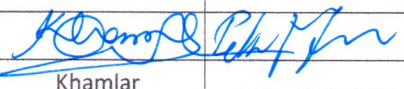
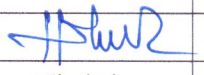
NAM NGIEP1 POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

March 2019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ABBREVIATIONS / 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
ECOCD	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 Chulalongkhorn 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

In March 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received a single Site Decommissioning and Rehabilitation Plan and had another document carried over from February 2019 for review and approval.

The monthly site inspection by the Environmental Management Unit (EMU) of Bolikhamxay Province was not scheduled in March 2019. The Quarterly site visit by the EMU of Xaysomboun Province is planned in late April 2019.

The effluent monitoring results for the camps in March 2019 indicate that the measurements of BOD_5, faecal coliform and total coliform comply with the relevant effluent standards for some camps whereas the results of a few parameters for Owner's Site Office and Village, Obayashi Camp and IHI Field Shop 276 Camp did not comply with the Standards. V&K Camp and Zhefu Camp were fully compliant with the Standards.

In March 2019, the Dissolved Oxygen (DO) levels at the surface of the Main Reservoir (R1, R2, R3, R4 and R5) were between 6.00 mg/L – 7.86 mg/L, for the Re-regulation Reservoir (R6 and R7) were generally between 6.73 mg/L – 7.87 mg/L and the DO at the Nam Ngiep downstream of the Re-regulation dam (NNG05) has remained above 7 mg/L.

A total of 88.1 m^3 of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 12.7 m^3 compared to February 2019. EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and the camps. A total of 32,703 kg of recyclable waste (mostly scrap metal) was sold to Khounmixay Processing Factory by the Contractors. A total of 111 m^3 of solid waste from Phouhomxay, Thahuea and Hat Gniun Villages was disposed of at the Houay Soup Landfill.

A final consultation workshop to discuss and endorse the NNP1 Watershed Management Plan (MWP) was organized on 13 March 2019 at the Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF), in Vientiane Capital. The workshop was chaired by a Vice Minister of MAF and attended by 40 people consisting of representatives of concerned GOL sectors. The meeting agreed in principle to endorse the Plan but prior to submission to the MAF for signing, it was recommended that the Drafting Committee including NNP1PC should improve and revise some of the points related to the village land uses in order to define and agree on the boundary of the Totally Protection Zones and Controlled Use Zones within NNP1 watershed, the development of community infrastructure for the villages located in the watershed area as well as to increase the budget allocation for livelihood development. NNP1PC-EMO continues to improve the Lao translation of the Plan addressing comments received from the workshop and plans to submit the final Plan to MAF in April 2019 for review and signing.

The WRPO's coordination meeting on the AIP2019 development was organized on 13 March 2019 after the Final Workshop on NNP1 WMP. Xaysomboun and Bolikhamxay Provincial WRPOs agreed with the review and comments to further improve the draft AIP2019. The draft AIP2019 will be reviewed and approved by NNP1PC and ADB prior to further submission and approval by Provincial Governor of each province. The implementation of AIP 2019 is expected to start from May 2019.

A Final Technical Workshop to review the draft Provincial Regulation for NNP1 Watershed and Reservoir Management with WRPO was organized in Xaysomboun Province on 26 March 2019. The Final Workshop with the Drafting Committee members consisting of the vice-chair of Provincial Assembly and Head of the Department of Justice as well as other key members from

line departments is scheduled to be held on 01 April 2019 to discuss and endorsed the final draft Regulation.

NNP1PC together with its Biodiversity Consultant completed the Biodiversity Offset Management Plan (BOMP) improvement in the first week of March 2019. The improved Plan was resubmitted to ADB and BAC on 11 March 2019. They provided confirmations to close the review on 21 and 22 March 2019 respectively after NNP1PC had addressed their final comments on 13 and 20 March 2019.

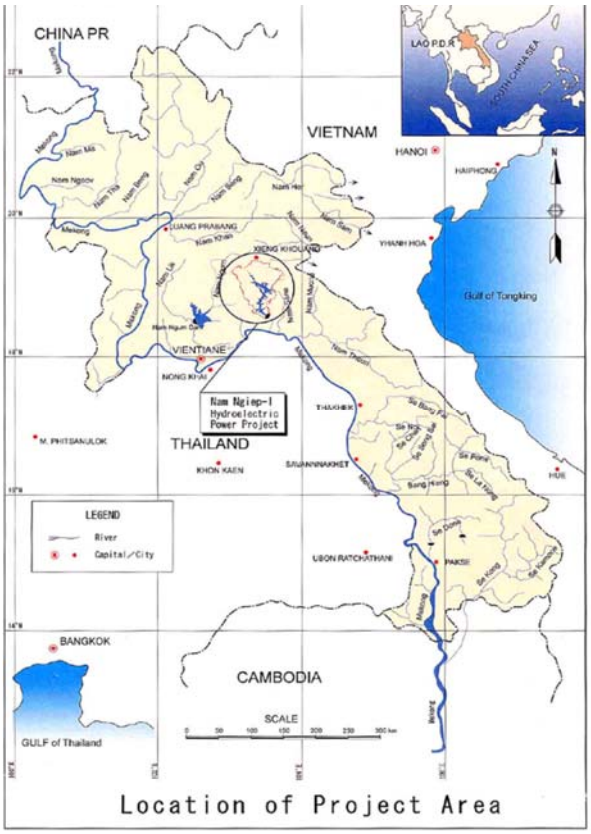
NNP1PC-EMO continues the improvement of the Lao translation of the Plan. The improved Lao translation is expected to be ready by the end of April 2019. A technical workshop with Bolikhaxmay Provincial Biodiversity Offset Management Unit (BOMU) and concerned GOL sectors was tentatively scheduled in mid-May 2019.

The fish catch monitoring for February 2019 in Nam Ngiep watershed was dominated by three species groups and two species. These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Hemibagrus filamentus* which is classified as Data Deficient. However, the record also included three species that are classified as Vulnerable (VU) species, and four Near Threatened (NT) species.

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 Bolikhan 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 Bolikhan 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.

Figure 4-2 shows the overall progress of the Project in terms of value of work done and paid. It is shown that all works are substantially complete except for the Hydro-Mechanical Works. In fact the works of this Contractor are complete but not yet paid under contract payment terms. Both Civil and Transmission Works are complete except for minor outstanding work and defects

with the Civil Contractor carrying out almost 20 per cent more value of work in the original contract period. The Electrical and Mechanical Works Contractor is shown almost 100 per cent complete but additional work has been necessary to disassemble and reassemble the units due to the main powerhouse inclination problem. Actual overall cumulative work progress by value of work carried out and paid for until the end of March 2019 for all contracts was 99.7 %[1] (compared to planned progress of 99.6 %), 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.

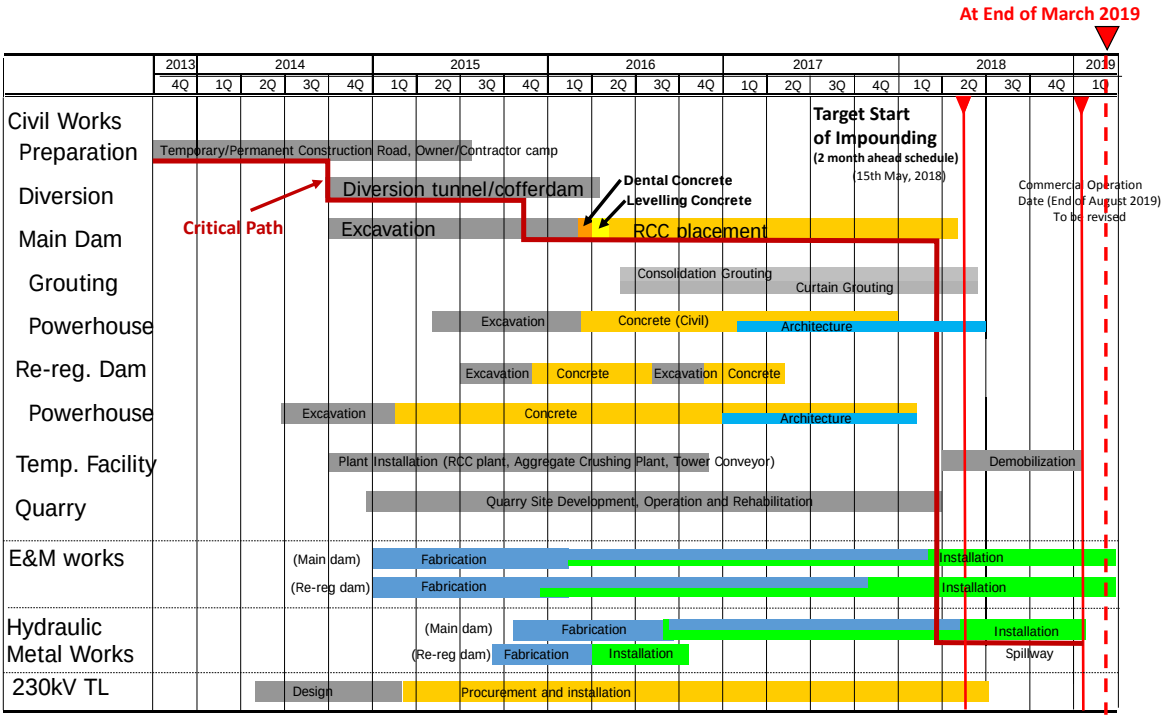
The overall construction schedule and progress curve (by achieved Milestone Payments) are shown in

Figure 2-1.

[1] The progress to-date is calculated as (Cumulative Amount of Achieved Interim Milestone Payments) / (Total Agreed Original Price of Construction Contracts) and expressed as a percentage. These totals exclude varied works and other adjustments allowed under each Contract.

[2]The progress to-date is calculated as (Cumulative Value Achieved for Completed Work by Variation Order or Other Adjustment) / (Total Budget Contingency Amount)

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 Notice to Proceed 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 March 2019 was 100 % (compared to planned progress of 100 %) 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 in October 2014 on the left bank, these 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 in total than expected and part of this additional work was necessary to construct a 'shear key' structure due to the weak layers of rock encountered in the dam foundation. Following significant efforts on Site, the additional excavation work was completed at the end of February 2016.

2.1.2 RE-REGULATION DAM AND POWERHOUSE

The re-regulation powerhouse excavation and cofferdam works for the first 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 overall re-regulating dam and powerhouse works at the left bank section and the right bank and labyrinth weir are shown in ***Figure 2-2*** below:

FIGURE 2-2: 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, excavated over 600 m in length and 10 m in diameter, was commenced in October 2014 by drill and blast techniques and completed in late September 2015. The river diversion took place on 31 October 2015 after completion of inlet and outlet structures together with construction of earth-fill cofferdams upstream and downstream.

The second diversion to divert the river from the diversion tunnel through the bottom outlet or conduit in the dam was implemented on 13 January 2018. Dewatering of the diversion tunnel and construction of the concrete plug was commenced during January 2018. Concrete works and the valve installation for discharge was completed before the start of main dam impounding. On 22 May 2018, the valve discharge commenced by using 3 valves with around 5 m3/s discharge in total. Construction of concrete plug including valve was completed on 27 January 2019.

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 for this cofferdam were completed on 2 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. Decommissioning and rehabilitation is underway on both plants and almost completed for the Aggregate Crushing Plant.

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 areas are on the right bank has been available for operation since January 2015, as was the adjacent waste Disposal Area No.9. Disposal Area No.9 along Road P1 near the start of Road T5 started operation in April 2015. Unsuitable material from the quarry has ceased to be hauled to Disposal Area No.6 and Disposal Area No.9 has been developed by the Electrical and Mechanical Works Contractor as stated above.

2.2 ELECTRICAL AND MECHANICAL WORKS

The EMW Contract was executed between Hitachi-Mitsubishi Hydro Corporation and NNP1PC on 13 June 2014 and the NTP was issued in 03 October 2014. The cumulative work progress of the Electrical and Mechanical Works by value at the end of January 2019 was 98.8 % (compared to planned progress of 100.0 %).

Figure 4.2-1: Lowering of rotor (Unit 1)

Figure 4.2-2: Lowering of collector ring (Unit 1)

Figure 4.2-3: Measurement of shaft inclination (Unit 1)

Figure 4.2-4: Assembly of loose flange (Unit 1)

Figure 4.2-5: Installation of speed signal generator cables (Unit 2)

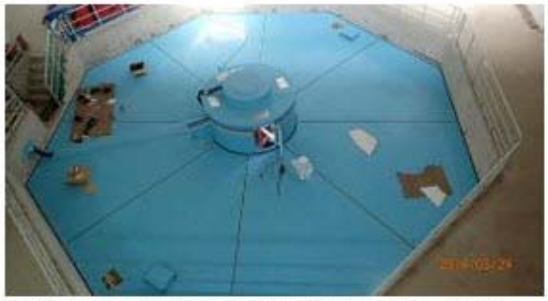


Figure 4.2-6: Assembly of generator air housing (Unit 2)

Figure 4.2-7: Assembly of platform inside turbine pit (Unit 2)

Figure 4.2-8: Assembly of loose flange (Unit 2)

Figure 4.2-9: Installation of water flow measuring equipment for penstock

Figure 4.2-10: Inspection for electrical cubicles

Figure 4.2-11: Reactive power capacity control test to EDL grid

Figure 4.2-12: Unit heat run test

Figure 4.2-13: Noise test for main transformer

Figure 4.2-14: Generator efficiency test

Figure 4.2-15: Ceremony prior to72-hour trial running test of Unit

Figure 4.2-16: Start of 72-hour trial running test of Unit

Figure 4.2-17: Monitoring during unit trial run test

Figure 4.2-18: Completion of 72-hour trial running test of Unit

Figure 4.2-19: Final punch list inspection

2.3 HYDRO-MECHANICAL WORKS

The HMW Contract 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 March 2019 was 100 % (compared to planned progress of 100 %). The Highlights and main activities carried out during this month are described below:

TABLE 2-1 : PROGRESS OF SPILLWAY GATE ERECTION AT THE MAIN DAM AT THE END OF MARCH 2019.

FIGURE 2-3: PROGRESS OF SPILLWAY GATE ERECTION AT THE MAIN DAM IN MARCH 2019

FIGURE 2-4: COMPLETED WET TEST OF THE GATE LEAF FOR SPILLWAY GATES NOS.3 AND 4 AT THE MAIN DAM AT THE END OF MARCH 2019.

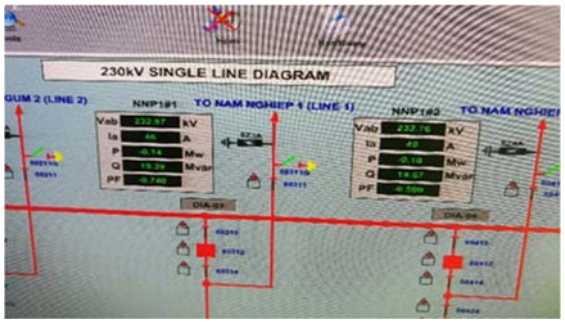
FIGURE 2-5 : SPILLWAY GATE OPERATION AND DISCHARGE FROM GATE NO.1 IN THE MAIN DAM AT THE END OF MARCH 2019.

