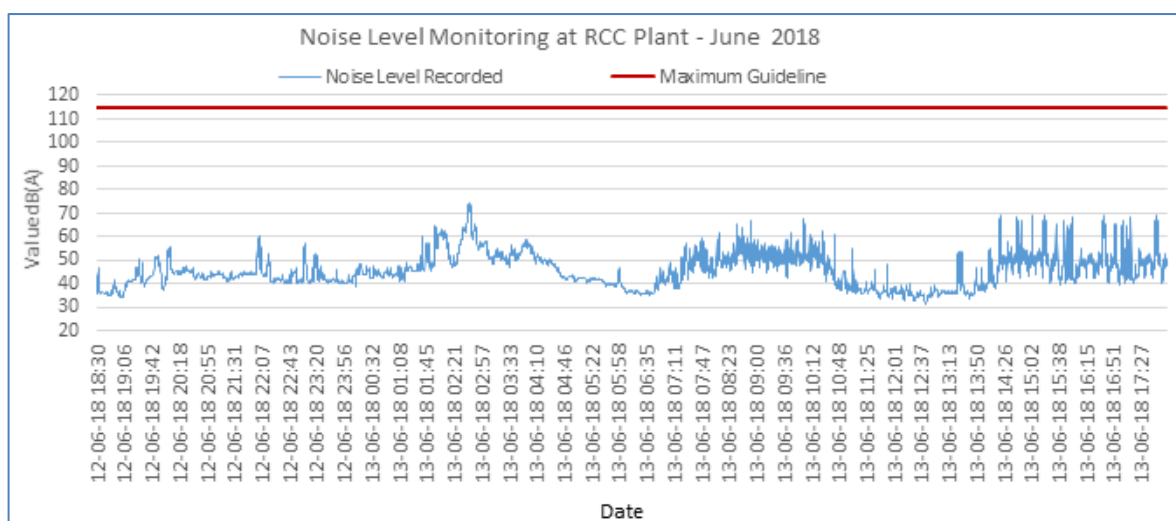
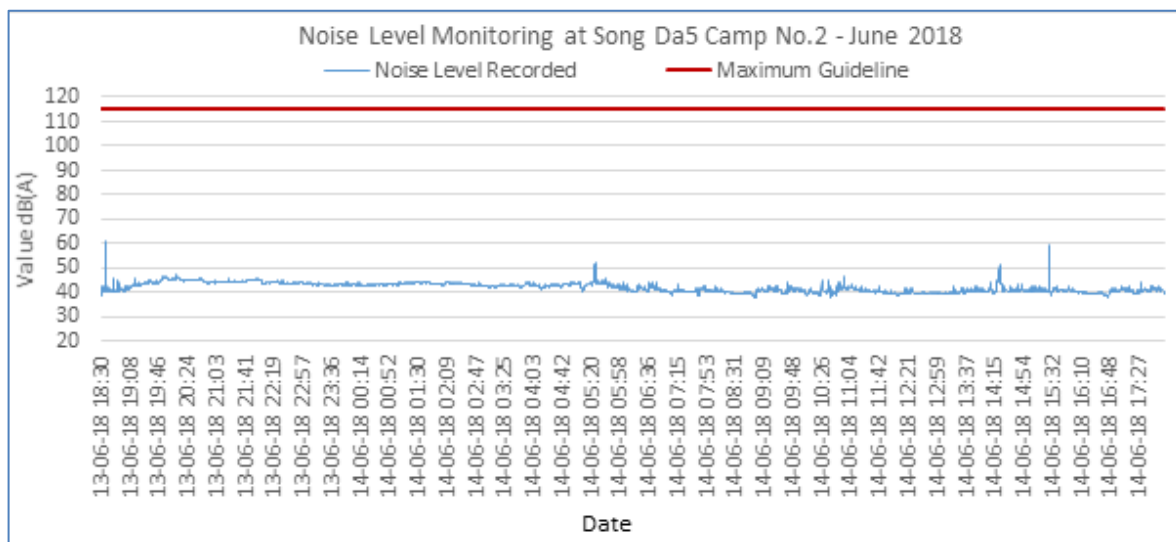
Figure C- 3: Results of Noise Level Monitoring at the Aggregate Crushing Plant in June 2018

