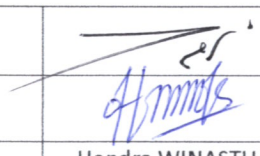
NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

October 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 October 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received a single location Site Decommissioning and Rehabilitation Plan for its review and approval.

The monthly site visit by the Bolikhan District EMU was not carried out in October 2019 and was rescheduled to be carried out in November 2019.

The effluent monitoring results for the camps in October 2019 indicate that the results of ammonia nitrogen and total nitrogen continue to fluctuate over the month and comply with the relevant effluent standards for some camps. The results for the former IHI Camp [EF14] which was taken over by NNP1PC (Environmental and Social Division) in August 2019 did not comply with the Standards. In addition, non-compliances for total coliform and faecal coliform were recorded at the ESD Camp [EF14], Song Da 5 Camp No.1 [EF07] and V&K Camp [EF10] on first fortnightly sampling.

The Dissolved Oxygen (DO) levels at the surface of the Main Reservoir (R1, R2, R3, R4 and R5) were generally between 6 mg/L and 8 mg/L. In the Re-regulation Reservoir (R6 and R7), the DO was generally below 4 mg/L during periods.

The turbine in the re-regulation powerhouse is under repair and all water from the re-regulation dam has therefore been discharged through the gate and, or over the labyrinth weir, which has aerated the water and brought the DO in Nam Ngiep downstream of the Re-regulation Dam above 6 mg/L in all stations.

A total of 64.2 m3 of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 9.2 m3 compared to September 2019. A total of 2,793.5 kg of recyclable waste was recorded at the Community Waste Bank. A total of 55 m3 of solid waste from Phouhomxay, Thahuea and Hat Gniun Villages was disposed of at the Houay Soup Landfill.

The budget summary of AIP2019 related to the No Net Loss from both Provinces was submitted to ADB on 25 September 2019. ADB provided comments on 15 October 2019 and the revised version with further clarification was re-submitted to ADB on 19 October 2019. NNP1PC did not receive further comments from ADB until the end of October 2019.

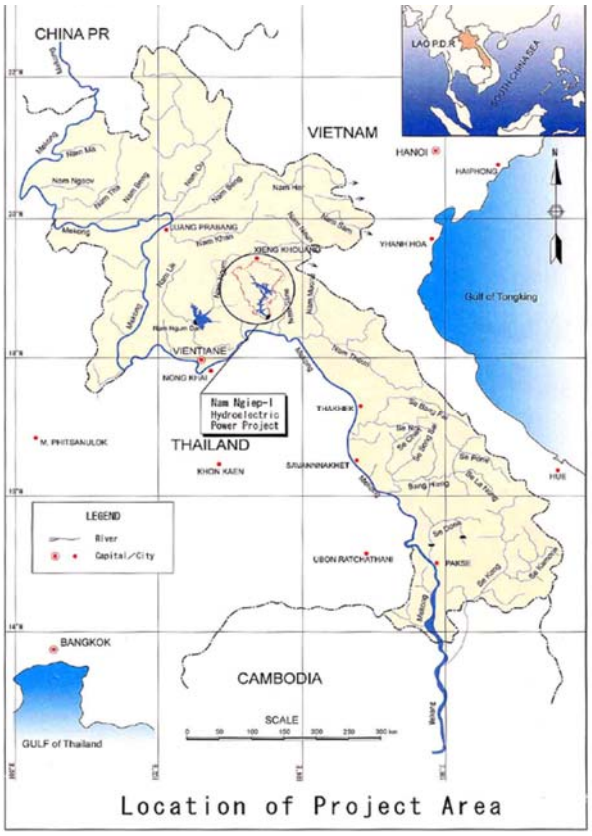
Biodiversity offset related activities under the components of spatial planning and regulation and as well as law enforcement were carried out according to the approved NC-NX AIP2019.

The fish catch monitoring for September 2019 in Nam Ngiep watershed was dominated Channa striata, Clarias batrachus, and species groups of Poropuntius, Hampala, and Mastacemeblus that are classified as Least Concern (LC) according to the IUCN Red List.

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 were 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 2-1 Shows the progress of the minor and outstanding work and defects that comprise the punch list items for each of the principal contracts for the Project.

FIGURE 2-1: SUMMARY OF PUNCH LIST PROGRESS AS OF THE END OF OCTOBER

Type of Contract Works		Total Items	Items Completed	Completion by No. of Items	Total Value of Items	Value Completed	Completion by Value	Taking-Over
		(No.)	(No,)	(%)	(USD)	(USD)	(%)	(Date)
Civil	RR Power Station	74	74	100	108,890	108,890	100	31-Jan-19
	Main Power Station	482	480	99	5,507,375	5,307,375	96	31-Jan-19
Electro-Mechanical	RRPS	170	170	100	6,515	6,515	100	16-Mar-19
	MPS	95	90	95	10,950	9,450	86	27-Aug-19
Hydro-Mechanical	RRPS	39	39	100	8,825	8,825	100	16-Mar-19
	MPS	174	174	100	13,775	13,775	100	31-Mar-19
230 kV Transmission Line		301	301	100	150,000	150,000	100	31-Jul-18

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 as the value of achieved Interim Milestone Payments excluding advance payment.