2.4 230KV TRANSMISSION LINE WORKS

The 230 kV Transmission Line Contract was executed between Loxley-Sri Consortium and NNP1PC on 11 July 2014 and the NTP was issued to the 230 kV TL Works 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 %).


FIGURE 2-6: TOWER NO. 3


FIGURE 2-7: PREPARATION FOR MEGGER TEST SECTION PWH-T3 & VISUAL CHECK ALONG THE LINE ROUTE BEFORE THE ENERGIZATION TEST

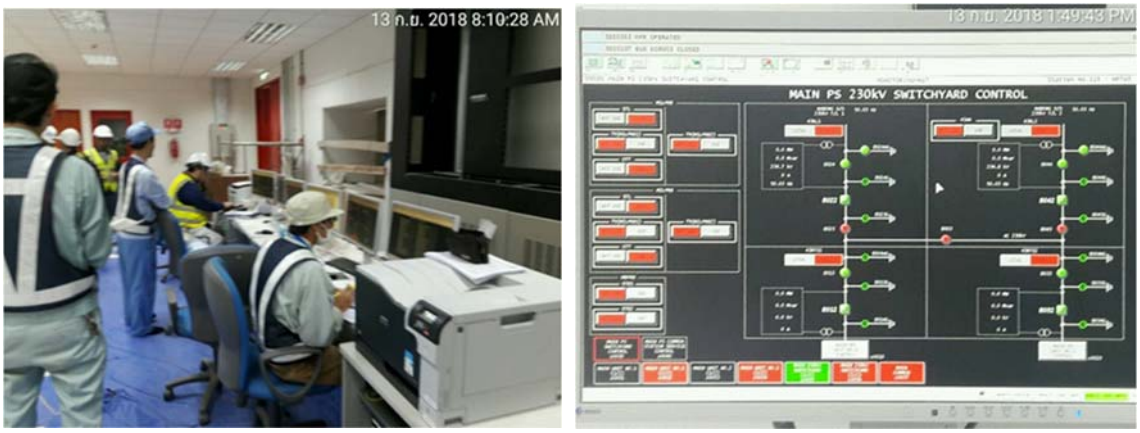


FIGURE 2-8: THE ENERGIZATION WORK FOR THE 230 KV TRANSMISSION LINE FROM NABONG SUBSTATION TO MAIN POWER HOUSE NNP1

Figure 2-9: Preparation for placement of gabion for foundation base of tower no.1

3. ENVIRONMENTAL MANAGEMENT MONITORING

3.1 COMPLIANCE MANAGEMENT

In March 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one Site Decommissioning and Rehabilitation Plan and had one document carried over from February 2019 for review and approval.

TABLE 3-1: *SS-ESMMP AND DOCUMENTS REVIEW STATUS IN MARCH 2019*

Title	Date Received	Status
Site Decommissioning and Rehabilitation Plan IIS Contractor field shop and 276 Subcontractor camp	27 February 2019 (1st submission)	No objection with comments on 11 March 2019
Site Decommissioning and Rehabilitation Plan for HMH Subcontractor Zhefu labour camp No.1	06 March 2019 (1st submission)	No objection with comments on 18 March 2019

The status of compliance reports (Observation of Non-Compliance or ONC, Non-Compliance Report or NCR) issued by NNP1PC to the Contractors is summarized in ***Table 3-2***.

TABLE 3-2: SUMMARY OF ONC AND NCR

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from February 2019	3	0	1	0
Newly Opened in March 2019	5	0	0	0
Total in March 2019	**11**	**1**	**1**	**0**
Resolved in March 2019	7	1	1	0
Carried over to April 2019	1	0	0	0
Unsolved Exceeding Deadlines	**0**	**0**	**0**	**0**

3.1.1 INSPECTION BY ENVIRONMENT MANAGEMENT UNIT

The monthly site inspection by the Environmental Management Unit (EMU) of Bolikhamxay Province was not planned in March 2019. The quarterly site visit by the EMU Xaysomboun Province is planned after the Lao New Year in April 2019.

3.2 ENVIRONMENTAL QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD_5), faecal coliforms, E.Coli bacteria and total coliforms have been carried out by NNP1PC's environmental laboratory since August 2017.

All data are reported to the Ministry of Natural Resources and Environment (MONRE) monthly and quarterly to the ADB. The reports are also published on the Company's website at https://namngiep1.com/resources/monitoring-reports/.

3.2.1 EFFLUENT DISCHARGE FROM CAMPS AND CONSTRUCTION SITES

Detailed monitoring results are provided in ***Annex B*** of this Report. The effluent monitoring results for the camps in March 2019 indicate that the results of BOD_5, faecal coliform and total

coliform comply with the relevant effluent standards for some camps whereas the results of a few parameters for Owner's Site Office and Village, Obayashi Camp and IHI Field Shop 276 Camp did not comply with the Standards. V&K Camp and Zhefu Camp were fully compliant with the Standard.

The status of implementation of the corrective actions addressing non-compliances at the camps and key construction sites that continue to have non-compliances is summarized in ***Table 3-3***.

TABLE 3-3: ***STATUS OF CORRECTIVE ACTIONS FOR NON-COMPLIANCES AT CAMPS AND CONSTRUCTION SITES***

Site	Sampling ID	Status	Corrective Actions
Owner's Site Office and Village (OSOV)	EF01	Non-compliance for faecal coliform, total coliform, total nitrogen and ammonia-nitrogen. However, total coliform was back in compliance with the standard in the second fortnight sampling.	Following the recommendation from LTA, further maintenance of the wetland ponds was under way including flushing of the waste water pipeline and adjusting the pipe inclination to aid constant sub-surface flow which will be completed by April 2019.
Obayashi Corporation Camp	EF02	Non-compliance for faecal coliform, total coliform, total nitrogen and ammonia-nitrogen.	The Contractor has been advised to improve the operation of the waste water treatment system. The results will be monitored and reported in April 2019 Report.
Song Da 5 Camp No. 1	EF07	Non-compliance for ammonia nitrogen and total nitrogen.	As above.
Song Da 5 Camp No. 2	EF08	No sampling as all wetland ponds were dried-up.	Camp and WWTS decommissioning were in progress
Zhefu Camp (Subcontractor of Hitachi-Mitsubishi Hydro)	EF09	Full compliance.	No action is required.
V&K Camp	EF10	Full compliance.	No action is required.
HMH Main Camp (WWTS)	EF13	Non-compliance for TSS, COD, ammonia nitrogen and total nitrogen. However, TSS was back in compliance with the standard in the second fortnight sampling.	The Contractor has been advised to improve the operation of the waste water treatment system. The results will be monitored and reported in April 2019 Report.

Site	Sampling ID	Status	Corrective Actions
IHI Main Camp	EF14	Non-compliance for ammonia nitrogen and total nitrogen.	As above
IHI Field Shop 276 Camp	EF18	Non-compliance for BOD_5, COD, total nitrogen and ammonia-nitrogen for the first fortnightly sampling. However, all parameters complied with the standard during second fortnightly sampling.	

3.2.2 AMBIENT SURFACE WATER QUALITY MONITORING

The ambient surface water quality monitoring programme comprises 5 monitoring stations in the main reservoir (R1-R5), 2 stations in the re-regulation reservoir (R6 and R7), 5 stations in the mainstream Nam Ngiep (NNG01 and NNG05 to NNG08) and 4 stations in the main tributaries to Nam Ngiep (Nam Chiane [NCH01], Nam Phouan [NPH01], Nam Xao [NXA01] and Nam Houay Soup [NHS01]).

In addition, weekly depth profile monitoring (pH, DO, Conductivity, TDS and Temperature) has started since 18 September 2018 for stations located in the re-regulation and main reservoirs. The water quality programme is summarized in ***Table 3-4*** and the location of the monitoring stations are shown in ***Figure 3-1***.

TABLE 3-4: *MONITORING FREQUENCY FOR SURFACE WATER QUALITY PARAMETERS*

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Saturday	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C) and Turbidity (NTU)	- R5, main reservoir immediately upstream the main dam; - NNG05, Nam Ngiep downstream the re-regulation dam at Hat Gniun Village
Weekly	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU), TSS (mg/l), BOD_5 (mg/l), Faecal coliform (MPN/100 ml), Total coliform (MPN/100 ml)	- Main Reservoir: R1, R2, R3, R4, R5 - Re-regulation Reservoir: R6, R7 - Nam Ngiep downstream: NNG05 - Tributaries: NPH01, Nam Phouan
Fortnightly	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU)	All 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	All stations

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
	coliform (MPN/100 ml) and Hydrogen sulphide (mg/l)	

The monitoring results for key parameters (DO, TSS and BOD_5) during March 2019 are presented in ***Table 3-5***, ***Table 3-6***, and ***Table 3-7***. The full set of data for March 2019 is attached in ***Annex A***. In addition, the results for DO are presented as line graphs in

Figure 3-2.

Re-regulation Reservoir

The levels of DO in both R6 and R7 have remained well above 6.41 mg/L in the whole water column and with water temperatures unchanged from the surface to the bottom of the reservoir. There were no indications of a thermocline.

Main Reservoir

At R5, the DO level in the upper 4.5 m fluctuated from about 6.27 mg/L to 7.61 mg/L and the entire water column below 9.0 m had DO levels less than 0.78 mg/L.

At R4, the DO level in the upper 5.0 m fluctuated from about 5.45 mg/L to 7.73 mg/L and the entire water column below 7.5 m had DO levels below 0.77 mg/L.

The DO concentrations at R3 were recorded between 6.13 mg/L to 7.44 mg/L in the upper 4.0 m and the concentration of DO in the entire water column below 7.0 m was less than 1.5 mg/L.

The DO concentrations at R2 were between 5.18 mg/L to 7.5 mg/L in the upper 3.5 m. The DO concentration at R2 in entire water column between 6.0 – 15.0 m were 0.04 mg/L to 0.3 mg/L and DO level increased from 0.04 mg/L to 2.08 mg/L at 16.0 m until the bottom during March 2019.

The DO concentrations in the entire water column at R1 were from 5.86 mg/L to 7.6 mg/L.

The measurements indicate the formation of oxyclines in R2, R3, R4 and R5.

As expected, the TSS concentrations in the main reservoir have been consistently low since the start of impounding with a mean in R4 and R5 of 5 mg/L compared to high flow season means of about 100 mg/L – 250 mg/L and low flow season means of 20 mg/L - 50 mg/L.

The BOD_5 measurements in March 2019 were all within the standard and most of them below the limit of detection.

FIGURE 3-1: ***SURFACE WATER AND RE-REGULATION RESERVOIR WATER QUALITY MONITORING STATIONS***

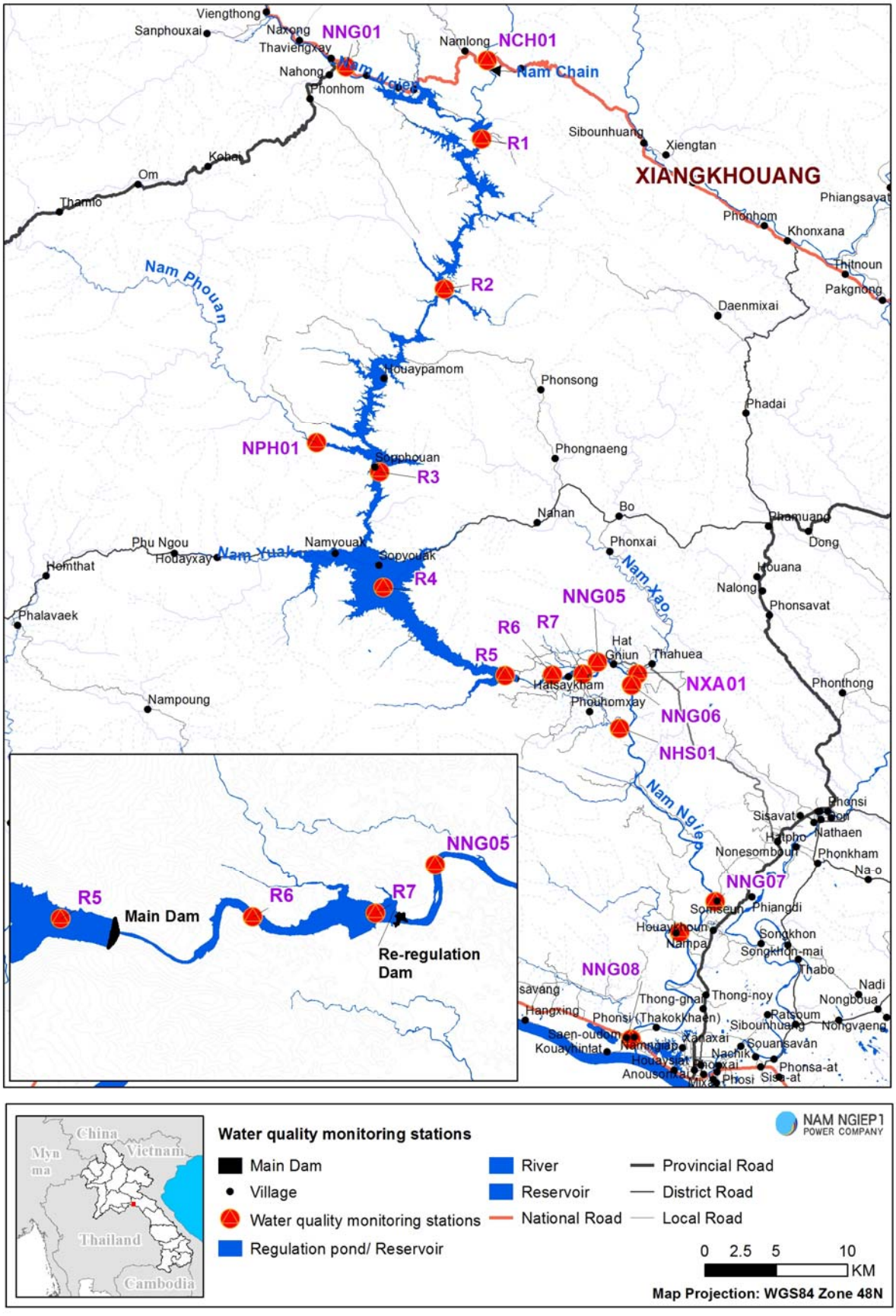


FIGURE 3-2: *CONCENTRATION OF DISSOLVED OXYGEN IN THE UPPER 0.2 M SINCE THE START OF IMPOUNDING*

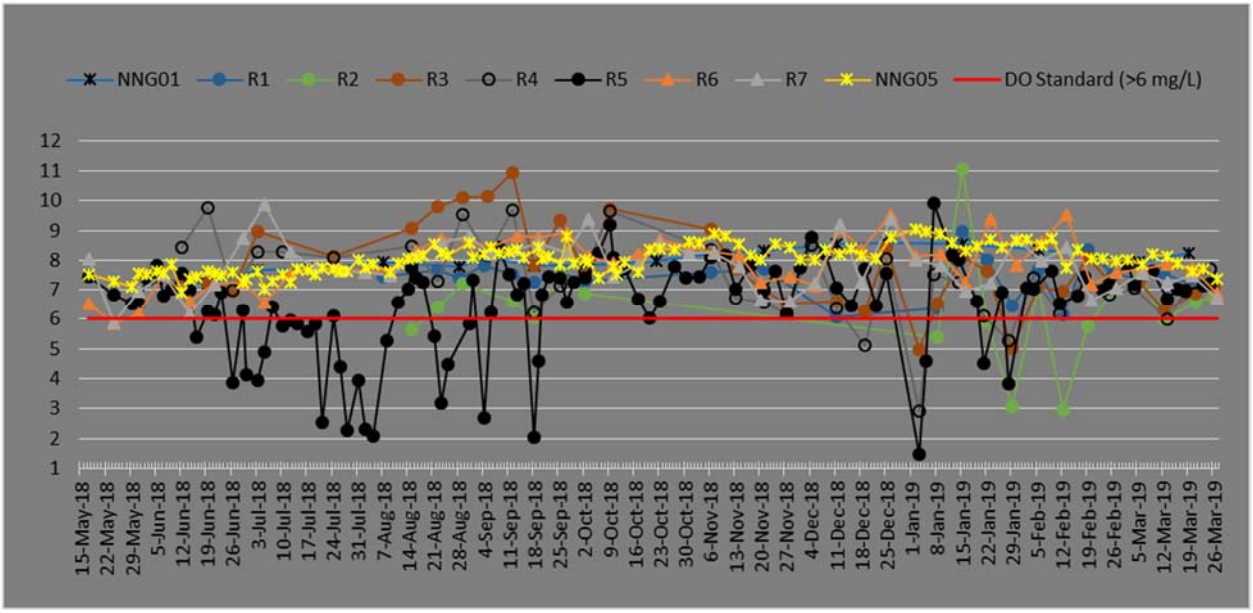


TABLE 3-5: *RESULTS OF SURFACE WATER QUALITY MONITORING FOR DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M, WATER QUALITY STANDARD: >6.0 MG/L*