Figure C- 4: Results of Noise Level Monitoring at the RCC Plant in June 2018**Table C- 5 and Table C- 6: Average Results of Noise Monitoring at Song Da5 Camp No. 2 and Sino Hydro Camp in June 2018****Song Da5 Camp No.2**

| Noise Level (dB) | 13-14/June/18 | | 14/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:30 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Maximum Value Recorded | 60.7 | 52.2 | 59.7 |
| Guideline Max | 115 | 115 | 115 |
| Average Data Recorded | 43.96 | 43.08 | 40.51 |
| Guideline Averaged | 70 | 50 | 70 |

Sino Hydro Temporary Worker Camp

| Noise Level (dB) | 20-21/June/18 | | 21/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:00 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Maximum Value Recorded | 81.2 | 71 | 64 |
| Guideline Max | 115 | 115 | 115 |
| Average Data Recorded | 49.89 | 48.89 | 43.66 |
| Guideline Averaged | 70 | 50 | 70 |

Figure C- 5: Results of Noise Level Monitoring at Song Da5 Camp No.2 in June 2018**Figure C- 6: Results of Noise Level Monitoring at Sino Hydro Temporary Worker Camp in June 2018**

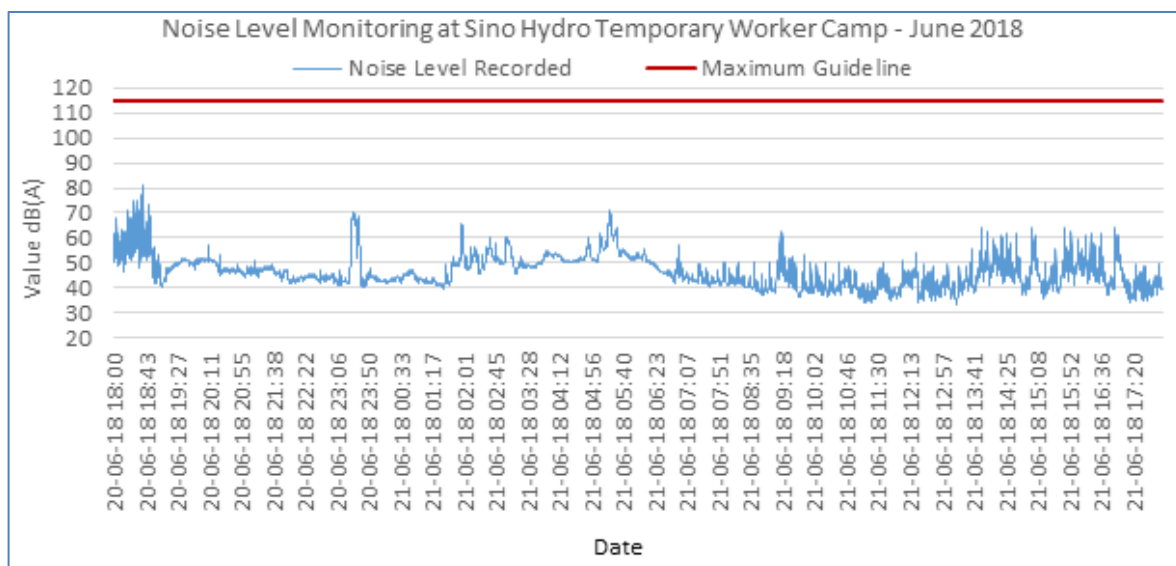


Table C- 8 and Table C- 9: Average Results of Noise Monitoring at Main Dam, and Lilama 10 Camp in June 2018

Main Dam

| Noise Level (dB) | 21-22/June/18 | | 22/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:00 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Data Record Max | 56 | 53.8 | 60.6 |
| Guideline Max | 115 | 115 | 115 |
| Data Record Average | 49.03 | 47.35 | 45.37 |
| Guideline Averaged | 70 | 70 | 70 |