The Civil Works overall was always on or ahead of schedule despite increased quantities of dam excavation and slope stabilisation and additional RCC placed in the shear key. During the initial dam excavation and since, it has been written in each Monthly Report, *'the complex bedding of hard over soft layers of rock and the folding nature of these layers in the foundation rock of the main dam below the old river bed had created difficulty to finalise the foundation design to the satisfaction of the Dam Safety Review Panel in all respects'.*

Accordingly, further review of the dam foundation design was carried out to create sufficient safety factor for stability against sliding of the dam on the weak zones. This resulted in further excavation and concreting of a shear key structure in the old river bed, taking the dam height to 167 m, measured from the deepest excavation level to the crest level, some 19 m higher than anticipated. The original schedule is maintained as a result of the combined efforts of the Owner, the Owner's Engineer and all the principal Contractors and their Subcontractors. The additional excavation works were completed at the end of February 2016 and RCC consolidation grouting and RCC placement for the main dam were commenced on 10 May and 19 April 2016 respectively. The concrete level at the main dam reached El. 321.9 m at the left bank on 29 April 2018 and at the right bank at the end of March 2018. The placed volume of

RCC was achieved in close to the planned schedule despite the losses of time resulting from the additional excavation and concreting in the foundation, the loss of fly-ash supply in December 2016, and the fatal accident.

Since the impounding of the Main Dam started on 15 May 2018, monitoring has been carried out to confirm the dam stability, especially to the right abutment where some anomalous results had been noted. Dam monitoring results are shown in a separate 'Monthly Report on Main Dam Instrumentation and Monitoring'. Many of the original concerns have been explained or are better understood. The unforeseen consequences which are considered likely to have been caused by the closing of bedding plane openings, as one of the possible causes considered, began unfolding with events in August 2018 when loading of the dam toe appeared to have caused an inclination of the main powerhouse to upstream and towards the old river bed such that the setting and fixing vertically of both turbine generating units within the required tolerances was not possible. This movement of the powerhouse also affected associated structures such as the penstocks and the intake valve. After the occurrence of this inclination issue, it has been found that artesian aquifer, which was not pressurized before initial impounding, exists under the main powerhouse foundation. Drainage to relieve the pressure is an important means of controlling the artesian aquifer. All current information and opinion are contained in the separate 'Root Cause Assessment of the Main Powerhouse Inclination' which was endorsed by academic authorities. This Report was sent to the insurance company in support of the insurance claim on this issue.

Monitoring of the instruments initially installed continues, more instruments were installed, further drainage drilling was carried out. As related above, all current information and opinion is contained in the separate September Monthly Report on Main Dam Instrumentation and Monitoring. This Report was sent to the Dam Safety Review Panel for review and comment. The reservoir water level of the main reservoir finally reached Full Supply Level of El. 320 m on 17 August 2019 whilst achieving dam safety. At the 19th DSRP Meeting which was held in October 2019, DSRP included in their Report a 'Dam Safety Endorsement' stating that the main dam, re-regulation dam and dyke are safe and fit for purpose, subject to a continued programme of appropriate monitoring, safe project operation and satisfactory resolution of the outstanding issues.

The leakage through drainage pipes from the Bottom Conduit Gate decreased from around 30 m3/min in June 2019 to 1 m3/min in September 2019 thanks to additional grouting using holes drilled from the main dam foundation gallery, a manageable amount, and the permanent concrete plug in this Conduit had been placed since 08 November 2018 after obtaining agreement of the DSRP and completed in 21 January 2019. NNP1PC will study various options to ensure that the reservoir water pressure is safely confined in the long term based on the recommendations of the DSRP.