Dissolved Oxygen (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
2-Mar-19						7.86			8.00							
4-Mar-19					7.07	7.16										
5-Mar-19	7.94	7.42	7.5	7.29									8.11	8.04		
6-Mar-19							7.69	7.55	7.87	7.82	7.58	7.58			6.8	6.37
9-Mar-19						7.63			8.21							
12-Mar-19		7.56	6.00	6.29										8.13		
13-Mar-19					6.00	6.67	7.87	7.26	8.12	8.34	7.6	7.32			7.67	7.55
16-Mar-19						7.03			7.9							
18-Mar-19					6.95	6.97										
19-Mar-19	8.23												8.24			
20-Mar-19							7.73	7.49	7.64	7.36	7.34	7.14			6.33	6.16
21-Mar-19		7.15	6.58	6.86										7.76		
23-Mar-19						7.15			7.69							
25-Mar-19					7.72	7.22										
26-Mar-19		7.15	6.76	7.1										7.89		
27-Mar-19							6.87	6.73	7.35	7.16	7.17	7.01			6.44	7.33

TABLE 3-6: ***RESULTS OF SURFACE WATER QUALITY MONITORING FOR TOTAL SUSPENDED SOLIDS (MG/L) - WATER QUALITY STANDARD: NO STANDARD***

Total Suspended Solids (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
4-Mar-19					<5	<5										
5-Mar-19	6.98	<5	<5	<5									6.76	6.19		
6-Mar-19							<5	<5	<5	<5	7.42	6.81			<5	6.41
13-Mar-19						<5	<5	<5	18.14							
18-Mar-19						<5										
20-Mar-19							<5	<5	8.02							
25-Mar-19						<5										
27-Mar-19							<5	5.47	5.06							

TABLE 3-7: ***RESULTS OF SURFACE WATER QUALITY MONITORING FOR BOD5 (MG/L) - WATER QUALITY STANDARD: < 1.5 MG/L***

BOD5 (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
4-Mar-19					<1	<1										
5-Mar-19	<1	1.09	<1	<1									<1	<1		
6-Mar-19							<1	1.28	<1	<1	<1	<1			<1	<1
13-Mar-19						<1	<1	<1	<1							
18-Mar-19						<1										
20-Mar-19							<1	1.2	1.26							

3.2.3 GROUNDWATER QUALITY MONITORING

During March 2019, community groundwater quality analyses were carried out for four wells located in Somseun village, Nam Pa Village, Thong Noy Village and Pou Village.

All results of community groundwater complied with the groundwater quality standards for water supply purposes, except with respect to faecal coliform and E.coli bacteria at Somseun, ThongNoy and Pou Villages.

TABLE 3-8: ***GROUNDWATER QUALITY MONITORING RESULTS IN SOMSUEN, NAM PA, THONG NOI AND POU VILLAGES***

Parameter (Unit)	Site Name	Somseun village	NamPa village	ThongNoy village	Pou village
	Station	GSXN01	GNPA01	GTHN01	GPOU01
	Guideline				
pH	6.5 - 9.2	7.1	6.96	6.94	7.07
Sat. DO (%)		84.9	85.2	76.6	90.5
DO (mg/l)		6.63	6.46	5.72	6.64
Conductivity (µS/cm)		263	323	333	22.8
TDS (mg/l)		131.5	161.5	166.5	11.4
Temperature (°C)		27.1	27.8	28.6	28.5
Turbidity (NTU)	<20	0.51	0.73	1.13	2.87
Faecal coliform (MPN/100 ml)	0	22	0	240	2

E.coli Bacteria (MPN/100 ml)	0	17	0	27	0

In addition, on 12 March 2019 NNP1PC carried out landfill groundwater monitoring at NNP1 Solid Waste Landfill (4 monitoring wells) and at Houay Soup Solids Waste Landfill (1 monitoring well). Similar to previous monitoring results, the concentration of lead in the monitoring wells MW1, MW3, MW4 and MW5 exceeded the relevant groundwater quality standard. This is most likely the (natural) background level and is not attributed to the landfill. Lead has been detected in all wells from time to time both upstream and downstream the landfill. Furthermore, lead has not been detected in the leachate from landfill treatment ponds and the waste pits and all ponds of both landfills are lined with a HDPE liner protecting the groundwater against infiltration of leachate. These boreholes are more than 50 m deep and not used by staff or villagers.

TABLE 3-9: LANDFILL GROUNDWATER QUALITY MONITORING RESULTS IN NNP1 AND HOUAY SOUP LANDFILLS

		Site Name	NNP1 Landfill				Houay Soup Landfill
		Station	MW1	MW2	MW3	MW4	MW5
Date	Parameter (Unit)	Guideline					
12-Mar-19	pH		6.86	6.22	6.7	6.11	6.77
12-Mar-19	Sat. DO (%)		36.1	47.2	31	44.5	43
12-Mar-19	DO (mg/l)		2.82	3.7	2.44	3.37	3.41
12-Mar-19	Conductivity (µS/cm)		128.6	27.4	122.1	28	106.5
12-Mar-19	TDS (mg/l)		64.3	13.7	61.5	14	53.25
12-Mar-19	Temperature (°C)		26.5	26.4	26.2	28.3	25.8
12-Mar-19	Turbidity (NTU)		4.08	1.74	1.21	9.8	7.76
12-Mar-19	Total Nitrogen (mg/l)		0.52	0.3	0.3	0	0.36
12-Mar-19	Lead (mg/l)	<0.01	0.27	<0.01	0.072	0.035	0.426
12-Mar-19	Total Phosphorus (mg/l)		0.09	0.04	0.05	0.14	0.04
12-Mar-19	Faecal Coliform (MPN/100ml)		0	0	0	0	0
12-Mar-19	Total Coliform (MPN/100ml)		0	0	0	0	0
12-Mar-19	NH_3-N (mg/l)		0.35	0.08	0.06	0.11	0.12
12-Mar-19	Copper (mg/l)	<1	<0.003	<0.003	<0.003	<0.003	<0.003
12-Mar-19	Total Petroleum (mg/l)		<1.0	<1.0	<1.0	<1.0	<1.0
12-Mar-19	Water level (m)		28.74	38.58	26.18	24.8	15.3

3.2.4 GRAVITY FED WATER SUPPLY (GFWS) QUALITY MONITORING

During March 2019, water samples from water taps at Thahuea Village, Hat Gniun Village and Phouhomxay Village were analysed. The WPHX01 represents raw water in the head tank before the filtration system.

The results of the water quality analyses are presented in ***Table 3-10.*** All parameters complied with the National Drinking Water Standards except for faecal coliforms and E.Coli at WTHH02, WHGN02, WPHX01, WPHX02 (tap water at the primary school in Phouhomxay Village) and WPHX03 (tap water at a house in Phouhomxay Village). The villagers generally use the tap water

for washing and cleaning. They were informed about the results and encouraged to boil the water before drinking.

TABLE 3-10: RESULTS OF THE GRAVITY FED WATER SUPPLY QUALITY MONITORING

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
11-Mar-19	pH	6.5 - 8.6	7.99	8.26	7.82	7.24	7.04
11-Mar-19	Sat. DO (%)		100.5	106.8	88.6	92	95.6
11-Mar-19	DO (mg/l)		8.08	8.39	7.09	6.99	7.12
11-Mar-19	Conductivity (µS/cm)	<1,000	48.1	65.4	17.27	17.85	17.19
11-Mar-19	TDS (mg/l)	<600	24	32.6	8.5	8.9	8.5
11-Mar-19	Temperature (°C)	<35	24.9	26.2	25	26.8	28.9
11-Mar-19	Turbidity (NTU)	<10	1.45	2.41	0.73	1.12	0.76
11-Mar-19	Faecal Coliform (MPN/100 ml)	0	33	26	110	34	130
11-Mar-19	E.coli Bacteria (MPN/100 ml)	0	17	13	110	34	130
11-Mar-19	Lead (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
11-Mar-19	Fluoride (mg/l)	<1.5	0.27	0.31	0.18	0.37	0.15
11-Mar-19	Nitrate (mg/l)	<50	0.13	0.22	0.49	0.44	0.4
11-Mar-19	Nitrite (mg/l)	<3	<0.02	<0.02	<0.02	<0.02	<0.02
11-Mar-19	Total hardness (mg/l)	<300	35.4	38.6	16.1	16.1	14.5

3.2.5 LANDFILL LEACHATE MONITORING

During March 2019, the landfill leachate monitoring was not conducted at NNP1 Project Landfill and at Houay Soup Solid Waste Landfill because there was no leachate collected in the treatment ponds (all evaporated).

3.2.6 DUST MONITORING

The results indicate that the dust levels at the monitoring stations (Hat Gniun Village, Main Dam, Main Powerhouse, Song Da 5 Camp No.2, and Lilama 10 Camp) did not comply with the National Standard during the monitored period in March 2019. These elevated levels of PM10 are related to local slash and burn activities that occurred nearby the construction site during the monitored period. The results were shared internally with other relevant NNP1PC Technical Departments as a reference for follow-up inspection to ensure proper establishment of health and safety procedures.

3.2.7 NOISE MONITORING

During March 2019, noise monitoring was conducted for 72 consecutive hours at Hat Gniun Village and Phouhomxay Village, and for 24 consecutive hours at the Main Dam, Song Da 5 Camp No.2, Lilama 10 Camp and the Main Powerhouse.

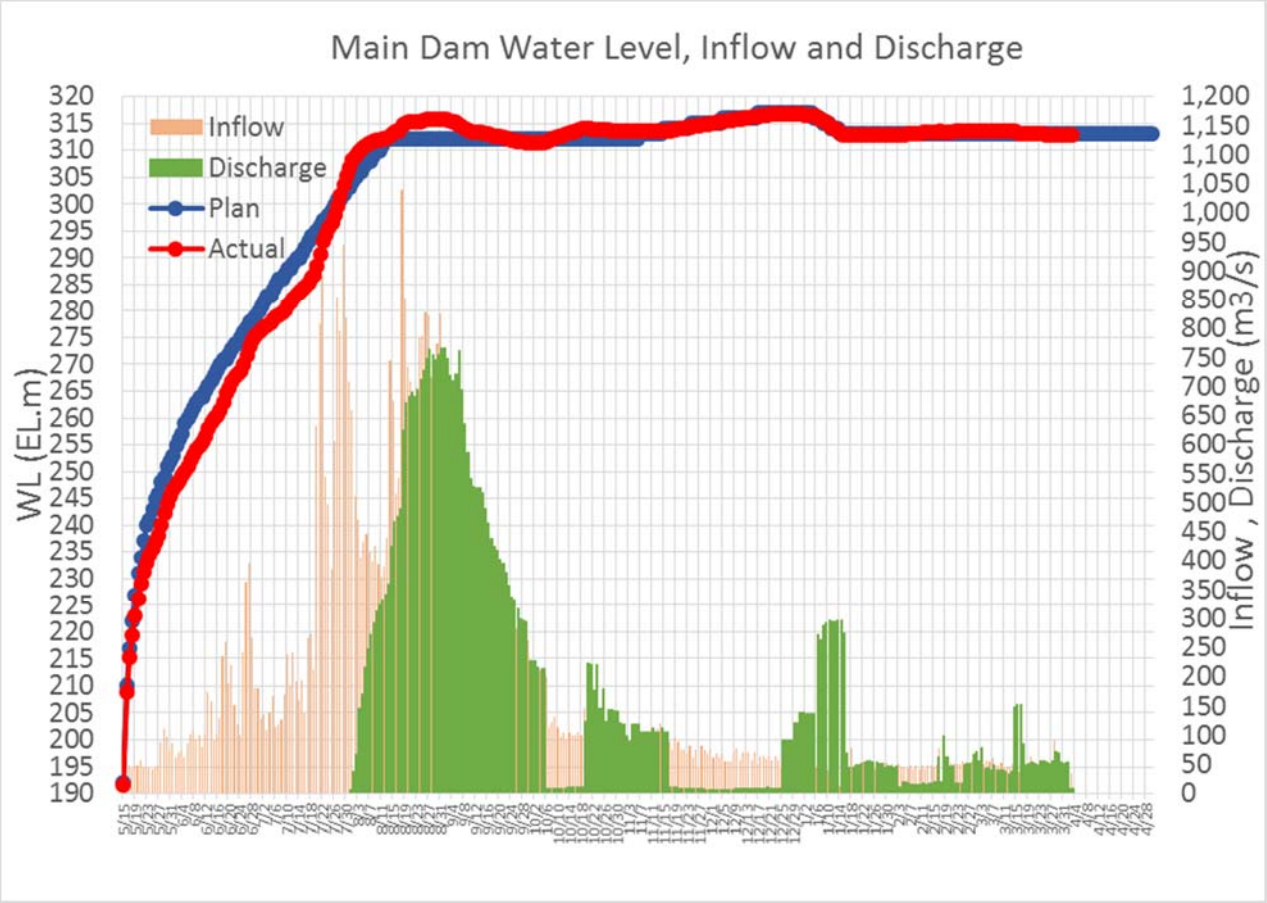
The results indicate that the recorded maximum noise levels and averaged noise levels complied with the Standard for all stations, except Hat Gniun Village (on 11-12 March 2019 during 22:01-

06:00), Phouhomxay Village (on 20-21 March 2019 during 22:01-06:00) and Main Powerhouse (on 26-27 March 2019 during 18:00-06:00).