Lilama 10 Camp

| Noise Level (dB) | 07-08/June/2018 | | 08/June/2018 |
|---------------------------|-----------------|---------------|--------------|
| | 18:00 – 22:00 | 22:01 – 06:00 | 06:00-18:00 |
| Maximum Value Recorded | 54.6 | 64.6 | 66.7 |
| Guideline Max | 115 | 115 | 115 |
| Average Data Recorded | 42.29 | 42.72 | 45.14 |
| Guideline Averaged | 70 | 50 | 70 |

Figure C-7: Results of Noise Level Monitoring at Main Dam (Top View Left Bank) in June 2018

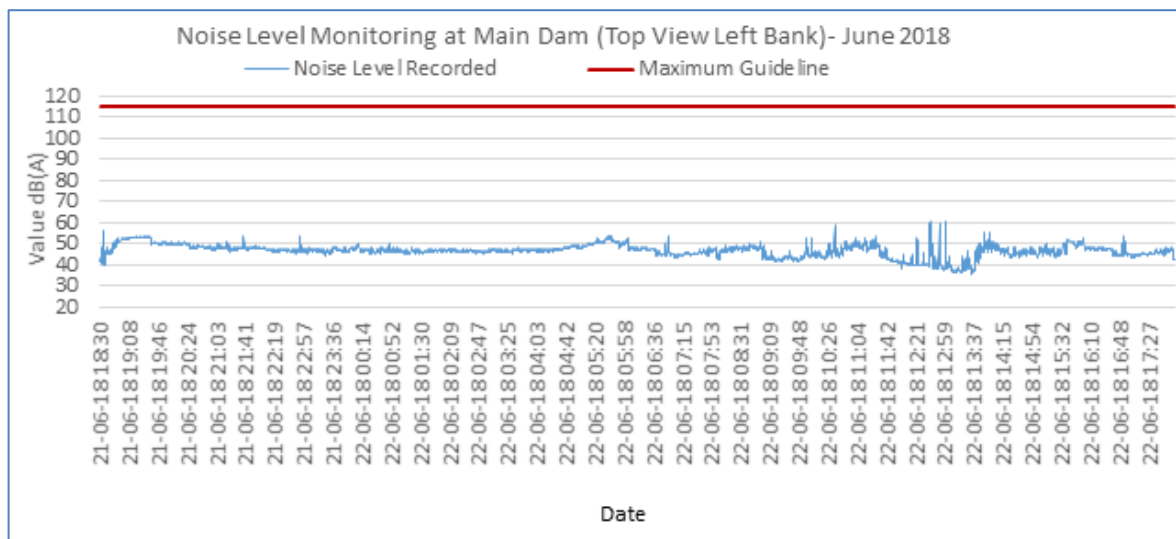
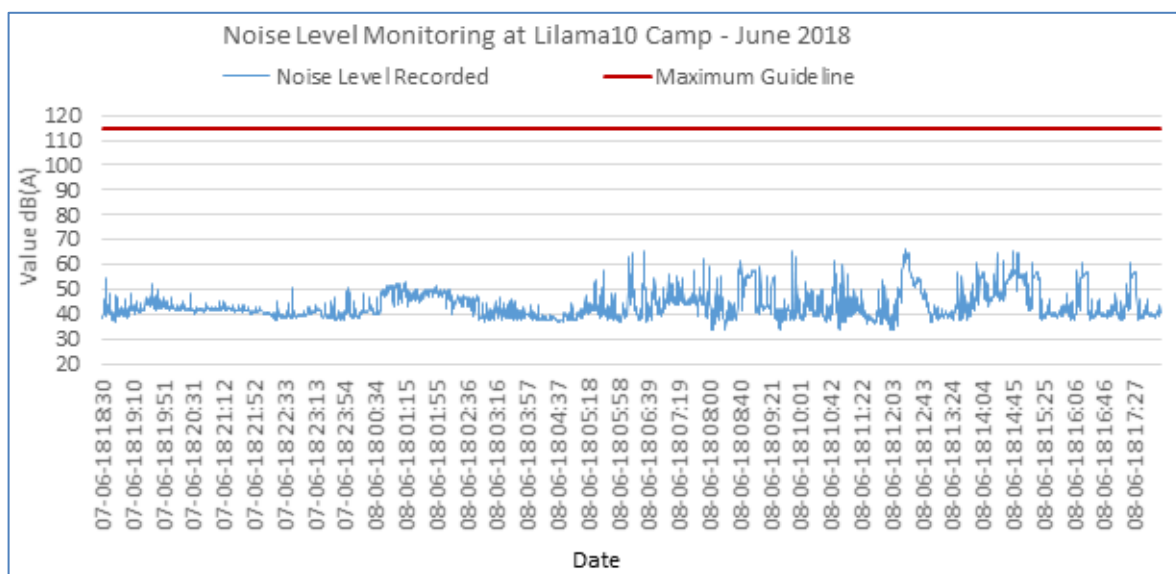