3.2.8 DISCHARGE MONITORING

The progress of impounding from 15 May 2018 to 31 March 2019 is presented on the graph in ***Figure 3-3*** indicating the water level in the main reservoir, the inflow to the main reservoir and the discharge from the main reservoir into the re-regulation reservoir. The inflow data shows the gradual reduction in flows from the end of the wet season into the dry season with inflows from about 100 m^3/s at the beginning of November 2018 to an average of about 48 m^3/s during March 2019, which is very close to the long-term average for the month of March (51 m^3/s)

FIGURE 3-3: PROGRESS OF IMPOUNDING THE MAIN RESERVOIR

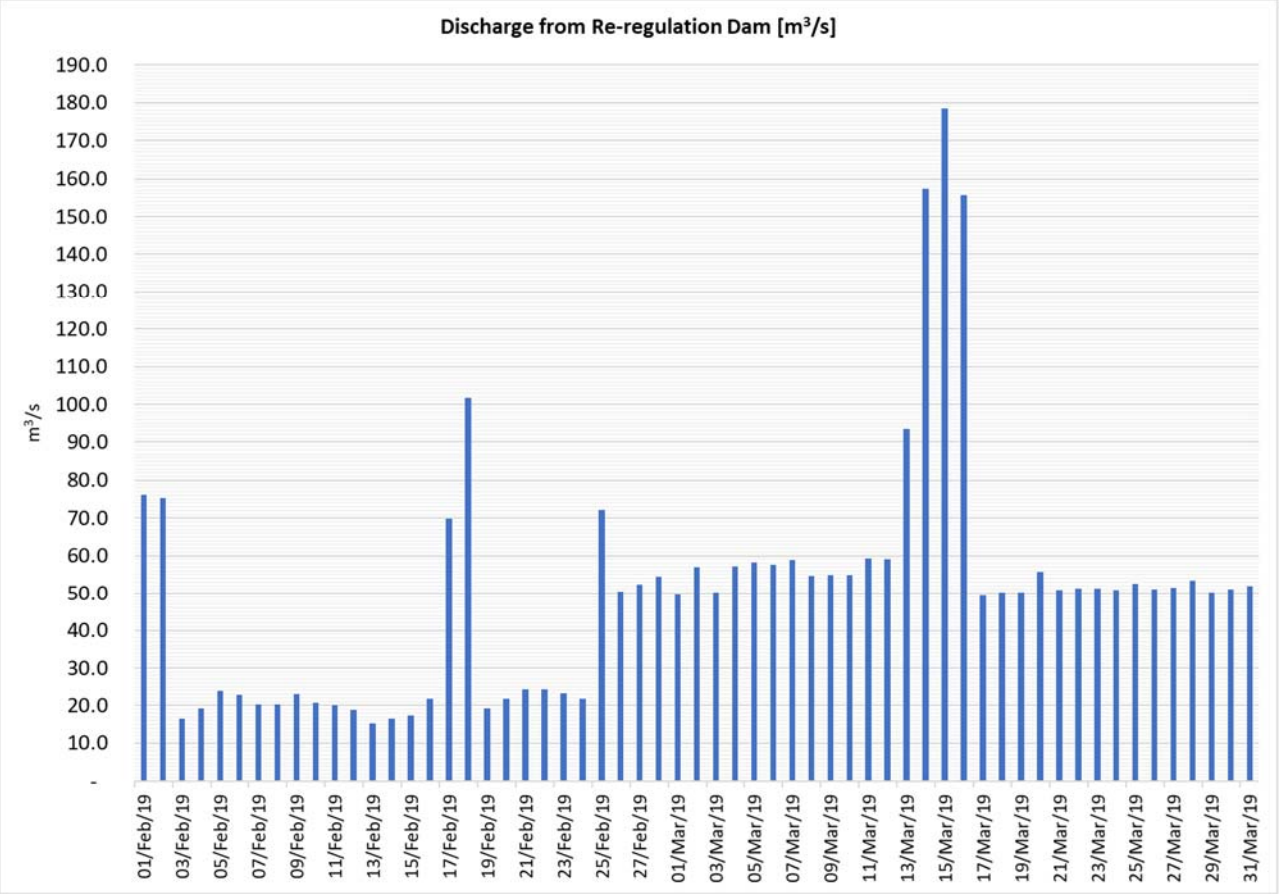


On 17 November 2018 the impounding of the main reservoir was restarted and continued until 25 December 2018. The water level in the reservoir rose with 3.2 m from 313.6 masl on 17 November 2018 to 316.8 masl on 25 December 2018. In the same period, the discharges from the main dam and the re-regulation dam were reduced (see ***Figure 3-3***) and maintained close to 10 m^3/s, which is well above the minimum flow requirement of 5.5 m^3/s. On 25 December 2018 the discharge from the main dam and the re-regulation dam was increased to equal the inflow to the main reservoir and this was maintained during the remaining part of December 2018. In the first two weeks of January 2019, the discharge from the re-regulation dam was increased to about 300 m^3/s or about 250 m^3/s above the inflow to the main reservoir thereby lowering the water level in the main reservoir by about 4 m to 312.8 masl. During the remaining part of January 2019, the discharge from the re-regulation dam was generally kept about 10-20 m^3/s

above the inflow to the main reservoir. From 03 February 2019 to 25 February 2019, the mean discharge from the re-regulation dam was kept at about 20 m^3/s (approximately 20 m^3/s lower than the inflow to the main reservoir), however with intermittent higher outflows in connection with testing of the turbine and the power generation in the re-regulation powerhouse. As presented in ***Figure 3-4***, the testing of the turbine and power generation has continued during March 2019 with the notable low discharge in the first week of March and the peaks in discharge of about 160 m^3/s from 14-16 March 2019.

The changes in the discharge from the re-regulation dam were informed in advance to the RMU and to the heads of the downstream villages, who then announced the changes to the communities over the village speaker systems.

FIGURE 3-4: DISCHARGE MONITORING AT THE RE-REGULATION DAM IN FEBRUARY AND MARCH 2019



3.2.9 NAM NGIEP DOWNSTREAM WATER DEPTH MONITORING

In March 2019, EMO carried out four boat missions to monitor the water depth in the Nam Ngiep downstream of the re-regulation dam. EMO has currently identified 19 sites with potential shallow water depths. The monitoring showed that all these sites had water depths from 0.2 – 1.9 m with some difficulties navigating on 6 March 2019 (4 sites) along the river due to the decreased discharge from the re-regulation dam as mentioned in Section 1.3 above.

3.3 PROJECT WASTE MANAGEMENT

3.3.1 SOLID WASTE MANAGEMENT

In March 2019, a total of 88.1 m^3 of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 12.7 m^3 compared to February 2019. During March 2019, EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and the camps. Mixed waste inside the waste bins was found out at ZHEFU camp, LILAMA 10 camp, 276 camp and Song Da 5 camp Nos.1 and 2. NNP1PC instructed the supervisors of all concerned Contractors and subcontractors to ensure proper waste management practices.

A total of 32,703 kg of recyclable waste (mostly scrap metal) was sold to Khounmixay Processing Factory by the Contractors. The remaining scrap metal will be sold or transported off site by the Contractor later on.

TABLE 3-11: AMOUNTS OF RECYCLABLE WASTE SOLD

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 31 March 2019
Construction Activity				
1	Scrap metal	kg	0	49,239
Sub-Total 1		**kg**	**0**	**49,239**
Camp Operations				
2	Glass bottles	kg	26	590
3	Plastic bottles	kg	28	243
4	Paper/Cardboard	kg	50	166
5	Aluminium cans	kg	4.5	97
Sub-Total 2		**kg**	**108.5**	**1,096**
Grand Total 1+2		**kg**	**108.5**	**50,335**

The villagers of Phouhomsay Village collected a total of 3,596 kg of food waste from selected camps for animal feed in March 2019, a decrease of 319 kg compared to February 2019 as a result of Kenber Camp decommissioning and a reduction in the number of construction workers at Song Da 5 Camps.

TABLE 3-12: AMOUNTS OF FOOD WASTE COLLECTED BY VILLAGERS

No.	Site Name	Unit	Total
1	Song Da 5 Camp No. 2	kg	81
2	Song Da 5 Camp No. 1	kg	602
3	Obayashi Corporation Camp	kg	1,064
4	Owner's Village and Site Office (OSOV)	kg	1,115
5	LILAMA 10 Camp	kg	734
Total		**kg**	**3,596**

3.3.2 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

The types and amounts of hazardous waste collected and transported for off-site treatment and final disposal at Khounmixay Processing Factory in March 2019 are shown below.

TABLE 3-13: RESULTS OF HAZARDOUS MATERIAL INVENTORY

No.	Hazardous Waste Type	Unit	Total in March 2019 (A)	Disposed (B)	Remainder (A - B)
1	Used hydraulic and engine oil	Litre	3,920	0	3,920
2	Contaminated soil, sawdust and concrete	bag	515	0	515
3	Used tyre	Piece	233	0	233
4	Used oil filters	Piece	205	0	205
5	Used oil mixed with water	Litre	200	0	200
6	Halogen/fluorescent bulbs	unit	140	0	140
7	Ink cartridge	unit	139	0	139
8	Empty paint and spray cans	can	128	0	128
9	Empty used chemical drum/container	Drum (200L)	108	0	108
10	Empty contaminated bitumen drum/container	Drum (200L)	101	1	100
11	Empty used oil drum/container	Drum (20 L)	54	8	46
12	Contaminated textile and material	kg	27	0	27
13	Lead acid batteries	unit	22	0	22
14	Clinic Waste	Kg	10.4	0	10.4
15	Lithium-ion batteries	unit	7	0	7
16	Empty used oil drum/container	Drum (200 L)	2	2	0

3.4 COMMUNITY WASTE MANAGEMENT

3.4.1 COMMUNITY RECYCLING PROGRAMME

In March 2019, a total of 2,513 kg of recyclable waste was recorded at the Community Waste Bank, a decrease of 101 kg compared to February 2019.

TABLE 3-14: *TYPES AND AMOUNTS OF RECYCLABLE WASTE TRADED AT THE COMMUNITY WASTE BANK*

Types of Waste	Unit	Remaining in Feb 2019	Additions in Mar 2019	Sold	Remaining in Feb 2019
Scrap metal	kg	44	0	0	44
Glass bottles	kg	1,675.5	225	345	1,555.5
Paper/cardboard	kg	701	212.5	0	913.5
Aluminium cans	kg	40	18	48	0
Plastic bottles	kg	154	100	254	0
Total	**kg**	**2,614.5**	**555.5**	**647**	**2,513**

3.4.2 COMMUNITY SOLID WASTE MANAGEMENT

In March 2019, a total of 111 m^3 of solid waste was collected from Phouhomxay, Thahuea and Hat Gniun Villages. The solid waste was transported to Houay Soup Landfill where recyclable materials were segregated before being disposed of at the landfill.

On 07 March 2019, RMU, ESD staff and villagers of Phouhomxay Village carried out a monthly CSR activity (village clean-up). The solid waste was transported to and disposed of at Houay Soup landfill by the local contractor.

3.5 WATERSHED AND BIODIVERSITY MANAGEMENT

3.5.1 WATERSHED MANAGEMENT

3.5.1.1 WATERSHED MANAGEMENT PLAN

A final consultation workshop to discuss and endorse the NNP1 Watershed Management Plan (MWP) was organized on 13 March 2019 at the Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF), in Vientiane Capital. The workshop was chaired by a Vice Minister of MAF and attended by 40 people consisting of representatives from the Watershed and Reservoir Protection Offices (WRPOs) and Watershed and Reservoir Protection Committees (WRPCs) as well as relevant Provincial Departments from Xaysomboun and Bolikhamxay Provinces, and central Government including representatives from the Department of Water Resources (DWR) under the Ministry of Natural Resources and Environment (MoNRE).

The conclusions and agreements from the workshop are summarized as the following:

1. The meeting agreed in principle to endorse the NNP1 Watershed Management Plan but prior to submission to the MAF for signing, the Chair recommended the drafting Committee including NNP1PC to improve and revise some of the following points:
   - Under the Component 1, the land-uses including the agriculture and forest land shall be revisited and improved in accordance with relevant laws and regulations in order to define and agree on the TPZs and CUZs within the NNP1 watershed.
   - Based on the lessons learned from Xe Pian-Xe Nam Noi Project, Component 5 needs to add activities on the Emergency Response Plan, particularly the early warning system at upper and downstream areas of NNP1 and coordination mechanism need to be elaborated in the NNP1 WMP. NNP1PC clarified that the Company has prepared a project specific Emergency Action Plan which the Company will further develop in collaboration with the Ministry of Labour and Social Welfare. The Chair suggested to make references to this Emergency Action Plan in the WMP.
   - Under Component 6, the Chair advised to include the development of community infrastructure for the villages located in the watershed area. For instance, schools, healthcare centres, clean water supply systems, electricity supply, etc.
   - The allocation of budget to each component shows that Component 6 is quite small compared with the administrative budget and budget for hiring experts, thus it is recommended for revision.
2. Regarding the Organisation Structures of NNP1 Watershed Management Plan and Biodiversity Offset Management Plan, the Chair agreed to amend the MAF Minister Agreement on the Establishment of Forest Resources Management and Protection Committee in the Watershed of Hydropower Projects for the whole country to include relevant stakeholders, such as relevant departments under MONRE and Ministry of Energy and Mines (MEM). Provincial Committees and Secretariats shall also improve their institutional arrangements by involving line agencies at the district and village levels.
3. Regarding the issues of rubber plantation, the Chair asked NNP1PC together with XSB and BLK WRPOs to recollect data of the rubber plantation areas including information on how many hectares were compensated, owned by how many households, how many hectares are

flooded by the NNP1 reservoir as well as how many hectares located inside the Total Protected Zones and Controlled Use Zones and how many households own these plots, make it clear and promptly find the solution for future management.

4. The procurement of technical assistance should be open for both external (NGO) and internal experts like the National University of Lao PDR and other research centres in order to support the local technicians and professionals, etc.

NNP1PC-EMO continues to improve the Lao version of the Plan addressing the comments from the workshop. The Plan is expected to be submitted to MAF in April 2019.

The WRPO's coordination meeting on the AIP2019 development was organized on 13 March 2019 after the Final Workshop on NNP1 WMP. Xaysomboun and Bolikhamxay Provincial WRPO presented the overall progress of development and draft of AIP2019. The key notes from the discussions are summarised below:

1. Bolikhamxay Provincial WRPO agreed with the latest revision of AIP2019 by NP1PC-EMO. NNP1PC also clarified that the advance payment by GOL for WRPO utilities and administration during 2016-2018 when the AIP was yet approved could be reimbursed but it is subject to further discussion and agreement with ADB.
2. Xaysomboun Provincial WRPO was advised by NNP1PC and DOF to revisit the draft and prioritize the proposed activities considering the period of implementation (remaining months in 2019) and their resource capacities.
3. AIP and fund disbursement should be reviewed and approved on an annual basis which is in line with NNP1PC financial procedure.
4. The AIP2019 needs to be reviewed and approved by NNP1PC and ADB prior to further submission and approval by Provincial Governor of each Province. The soonest implementation of AIP 2019 is expected to be started from May 2019.

The operation of checkpoints in both Provinces continued in March 2019. The checkpoints made 666 records of people accessing the main reservoir through the checkpoint at Houayxay Village (Hom District, Xaysomboun Province).

The main reasons why people access the reservoir include fishing and hunting (142 records), agriculture (142 records), livestock raising (127 records) and other purpose (255 records). The checkpoint in Pou Village recorded 950 boats entering the reservoir and 911 boats leaving the reservoir. Military staff appointed at the checkpoints are not law enforcement officers for Forestry Law and Wildlife and Aquatic Animal Law. Thus, they are only responsible for security checks and report the incidents to the WRPO for further actions. An approval of the WMP will be needed to provide the basis for the preparation and implementation of the AIP 2019 that will include full patrolling activities in the TPZs and the reservoir.

The Management Team of NNP1 ESD and Xaysomboun Provincial Watershed and Reservoir Protection Committee (WRPC) conducted a site visit in the NNP1 main reservoir on 26 March 2019 with the following discussion and agreement:

1. Xaysomboun Provincial WRPO technical staff to be immediately assigned in Houaxay Village once the AIP2019 is approved;
2. The fishery activities in the main reservoir particularly in Houayphamom area to be stopped because they use electric fishing and other prohibited equipment that do not comply with existing law and regulation;

3. Relevant GOL sectors should coordinate with Xaysomboun Provincial WRPO to monitor and register all the boats that operate in the main reservoir. The navigation route will be identified and the fee will be based on the boat size and boat engine capacity;
4. NNP1PC Compensation Team will provide the information of compensated land within Houaxay Village. It is necessary to have an official notification letter from GOL that the compensated cultivated area will be a reforestation area according with watershed regulation and so any activities within it should be stopped to avoid further forest encroachment.
5. Strict patrolling should be commenced by military and relevant GOL offices to avoid further encroachment into the TPZ;
6. Xaysomboun PAFO to complete the improvement of Provincial Regulation and submit it to Xaysomboun Provincial Assembly as soon as possible so that the approval could be obtained not later than 04 April 2019;
7. Xaysomboun Provincial WRPO will issue a notification letter to request salvage logging committee to report the logs collection in Nahan Village to the two provinces and Department of Forestry (DOF) for acknowledgement and further guidance;
8. Xaysomboun Provincial WRPC and WRPO agreed on the process for WRPO sub-office establishment that a construction company will be procured and a field survey will be commenced together with Xaysomboun Provincial WRPO technical team prior to bidding. In addition, Xaysomboun Provincial WRPC and WRPO also planned to procure boats with boat engine of 20 to 30 horse power for patrolling activity and a communication system will be established using walkie-talkie to ease the communication in the off-network coverage within NNP1 watershed and main reservoir.

3.5.1.2 PREPARATION OF PROVINCIAL REGULATION FOR WATERSHED MANAGEMENT

A Final Technical Workshop to review the draft Provincial Regulation for NNP1 Watershed and Reservoir Management with concerned GOL sectors was organized in Xaysomboun Province on 26 March 2019 with the participants from Watershed and Reservoir Protection Office (WRPO)

The main objectives of the Final Technical Workshop were:

1. To present and discuss the improved draft Regulation based on the comments provided by Provincial Assembly and concern sectors obtained between January and March 2019;
2. Make amendments for submission to the Drafting Committee to further discuss and finalize this draft in a Final Workshop scheduled on 01 April 2019.

3.5.2 BIODIVERSITY OFFSET MANAGEMENT

3.5.2.1 PREPARATION OF BIODIVERSITY OFFSET MANAGEMENT PLAN

NNP1PC together with its Biodiversity Consultant completed the improvement of the Biodiversity Offset Management Plan in the first week of March 2019. The improved Plan was resubmitted to ADB and BAC on 11 March 2019. They provided confirmations to close the review on 21 and 22 March 2019 respectively after NNP1PC had addressed their final comments on 13 and 20 March 2019.

NNP1PC-EMO continues with the improvement of the Plan in Lao version. The improved Lao version is expected to be ready by end of April 2019 for sharing with GOL. A technical workshop with Bolikhaxmay Provincial Biodiversity Offset Management Unit (BOMU) and concerned GOL sectors was tentatively scheduled in mid-May 2019.

3.5.2.2 IMPLEMENTATION OF PRE-BIODIVERSITY OFFSET MANAGEMENT PLAN (BOMP)

The Pre-BOMP2B proposal was approved by ADB and agreed by BOMC at the end of September 2018. A total of USD 88,578 was disbursed in September 2018 for the continuation of the checkpoint operation and patrolling from September 2018 – March 2019.

In March 2018, two patrolling teams with a total of 18 people conducted forest patrolling for 16 days in Viengthong and 17 days in Xaychamphone Districts. The patrolling covered 10 biodiversity areas within the NC-NX Offset Site in these Districts. The team recorded nine cases of wildlife hunting with five temporary hunting camps and two small wire snares, 10 cases of unregulated fishing, and three cases of NTFP extraction by local villagers. In addition, one Serow (approximate weight of 25 kg) was confiscated with fines and written warning made to the offenders at Ban Sopkhone by the Xaychamphone team.

Bolikhamxay Provincial BOMU together with NNP1PC-EMO have completed the draft of AIP2019 and NNP1PC submitted it to ADB and BAC for review and approval on 22 March 2019. BAC provided comments on 27 March 2019 accepting the proposal with a condition that the AIP will be revised by the Biodiversity Service Provider once they are on board. ADB did not provide any comments yet by the end of March 2019.

3.6 FLOATING DEBRIS REMOVAL

A contractual agreement between NNP1PC and floating debris contractor was signed on 01 March 2019 and a Notice to Proceed was issued by NNP1PC on 04 March 2019.

The Contractor started cutting and burning the logs in the middle of main reservoir from 14 March 2019 and mobilized the equipment to assemble the log boom on 26 March 2019.

FIGURE 3-5: POTENTIAL LOCATION FOR TEMPORARY LOG BOOM INSTALLATION

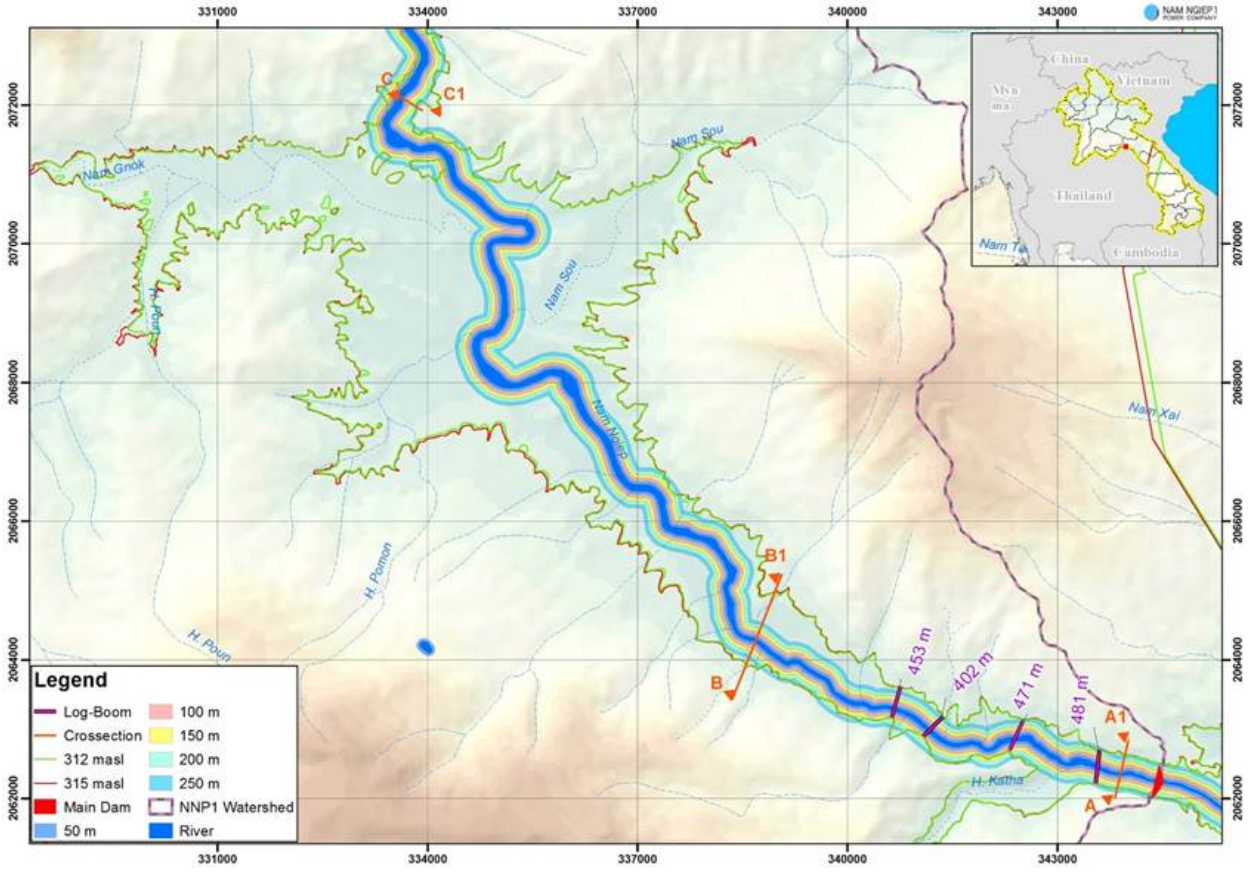
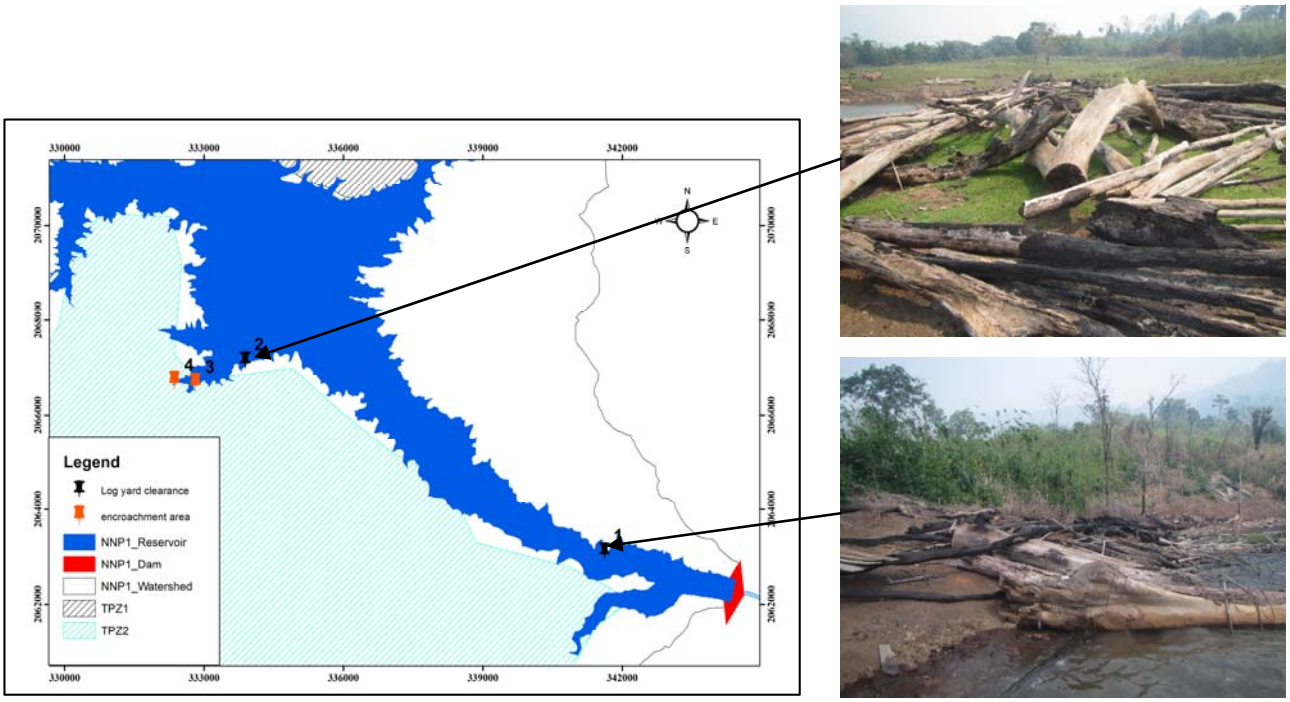
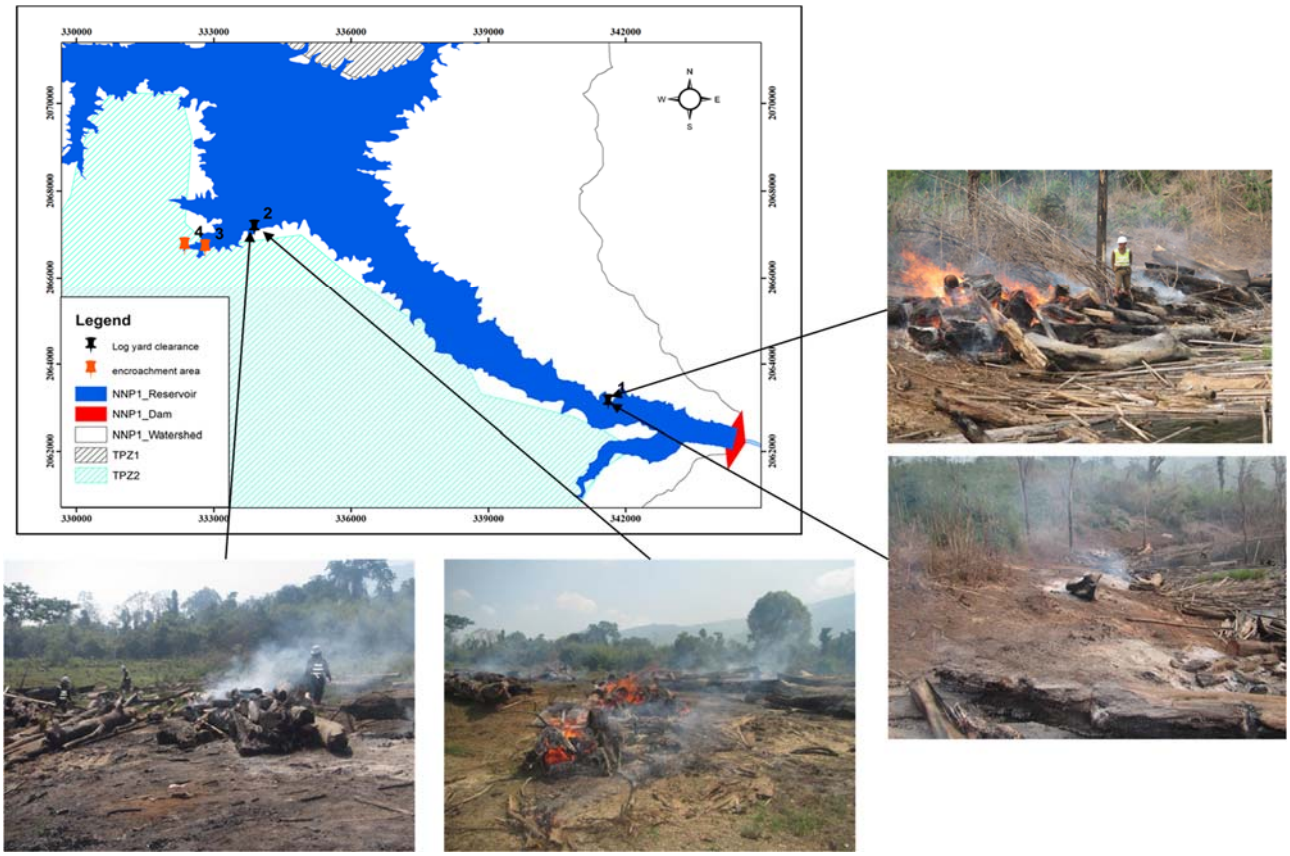


FIGURE 3-6: REPRESENTATIVE PHOTOS OF COLLECTING LOGS, CUTTING, AND BURNING IN THE MIDDLE OF MAIN RESERVOIR





4. FISHERY MONITORING

Three species groups and two species dominated the fish catch by weight in February 2019 as listed in ***Table 4-1.*** These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species[2], except *Hemibagrus filamentus* which is classified as Data Deficient.