Figure C- 8: Results of Noise Level Monitoring at Lilama10 Camp in June 2018**Table C-9 and Table C-10: Average Results of Noise Monitoring at Main Powerhouse, and Sino Hydro Camp in June 2018****Main Powerhouse**

| Noise Level (dB) | 29-30/June/18 | | 30/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:00 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Data Record Max | 78.6 | 62.8 | 79.5 |
| Guideline Max | 115 | 115 | 115 |
| Data Record Average | 55.07 | 46.83 | 64.45 |
| Guideline Averaged | 70 | 70 | 70 |

Sino Hydro Camp

| Noise Level (dB) | 11-12/June/18 | | 12/June/18 |
|---------------------------|---------------|---------------|-------------|
| | 18:00 – 22:00 | 22:01 – 06:00 | 06:01-18:00 |
| Maximum Value Recorded | 69.6 | 72.8 | 67.9 |
| Guideline Max | 115 | 115 | 115 |
| Average Data Recorded | 44.90 | 52.96 | 42.63 |
| Guideline Averaged | 70 | 50 | 70 |

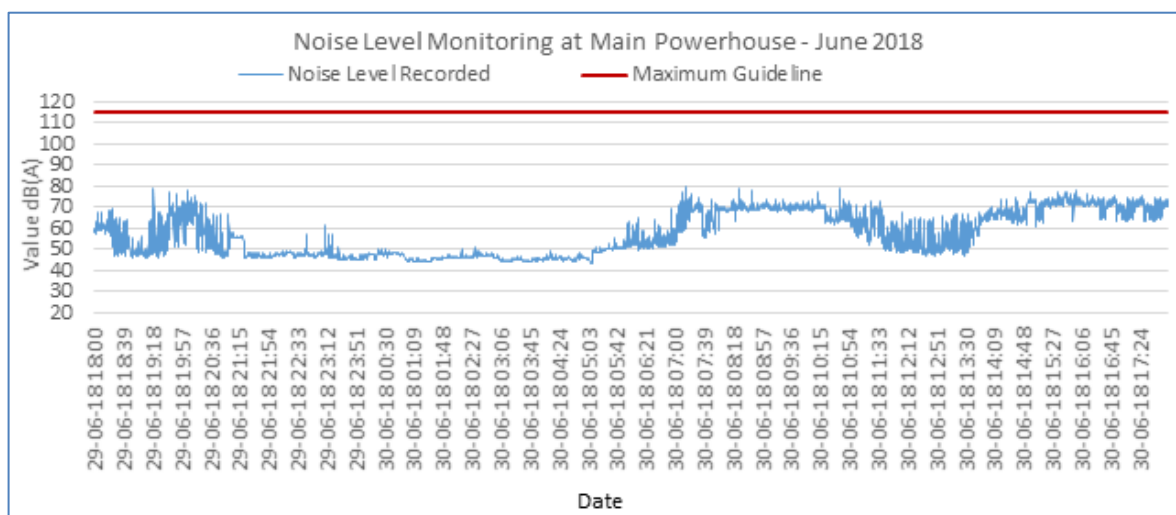
Figure C- 9: Results of Noise Level Monitoring at Main Powerhouse in June 2018

Figure C-10: Results of Noise Level Monitoring at Sino Hydro Camp in June 2018