TABLE 4-1: FISH SPECIES DOMINATING THE FISH CATCH IN FEBRUARY 2019

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Poropuntius normani, Poropuntius laoensis,Poropuntius carinatus	ปาจาด	924.2	LC
Cyclocheilichthys apogon	ปาดอกงิ้อ	34.7	LC
Hemibagrus nemurus, Hemibagrus filamentus	ปาก็ด	32.9	LC, DD
Channa striata	ปาถ่	29	LC
Hampala dispar, Hampala macrolepidota	ปาสูด	28.9	LC

[2] The IUCN Red List of Threatened Species is the world's most comprehensive inventory and classification of threatened species. The Red List classifies species into nine groups: Extinct (EX), Extinct in the wild (EW), Critically endangered (CR), Endangered (EN), Vulnerable (VU), Near threatened (NT), Least concern (LC), Data deficient (DD), and Not evaluated (NE). The term "Threatened" includes Critically Endangered, Endangered, and Vulnerable.

The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in February 2019 is presented in ***Table 4-2***. The list includes three species that are classified as Vulnerable (VU) species, and four Near Threatened (NT) species.

TABLE 4-2: *THREATENED SPECIES OF FEBRUARY 2019 FISH CATCH*

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Bangana behri	ปาอ่า	15.5	VU
Cirrhinus cirrhosus	ปามอมจับ/ปาแกง	8.7	VU
Cirrhinus molitorella	ปาแกง	4.8	NT
Neolissochilus stracheyi	ปาสอง	2.5	NT
Ompok bimaculatus	ปาเซือม	6.2	NT
Onychostoma gerlachi	ปาถิง	11.2	NT
Scaphognathops bandanensis	ปาอวมไฟ/ปาป่วม	3.2	VU

The total recorded monthly fish catch for the downstream and upstream fishing households and the Mekong control group involved in the monitoring programme from July 2015 to February 2019 is presented in ***Figure 4-1***. Note that the upstream fish catch excludes the fish catch from the fishing households in Zone 2LR because these households were resettled during Q4-2017. In addition, the recording days was reduced from 30 days/month to only seven days/month starting from February 2019 due to Company financial constraint. However, redesigning the sampling program have been carefully discussed with fishery expert and noted that NNP1PC needs to continue the monitoring and the long trend data analysis should carefully consider the different sampling programs that were implemented.

FIGURE 4-1: TOTAL RECORDED MONTHLY FISH CATCH JULY 2015 - FEBRUARY 2019

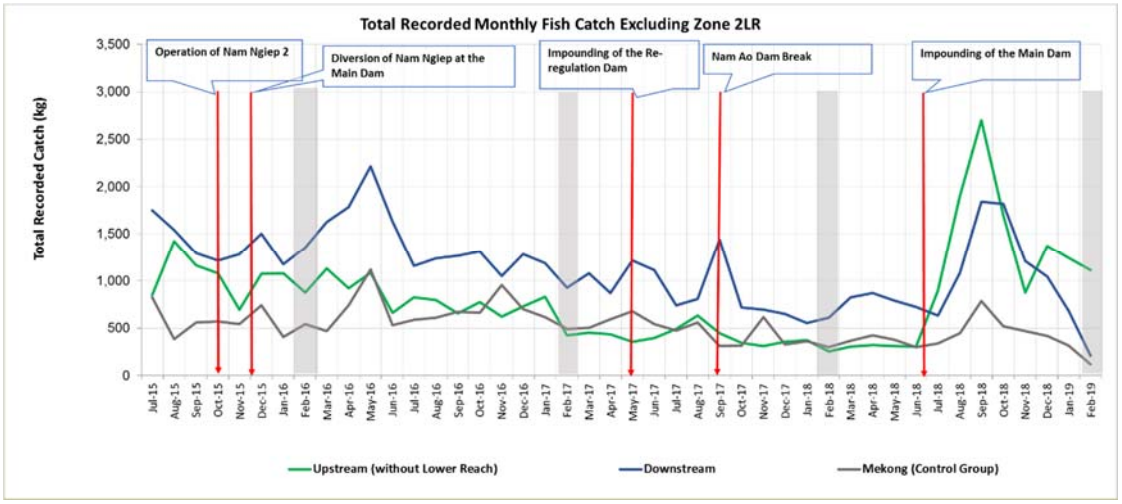
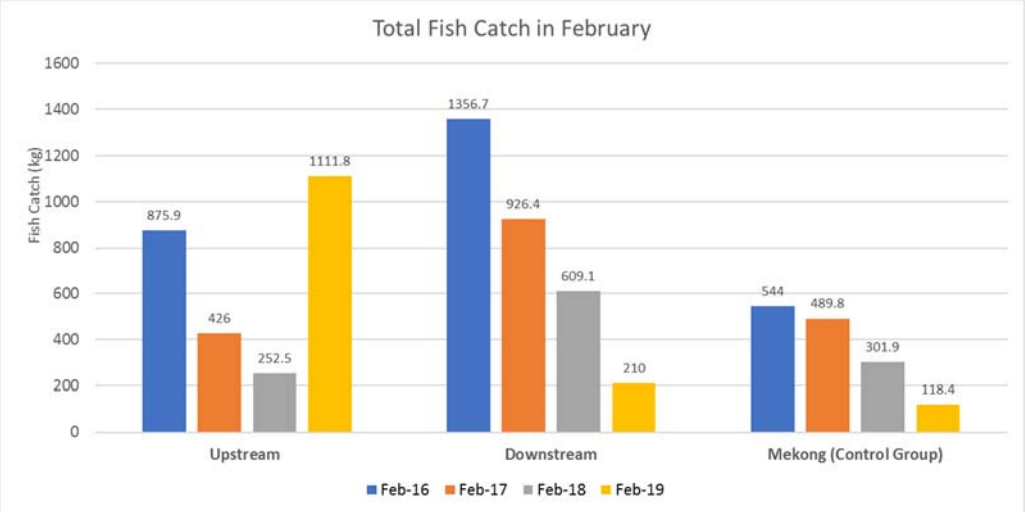


Table 4-3 and ***Figure 4-2*** show the total recorded fish catch for February 2016, February 2017, February 2018 and February 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved fishing households.

TABLE 4-3: TOTAL RECORDED FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN FEBRUARY 2016, FEBRUARY 2017, FEBRUARY 2018 AND FEBRUARY 2019

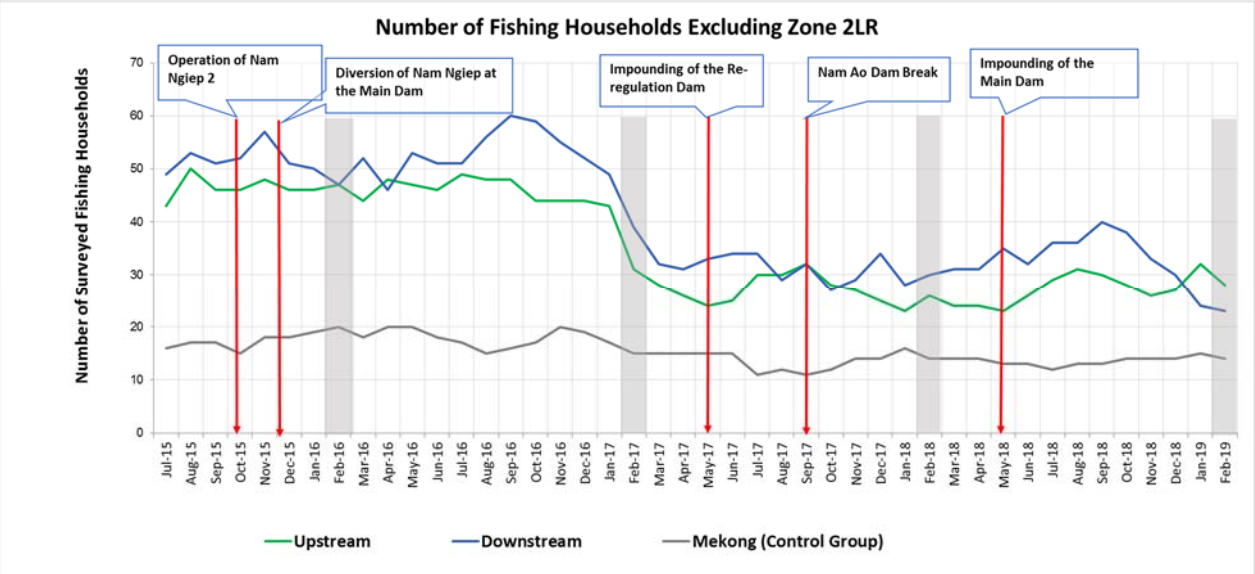
Fishing Zone	February 2016 (kg)	February 2017(kg)	February 2018 (kg)	February 2019 (kg)
Upstream	875.9	426	252.5	1,111.8
Downstream	1,356.7	926.4	609.1	210
Mekong Control Group	544	489.8	301.9	118.4

FIGURE 4-2: TOTAL RECORDED FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN FEBRUARY 2016, FEBRUARY 2017, FEBRUARY 2018 AND FEBRUARY 2019



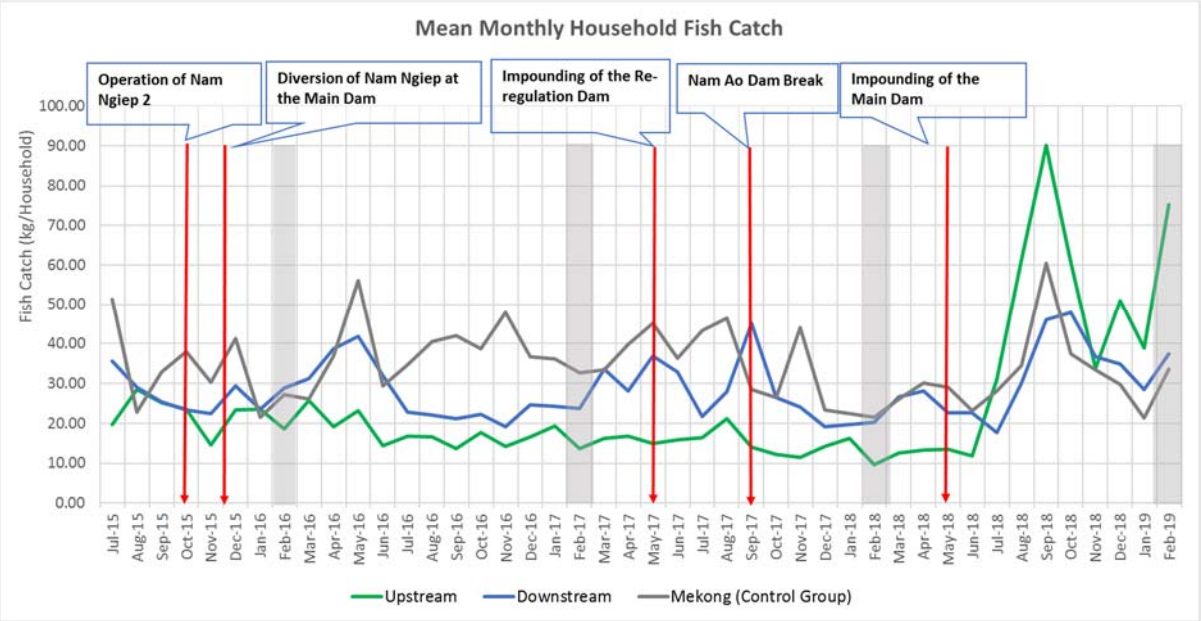
The numbers of fishing households involved in the fish catch monitoring programme are displayed in ***Figure 4-3****Error! Reference source not found.*.

FIGURE 4-3: NUMBER OF FISHING HOUSEHOLDS INVOLVED IN THE FISH CATCH MONITORING PROGRAMME



The mean monthly household fish catch from July 2015 to February 2019 for the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are presented in ***Figure 4-4.***

FIGURE 4-4: MEAN MONTHLY HOUSEHOLD FISH CATCH WITHOUT ZONE 2LR



The mean household fish catch for February 2016, February 2017, February 2018 and February 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group are displayed in ***Table 4-4.***

TABLE 4-4: MEAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR

Fishing Zone	February 2016 (kg)	February 2017 (kg)	February 2018 (kg)	February 2019 (kg)
Upstream	18.6	13.7	9.7	75.18
Downstream	28.9	23.8	20.3	37.48
Mekong Control Group	27.2	32.7	21.6	33.61

The mean monthly fish catch per household per fishing day are displayed in ***Figure 4-5***, and the mean fish catch per household per fishing day February 2016, February 2017, February 2018 and February 2019 are shown in

Table** 4-5**.

FIGURE 4-5: MEAN MONTHLY HOUSEHOLD FISH CATCH PER FISHING DAY

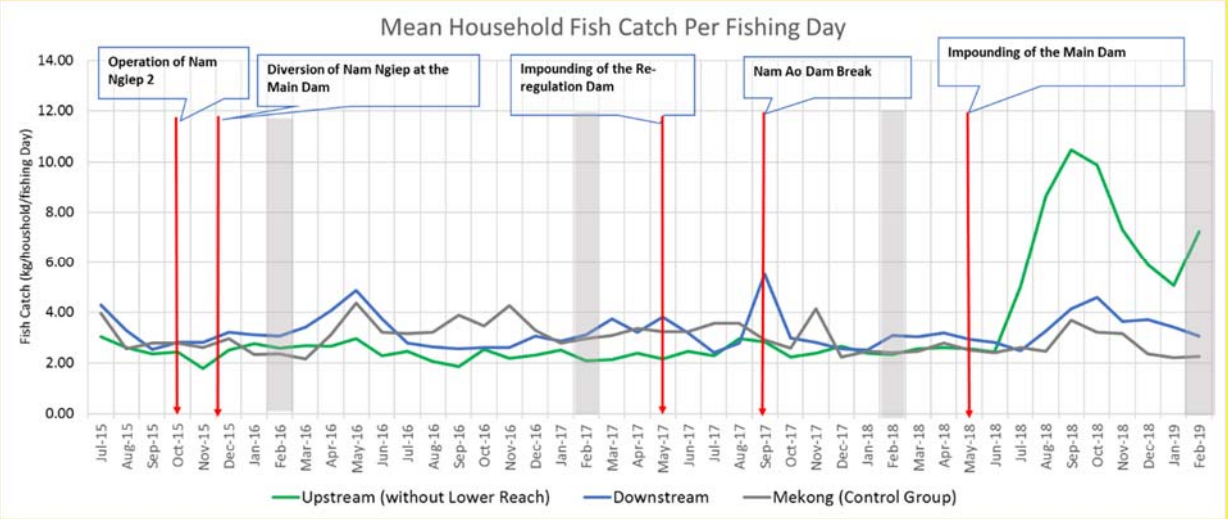


TABLE 4-5: MEAN HOUSEHOLD FISH CATCH PER FISHING DAY IN FEBRUARY

Fishing Zone	February 2016 (kg)	February 2017 (kg)	February 2018 (kg)	February 2019 (kg)
Upstream	2.58	2.08	2.34	7.24
Downstream	3.05	3.10	3.08	3.06
Mekong (Control Group)	2.35	2.95	2.42	2.26

ANNEXES

ANNEX A: RESULTS OF WATER QUALITY MONITORING

TABLE A- 1: *RESULTS OF MAIN RESERVOIR, RE-REGULATION RESERVOIR AND SURFACE WATER (NAM NGIEP RIVER) QUALITY MONITORING*

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	**Parameters (Unit)**	**Guideline**												
2-Mar-19	pH	5.0 - 9.0						8.35			8.38			
4-Mar-19	pH	5.0 - 9.0					7.99	8.45						
5-Mar-19	pH	5.0 - 9.0	8.5	8.53	8.48	7.8								
6-Mar-19	pH	5.0 - 9.0							7.99	7.93	8.17	7.29	6.61	7
9-Mar-19	pH	5.0 - 9.0						7.25			7.01			
12-Mar-19	pH	5.0 - 9.0		8.35	7.98	8.41								
13-Mar-19	pH	5.0 - 9.0					7.86	7.93	8.04	7.06	8.42	7.93	6.84	6.97
16-Mar-19	pH	5.0 - 9.0						8.49			8.37			
18-Mar-19	pH	5.0 - 9.0					8.32	8.04						
19-Mar-19	pH	5.0 - 9.0	8.29											
20-Mar-19	pH	5.0 - 9.0							8.01	8.18	8.08	7.26	6.87	6.82
21-Mar-19	pH	5.0 - 9.0		8.87	8.39	8.9								
23-Mar-19	pH	5.0 - 9.1						8.06			8.19			
25-Mar-19	pH	5.0 - 9.2					8.26	8.41						
26-Mar-19	pH	5.0 - 9.3		8.43	8.63	8.44								
27-Mar-19	pH	5.0 - 9.4							8.15	8.08	8.19	7.79	6.75	6.72
2-Mar-19	Sat. DO (%)							99.6			101			
4-Mar-19	Sat. DO (%)						89.8	90.1						
5-Mar-19	Sat. DO (%)		103.1	96	96.3	93.4								
6-Mar-19	Sat. DO (%)								94	94.7	102.8	100.4	99.1	101
9-Mar-19	Sat. DO (%)							97.8			103.6			
12-Mar-19	Sat. DO (%)			96.9	75.6	78.4								
13-Mar-19	Sat. DO (%)						74.5	82.7	94.9	90.4	102.1	103	95.9	94.2
16-Mar-19	Sat. DO (%)							90.7			99			
18-Mar-19	Sat. DO (%)						88.3	88.2						
19-Mar-19	Sat. DO (%)		100.3											
20-Mar-19	Sat. DO (%)								94.8	92.8	97.9	97.2	96.8	94.8
21-Mar-19	Sat. DO (%)			93.5	85.2	87.9								
23-Mar-19	Sat. DO (%)							93.5			96.6			
25-Mar-19	Sat. DO (%)						98.6	92.5						
26-Mar-19	Sat. DO (%)			93.6	87.3	90.7								
27-Mar-19	Sat. DO (%)								83.7	84.2	95.1	93.1	93.7	95
2-Mar-19	DO (mg/l)	<6.0						7.86			8			
4-Mar-19	DO (mg/l)	<6.0					7.07	7.16						
5-Mar-19	DO (mg/l)	<6.0	7.94	7.42	7.5	7.29								
6-Mar-19	DO (mg/l)	<6.0							7.69	7.55	7.87	7.82	7.58	7.58
9-Mar-19	DO (mg/l)	<6.0						7.63			8.21			
12-Mar-19	DO (mg/l)	<6.0		7.56	6	6.29								
13-Mar-19	DO (mg/l)	<6.0					6	6.67	7.87	7.26	8.12	8.34	7.6	7.32
16-Mar-19	DO (mg/l)	<6.0						7.03			7.9			
18-Mar-19	DO (mg/l)	<6.0					6.95	6.97						
19-Mar-19	DO (mg/l)	<6.0	8.23											
20-Mar-19	DO (mg/l)	<6.0							7.73	7.49	7.64	7.36	7.34	7.14
21-Mar-19	DO (mg/l)	<6.0		7.15	6.58	6.86								
23-Mar-19	DO (mg/l)	<6.0						7.15			7.69			

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
25-Mar-19	DO (mg/l)	<6.0					7.72	7.22						
26-Mar-19	DO (mg/l)	<6.0		7.15	6.76	7.1								
27-Mar-19	DO (mg/l)	<6.0							6.87	6.73	7.35	7.16	7.17	7.01
2-Mar-19	Conductivity (µs/cm)							52.5			53.5			
4-Mar-19	Conductivity (µs/cm)						68	69						
5-Mar-19	Conductivity (µs/cm)		60.8	87	82	71								
6-Mar-19	Conductivity (µs/cm)								71	71	51.2	61	53.1	55.6
9-Mar-19	Conductivity (µs/cm)							50.8			52.6			
12-Mar-19	Conductivity (µs/cm)			87	84	71								
13-Mar-19	Conductivity (µs/cm)						69	69	74	72	52.2	52.8	52.1	53.9
16-Mar-19	Conductivity (µs/cm)							51.1			53.9			
18-Mar-19	Conductivity (µs/cm)						69	69						
19-Mar-19	Conductivity (µs/cm)		69											
20-Mar-19	Conductivity (µs/cm)								72	72	54.3	55.3	53.3	52.6
21-Mar-19	Conductivity (µs/cm)			86	84	72								
23-Mar-19	Conductivity (µs/cm)							50.4			54			
25-Mar-19	Conductivity (µs/cm)						69	69						
26-Mar-19	Conductivity (µs/cm)			88	84	71								
27-Mar-19	Conductivity (µs/cm)								73	73	54	52.4	53.3	52.8
2-Mar-19	TDS (mg/l)							26.25			26.75			
4-Mar-19	TDS (mg/l)						34	34.5						
5-Mar-19	TDS (mg/l)		30.4	43.5	41	35.5								
6-Mar-19	TDS (mg/l)								35.5	35.5	25.5	30.5	26.5	27.8
9-Mar-19	TDS (mg/l)							25.4			26.3			
12-Mar-19	TDS (mg/l)			43.5	42	35.5								
13-Mar-19	TDS (mg/l)						34.5	34.5	37	36	26.1	26.4	26.5	26.95
16-Mar-19	TDS (mg/l)							25.55			29.65			
18-Mar-19	TDS (mg/l)						34.5	34.5						
19-Mar-19	TDS (mg/l)		34.5											
20-Mar-19	TDS (mg/l)								36	36	27	27.5	26.5	26.3
21-Mar-19	TDS (mg/l)			43	42	36								
23-Mar-19	TDS (mg/l)							25.2			27			
25-Mar-19	TDS (mg/l)						34.5	34.5						
26-Mar-19	TDS (mg/l)			44	42	35.5								
27-Mar-19	TDS (mg/l)								36.5	36.5	27	26.2	26.65	26.4
2-Mar-19	Temperature (°C)							25.6			25.9			
4-Mar-19	Temperature (°C)						27.62	27.3						
5-Mar-19	Temperature (°C)		26.5	28.77	28.29	28.22								
6-Mar-19	Temperature (°C)								25.36	27.08	28	27.9	28	28.6
9-Mar-19	Temperature (°C)							26.3			25.6			
12-Mar-19	Temperature (°C)			28.03	27.65	26.76								
13-Mar-19	Temperature (°C)						26.44	26.37	24.76	26.58	25.9	25	26.2	27.2
16-Mar-19	Temperature (°C)							26.6			26			
18-Mar-19	Temperature (°C)						27.8	27.54						
19-Mar-19	Temperature (°C)		23.3											
20-Mar-19	Temperature (°C)								25.63	25.93	26.8	27.5	28.3	28.8
21-Mar-19	Temperature (°C)			29.84	28.56	28.08								
23-Mar-19	Temperature (°C)							27			25.7			
25-Mar-19	Temperature (°C)						27.86	28.19						
26-Mar-19	Temperature (°C)			29.78	28.45	27.94								

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
27-Mar-19	Temperature (°C)								25.61	27.63	27.6	27.7	28.1	29.9
2-Mar-19	Turbidity (NTU)							1.02			8.88			
4-Mar-19	Turbidity (NTU)						1.14	0.77						
5-Mar-19	Turbidity (NTU)		5.96	1.24	0.92	0.93								
6-Mar-19	Turbidity (NTU)								3.98	4.22	4.6	9.13	5.58	6.17
9-Mar-19	Turbidity (NTU)							1.06			4.31			
12-Mar-19	Turbidity (NTU)			1.06	0.99	1.07								
13-Mar-19	Turbidity (NTU)						1.54	1.45	6.33	6.33	8.47	8.68	5.44	5.32
16-Mar-19	Turbidity (NTU)							2.6			5.81			
18-Mar-19	Turbidity (NTU)						0.85	0.96						
19-Mar-19	Turbidity (NTU)		6.92											
20-Mar-19	Turbidity (NTU)								4.9	4.91	8.13	8.44	7.42	9.22
21-Mar-19	Turbidity (NTU)			1.3	1.01	1.08								
23-Mar-19	Turbidity (NTU)							2.62			5.09			
25-Mar-19	Turbidity (NTU)						1.04	0.96						
26-Mar-19	Turbidity (NTU)			1.97	1.1	1.17								
27-Mar-19	Turbidity (NTU)								6.2	5.07	5.14	5.39	5.12	6.33
4-Mar-19	TSS (mg/l)						<5	<5						
5-Mar-19	TSS (mg/l)		6.98	<5	<5	<5								
6-Mar-19	TSS (mg/l)								<5	<5	<5	<5	7.42	6.81
9-Mar-19	TSS (mg/l)													
12-Mar-19	TSS (mg/l)													
13-Mar-19	TSS (mg/l)							<5	<5	<5	18.14			
18-Mar-19	TSS (mg/l)							<5						
20-Mar-19	TSS (mg/l)								<5	<5	8.02			
25-Mar-19	TSS (mg/l)							<5						
27-Mar-19	TSS (mg/l)								<5	5.47	5.06			
4-Mar-19	BOD5 (mg/l)	<1.5					<1.0	<1.0						
5-Mar-19	BOD5 (mg/l)	<1.5	<1.0	1.09	<1.0	<1.0								
6-Mar-19	BOD5 (mg/l)	<1.5							<1.0	1.28	<1	<1	<1	<1
13-Mar-19	BOD5 (mg/l)	<1.5						<1.0	<1.0	<1.0	<1.0			
18-Mar-19	BOD5 (mg/l)	<1.5						<1.0						
20-Mar-19	BOD5 (mg/l)	<1.5							<1.0	1.2	1.26			
4-Mar-19	COD (mg/l)	<5					<5.0	<5.0						
5-Mar-19	COD (mg/l)	<5	<5	<5.0	<5.0	<5.0								
6-Mar-19	COD (mg/l)	<5							<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Mar-19	NH3-N (mg/l)	<0.2					<0.2	<0.2						
5-Mar-19	NH3-N (mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2								
6-Mar-19	NH3-N (mg/l)	<0.2							<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
4-Mar-19	NO3-N (mg/l)	<5					<0.02	0.03						
5-Mar-19	NO3-N (mg/l)	<5	<0.02	<0.02	<0.02	<0.02								
6-Mar-19	NO3-N (mg/l)	<5							<0.02	<0.02	<0.02	<0.02	0.03	<0.02
4-Mar-19	Faecal coliform (MPN/100 ml)	<1,000					22	17						
5-Mar-19	Faecal coliform (MPN/100 ml)	<1,000	540	7	8	13								
6-Mar-19	Faecal coliform (MPN/100 ml)	<1,000							130	79	79	130	110	130
13-Mar-19	Faecal coliform (MPN/100 ml)	<1,000						0	0	2	21			
18-Mar-19	Faecal coliform (MPN/100 ml)	<1,000						5						

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
20-Mar-19	Faecal coliform (MPN/100 ml)	<1,000							26	49	70			
4-Mar-19	Total Coliform (MPN/100 ml)	<5,000					79	27						
5-Mar-19	Total Coliform (MPN/100 ml)	<5,000	1,600	22	17	21								
6-Mar-19	Total Coliform (MPN/100 ml)	<5,000							130	79	240	350	350	350
13-Mar-19	Total Coliform (MPN/100 ml)	<5,000						23	8	17	350			
18-Mar-19	Total Coliform (MPN/100 ml)	<5,000						8						
20-Mar-19	Total Coliform (MPN/100 ml)	<5,000							140	110	140			
4-Mar-19	Phytoplankton Biomass (g dry wt/m3)						2	1.6						
5-Mar-19	Phytoplankton Biomass (g dry wt/m3)			1.8	2.2	2.6								
6-Mar-19	Phytoplankton Biomass (g dry wt/m3)								2.4	2				
4-Mar-19	Total Phosphorus (mg/l)						<0.01	<0.01						
5-Mar-19	Total Phosphorus (mg/l)			<0.01	<0.01	<0.01								
6-Mar-19	Total Phosphorus (mg/l)								<0.01	<0.01				
4-Mar-19	Total Dissolved Phosphorus (mg/l)						<0.01	<0.01						
5-Mar-19	Total Dissolved Phosphorus (mg/l)			<0.01	<0.01	<0.01								
6-Mar-19	Total Dissolved Phosphorus (mg/l)								<0.01	<0.01				
4-Mar-19	TOC (mg/l)						1.13	1.18						
5-Mar-19	TOC (mg/l)			1.47	1.38	1.14								
6-Mar-19	TOC (mg/l)								1.07	1.13				
4-Mar-19	Hydrogen Sulfide (mg/l)							<0.02						
6-Mar-19	Hydrogen Sulfide (mg/l)									<0.02	<0.02			

TABLE A- 1: *RESULTS OF SURFACE WATER QUALITY MONITORING IN NAM CHIAN, NAM PHOUAN, NAM XAO AND NAM HOUAY SOUP*

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
5-Feb-19	pH	5.0 - 9.0	8.76	8.48		
6-Feb-19	pH	5.0 - 9.0			7.87	7.78
12-Feb-19	pH	5.0 - 9.0		8.62		
13-Feb-19	pH	5.0 - 9.0			7.76	7.57
19-Feb-19	pH	5.0 - 9.0	8.22	8.49		
20-Feb-19	pH	5.0 - 9.0			7.28	6.81
26-Feb-19	pH	5.0 - 9.0		8.39		
27-Feb-19	pH	5.0 - 9.0			7.82	7.18
5-Feb-19	Sat. DO (%)		103.8	97.6		
6-Feb-19	Sat. DO (%)				87.6	94.3
12-Feb-19	Sat. DO (%)			92.5		

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
13-Feb-19	Sat. DO (%)				82.1	83.1
19-Feb-19	Sat. DO (%)		100.4	112.7		
20-Feb-19	Sat. DO (%)				82.3	74
26-Feb-19	Sat. DO (%)			93.4		
27-Feb-19	Sat. DO (%)				81.2	97
5-Feb-19	DO (mg/l)	<6.0	8.81	9.06		
6-Feb-19	DO (mg/l)	<6.0			7.2	7.82
12-Feb-19	DO (mg/l)	<6.0		8.9		
13-Feb-19	DO (mg/l)	<6.0			6.72	7.06
19-Feb-19	DO (mg/l)	<6.0	8.29	10.12		
20-Feb-19	DO (mg/l)	<6.0			6.71	6.09
26-Feb-19	DO (mg/l)	<6.0		8.21		
27-Feb-19	DO (mg/l)	<6.0			6.36	7.72
5-Feb-19	Conductivity (µs/cm)		26.1	71		
6-Feb-19	Conductivity (µs/cm)				117	56.1
12-Feb-19	Conductivity (µs/cm)			75		
13-Feb-19	Conductivity (µs/cm)				122.2	45.6
19-Feb-19	Conductivity (µs/cm)		32.5	71		
20-Feb-19	Conductivity (µs/cm)				94.1	61.5
26-Feb-19	Conductivity (µs/cm)			68		
27-Feb-19	Conductivity (µs/cm)				116.2	40.3
5-Feb-19	TDS (mg/l)		13.05	35.5		
6-Feb-19	TDS (mg/l)				58.5	28
12-Feb-19	TDS (mg/l)			37.5		
13-Feb-19	TDS (mg/l)				61.1	37.8
19-Feb-19	TDS (mg/l)		16	35.5		
20-Feb-19	TDS (mg/l)				24.8	30.75
26-Feb-19	TDS (mg/l)			34		
27-Feb-19	TDS (mg/l)				58	20
5-Feb-19	Temperature (°C)		21.3	18.94		
6-Feb-19	Temperature (°C)				24.2	24.1
12-Feb-19	Temperature (°C)			17.25		
13-Feb-19	Temperature (°C)					
19-Feb-19	Temperature (°C)		22.6	20.69		
20-Feb-19	Temperature (°C)				24.8	24.3
26-Feb-19	Temperature (°C)			21.86		
27-Feb-19	Temperature (°C)				26.8	25.3
5-Feb-19	Turbidity (NTU)		5.39	2.94		
6-Feb-19	Turbidity (NTU)				3.22	4.2
12-Feb-19	Turbidity (NTU)			3.14		
13-Feb-19	Turbidity (NTU)				3.12	3.58
19-Feb-19	Turbidity (NTU)		3.43	3.35		
20-Feb-19	Turbidity (NTU)				9.25	3.42
26-Feb-19	Turbidity (NTU)			13.55		
27-Feb-19	Turbidity (NTU)				4.12	5.79
5-Feb-19	TSS (mg/l)		8.44	<5		
6-Feb-19	TSS (mg/l)				<5	<5
5-Feb-19	BOD_5 (mg/l)	<1.5	<1	<1		
6-Feb-19	BOD_5 (mg/l)	<1.5			1.01	1.1
5-Feb-19	COD (mg/l)	<5	<5	<5		
6-Feb-19	COD (mg/l)	<5			11	6.1
5-Feb-19	NH_3-N (mg/l)	<0.2	<0.2	<0.2		
6-Feb-19	NH_3-N (mg/l)	<0.2			<0.2	<0.2
5-Feb-19	NO_3-N (mg/l)	<5	0.03	0.03		
6-Feb-19	NO_3-N (mg/l)	<5			0.03	0.03
5-Feb-19	Faecal coliform (MPN/100 ml)	<1,000	240	22		
6-Feb-19	Faecal coliform (MPN/100 ml)	<1,000			22	17
5-Feb-19	Total Coliform (MPN/100 ml)	<5,000	240	79		
6-Feb-19	Total Coliform (MPN/100 ml)	<5,000			79	110

ANNEX B: RESULTS OF EFFLUENT ANALYSES

TABLE B-1: *RESULTS OF CAMP EFFLUENTS IN MARCH 2019*

	Site Name	Owner's Site Office and Village		Obayashi Camp		SongDa5 Camp No.1	
	Station Code	EF01		EF02		EF07	
	Date	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19
Parameters (Unit)	**Guideline**						
pH	6.0 - 9.0	7.28	7.39	7.64	7.7	7.57	7.49
Sat. DO (%)		68	39.5	80.6	82.3	49.7	42
DO (mg/l)		5.21	3.03	6.24	6.5	3.92	3.38
Conductivity (µs/cm)		427	396	424	443	1,016	1,206
TDS (mg/l)		213.5	193	212	221.5	508	603
Temperature (°C)		27.5	28.1	27.1	26.4	26.7	25.7
Turbidity (NTU)		1.51	0.7	7.62	5.63	9.87	9.08
TSS (mg/l)	<50	<5	<5	6.8	5.8	13.5	8.1
BOD5 (mg/l)	<30	<6	<6	<6	<6	<6	<6
COD (mg/l)	<125	<25	<25	31.3	31.3	40.6	49.8
NH_3-N (mg/l)	<10.0	16.4	10.5	13.8	16	13.8	18.6
Total Nitrogen (mg/l)	<10.0	17.7	17	14.9	20.1	15.3	20.6
Total Phosphorus (mg/l)	<2	0.69	0.94	0.96	1.06	0.91	1
Oil & Grease (mg/l)	<10.0	<1		<1		<1	
Total coliform (MPN/100 ml)	<400	2,200	350	0	1,600	0	130
Faecal Coliform (MPN/100 ml)	<400	2,200	47	0	1,600	0	8
Effluent Discharge Volume (L/mn)		6	6	12	6	12	3
Chlorination Dosing Rate (ml/mn)		n/a	n/a	130	90	130	47
Residual Chlorine (mg/l)	<1.0	n/a	n/a	0.17	0.45	0.81	0.36

	Site Name	SongDa5 Camp No.2		Zhefu Camp		V&K Camp	
	Station Code	EF08		EF09		EF10	
	Date	01-Mar-19	15-Mar-19	01-Mar-19	02-Mar-19	01-Mar-19	02-Mar-19
Parameters (Unit)	**Guideline**						
pH	6.0 - 9.0	No sampling due to the camp was decommissioned.		7.83	7.82	7.83	7.82
Sat. DO (%)				101.7	133.3	101.7	133.3
DO (mg/l)				8.11	10.56	8.11	10.56
Conductivity (µs/cm)				415	253	415	253
TDS (mg/l)				207.5	146.5	207.5	146.5
Temperature (°C)				25.79	26.1	25.79	26.1
Turbidity (NTU)				9.25	4.06	9.25	4.06
TSS (mg/l)	<50			16.3	25.9	16.3	25.9
BOD5 (mg/l)	<30			7.77	<6	7.77	<6
COD (mg/l)	<125			34.3	49.3	34.3	49.3
NH_3-N (mg/l)	<10.0			4.5	2.1	4.5	2.1
Total Nitrogen (mg/l)	<10.0			5.05	3.31	5.05	3.31
Total Phosphorus (mg/l)	<2			0.16	0.11	0.16	0.11
Oil & Grease (mg/l)	<10.0			<1		<1	
Total coliform (MPN/100 ml)	<400			0	2	0	2
Faecal Coliform (MPN/100 ml)	<400			0	0	0	0
Effluent Discharge Volume (L/mn)				6	4	6	4
Chlorination Dosing Rate (ml/mn)				26	45	26	45
Residual Chlorine (mg/l)	<1.0			0.10	0.51	0.10	0.51

	Site Name	HM Main Camp		IHI Main Camp		Lilama10 Camp		IHI Field Shop 276 Camp	
	Station Code	EF13		EF14		EF17		EF18	
	Date	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19
Parameters (Unit)	**Guideline**								
pH	6.0 - 9.0	7.38	7.39	6.9	7.03	No sampling due to no inflow water at the chlorination system		6.42	7.11
Sat. DO (%)		77.9	94.2	50.2	42.8			53.6	78.7
DO (mg/l)		6.05	7.27	3.87	3.36			4.25	6.21
Conductivity (µs/cm)		992	453	970	691			816	385
TDS (mg/l)		496	226.5	485	345			408	192.5
Temperature (°C)		27.1	27.6	27.4	26.7			26.4	26.2
Turbidity (NTU)		37.11	26.27	9.46	13.32			71.89	17.33
TSS (mg/l)	<50	52.0	21.1	14.4	14.7			41.4	10.2

	Site Name	HM Main Camp		IHI Main Camp		Lilama10 Camp		IHI Field Shop 276 Camp	
	Station Code	EF13		EF14		EF17		EF18	
	Date	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19	01-Mar-19	15-Mar-19
Parameters (Unit)	**Guideline**								
BOD_5 (mg/l)	<30	<6	<6	<6	<6			46.44	<6
COD (mg/l)	<125	198	135	37.3	45.3			210	53.4
NH_3-N (mg/l)	<10.0	7.2	22.2	5.2	19.6			19.4	4.2
Total Nitrogen (mg/l)	<10.0	13.5	23.4	19.3	24			20.6	7.26
Total Phosphorus (mg/l)	<2	1.09	1.12	0.88	1.16			1.18	0.6
Oil & Grease (mg/l)	<10.0	11		<1				6	
Total coliform (MPN/100ml)	<400	0	0	0	0			0	0
Faecal Coliform (MPN/100ml)	<400	0	0	0	0			0	0
Effluent Discharge Volume (L/mn)		4.2	6	6	4			6	6
Chlorination Dosing Rate (ml/mn)		7	20	35	10			25	30
Residual Chlorine (mg/l)	<1.0	0.98	1.31	0.91	1.52			0.17	0.51

TABLE B-2: *RESULTS OF THE CONSTRUCTION AREA DISCHARGE IN MARCH 2019*

	Site Name	Spoil Disposal No.2			
	Station Code	DS04			
	Date	07-Mar-19	14-Mar-19	20-Mar-19	28-Mar-19
Parameter (Unit)	**Guideline**				
pH	6.0 - 9.0		7.32	6.81	6.83
Sat. DO (%)			68.5	46.9	56.1
DO (mg/L)			5.62	3.68	4.48
Conductivity (µs/cm)			59.4	81	66.2
TDS (mg/l)			29.7	40.5	33.1
Temperature (°C)			25	25.7	25.5
Turbidity (NTU)			8.06	14.37	20.44
TSS (mg/L)	<50			20.28	18.14
Oil & Grease (mg/L)	<10				

	Site Name	Upstream Spoil Disposal No.2			
	Station Code	DS04-US			
	Date	07-Mar-19	14-Mar-19	20-Mar-19	28-Mar-19
Parameter (Unit)	**Guideline**				
pH	6.0 - 9.0	7.91	7.62	8.15	7.93
Sat. DO (%)		63.8	48.9	84.8	68.3
DO (mg/L)		5.04	3.92	6.74	5.5
Conductivity (µs/cm)		15.86	17.11	16.11	18.26
TDS (mg/l)		7.93	8.5	8	9.13
Temperature (°C)		25.8	24.2	25.8	25
Turbidity (NTU)		7.17	10.11	8.68	8.7
TSS (mg/L)	<50	9.37		13.06	12.75
Oil & Grease (mg/L)	<10				

ANNEX C: AMBIENT DUST QUALITY

TABLE C-1: *24-HOUR AVERAGE DUST CONCENTRATIONS MEASURED IN HAT GNIUN 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	11-Mar-19 18:00	12-Mar-19 18:00	13-Mar-19 18:00
End Time	12-Mar-19 18:00	13-Mar-19 18:00	14-Mar-19 18:00
Average Data Record in 24h (mg/m^3)	0.325	0.346	0.373
Guideline Average in 24h (mg/m^3)	***0.12***	***0.12***	***0.12***

TABLE C-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	18-Mar-19 18:00	19-Mar-19 18:00	20-Mar-19 18:00
End Time	19-Mar-19 18:00	20-Mar-19 18:00	21-Mar-19 18:00
Average Data Record in 24h (mg/m^3)	0.042	0.047	0.047
Guideline Average in 24h (mg/m^3)	***0.12***	***0.12***	***0.12***

TABLE C-3 AND TABLE C-4: *AVERAGE RESULTS OF DUST MONITORING AT SONG DA5 CAMP NO. 2 AND LILAMA10 CAMP IN MARCH 2019*

Song Da5 Camp No.2 - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	25-Mar-19 18:00
End Time	26-Mar-19 18:00
Average Data Record -24h	0.130
Guideline	***0.12***

Lilama10 Camp - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	14-Mar-19 18:30
End Time	15-Mar-19 18:00
Average Data Record -24h	0.339
Guideline	***0.12***

TABLE C-5 AND TABLE C-6: AVERAGE RESULTS OF DUST MONITORING AT MAIN DAM, AND MAIN POWERHOUSE IN MARCH 2019

Main Dam - Dust Emission Average in 24 hours	
Period	**24 Hours**
Start Time	**04-Mar-19 18:00**
End Time	**05-Mar-19 17:30**
Average Data Record -24h	**0.135**
Guideline Average - 24h	***0.12***

Main Powerhouse - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	26-Mar-19 18:30
End Time	27-Mar-19 18:00
Average Data Record -24h	0.163
Guideline Average - 24h	***0.12***

ANNEX D: AMBIENT NOISE DATA

Table D-1: Average Results of Noise Monitoring at Hat Gniun Village in March 2019

Noise Level (dB)	11-12/March/19			12-13/March/19			13-14/March/19		
	18:30-22:00	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	68.70	58.80	70.20	56.20	60.50	67.10	56.80	55.40	65.70
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	49.19	47.19	44.20	42.66	40.88	42.60	44.51	43.07	41.99
Guideline Averaged	***55***	***45***	***55***	***55***	***45***	***55***	***55***	***45***	***55***

Table D-2: Average Results of Noise Monitoring at Phouhomxay Village in March 2019

Noise Level (dB)	18-19/March/19			19-20/March/19			20-21/March/19		
	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	54.10	48.70	83.30	54.60	51.30	69.10	67.50	6.00	67.50
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	39.03	36.52	43.21	44.51	43.99	42.92	51.59	48.21	46.07
Guideline Averaged	***55***	***45***	***55***	***55***	***45***	***55***	***55***	***45***	***55***

Table D-3 and Table D-4: Average Results of Noise Monitoring at Song Da5 Camp No. 2 and Lilama10 Camp in March 2019

Song Da5 Camp No.2

Noise Level (dB)	25-26/March/19		26/March/19
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	61.2	61.6	81.5
Guideline Max	***115***	***115***	***115***
Average Data Recorded	44.91	41.60	42.94
Guideline Averaged	***70***	***50***	***70***

Lilama10 Camp

Noise Level (dB)	14-15/March/2019		15/March/2019
	18:30 – 22:00	22:01 – 06:00	06:00-18:00
Maximum Value Recorded	55.2	54.6	62
Guideline Max	***115***	***115***	***115***
Average Data Recorded	40.13	36.99	41.06
Guideline Averaged	***70***	***50***	***70***

Table D-5 and Table D-6: Average Results of Noise Monitoring at Main Dam and Main Powerhouse in March 2019

Main Dam

Noise Level (dB)	04-05/March/19		05/March/19
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	57.3	57.4	60.3
Guideline Max	***115***	***115***	***115***
Data Record Average	54.20	54.66	51.49
Guideline Averaged	***70***	***70***	***70***

Main Powerhouse

Noise Level (dB)	26-27/March/19		27/March/19
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	71.4	71.6	83.3
Guideline Max	***115***	***115***	***115***
Data Record Average	70.67	70.67	69.43
Guideline Averaged	***70***	***70***	***70***