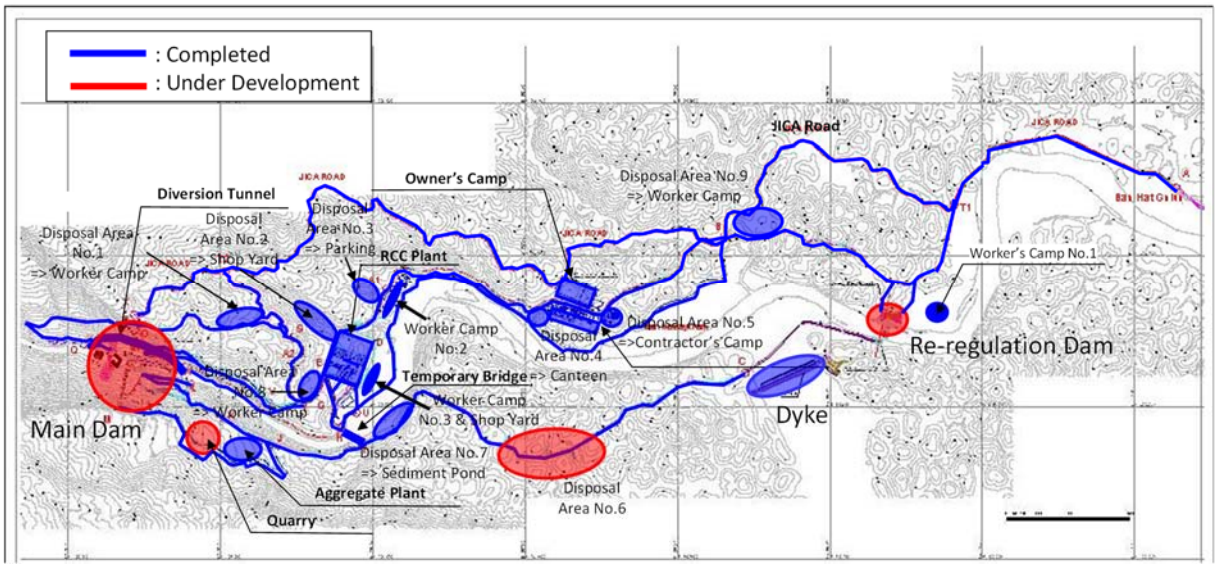
The repairs to the foundation of leg 4 of 230 kV TL Tower No.1 were completed in February 2019. The remaining excavation of the plunge pool was finished in January 2019. The reinforced concrete parapet wall was completed in December 2018 and road deck to the main dam crest and the concrete spillway chutes and piers completed in January 2019.

The issue of a Taking-over Certificate for the Civil Works for both the Re-regulation Power Station and the Main Dam and Main Powerhouse dated 31 January 2019 was made on 19 August 2019 and 22 October 2019, respectively.

2.1.1 ACCESS ROAD CONSTRUCTION

All main access road construction works were completed following an early December 2013 start, and maintenance of these will continue until the anticipated commissioning date in August 2019, six months after when the Civil Contract Time for Completion is reached. Temporary access roads are constructed to reach the various construction activities and others will be developed or modified as is necessary as activities change to reach current or new areas of dam concreting and consolidation grouting, the upstream and downstream cofferdams and the main powerhouse and belt conveyor support tower foundations. The layout of the access road system is as shown in ***Figure 2-2*** below. The Civil Contractor is responsible for decommissioning and rehabilitating the temporary roads as they become redundant.

Figure 2-2: Plan of Site Access Roads with Major Work Area and Temporary Facilities



2.1.2 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. The cost of the additional excavation and RCC concrete placement necessitated expenditure of contingency amounts provided exactly for such eventualities. The dental concreting works were commenced in March 2016, and conventional levelling concrete placement for the main dam in the 'shear key' structure up to El. 170.5 m was completed in the middle of April 2016. Consolidation grouting at the main dam area was commenced on 10 May 2016 and RCC concrete placement for the main dam body was commenced on 19 April 2016. Consolidation grouting covers the whole footprint of the main dam and RCC concrete placement and consolidation grouting are implemented in parallel, section by section. The progress of RCC concrete placement is 100 % complete. The dam height has reached crest level at El. 321.9 m at both left bank and right bank. The plunge pool excavation was started after main dam

impounding and this work has been suspended because of spilling water from spillway gate during rainy season in 2018. It has resumed from the end of October when the amount of inflow has decreased to around 100 m3/s and around 121,000 m3 or 100 % of total excavation has now been completed.

The diversion conduit gate of the main dam body has some leakage of water initially and the casting of the temporary concrete plug behind it was completed in the conduit in June 2018. The permanent concrete plug had been placed since 08 November 2018 after DSRP permission was granted.

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. The powerhouse concreting works has been completed in January 2019.

2.1.3 RE-REGULATION DAM, POWERHOUSE AND DYKE

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*** below. After the completion of the re-regulation dam above, impounding of the reservoir has been carried out having been commenced on 15 May and been completed on 24 May 2017. After Main Dam impounding started, the reservoir storage of the re-regulation dam has been used for the riparian discharge to downstream in accordance with the Concession Agreement.

FIGURE 2-3: COMPLETED RE-REGULATION DAM AND POWERHOUSE AT THE END OF JUNE 2018

2.1.4 TEMPORARY WORK FACILITY

2.1.4.1 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 m^3/s discharge in total. Construction of concrete plug including valve was completed on 27 January 2019.

2.1.4.2 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 02 April 2016.

2.1.4.3 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 are underway on both plants and almost completed for the Aggregate Crushing Plant.

2.1.4.4 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.

2.1.4.5 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 Notice to Proceed was issued in 03 October 2014. The cumulative work progress of the Electrical and Mechanical Works by value at the end of July 2019 was 98.8 % (compared to planned progress of 100.0 %). This apparent delay is simply due to the delay to issuing of the Taking-Over Certificate for the main powerhouse.

The main activities carried out during this month are described below:

Figure 4.2-1: Replacing Smoke and Heat Detector for Generator Unit 1 including Testing

Figure 4.2-2: Bolt Tightening of Guide Vane Servomotor for Units 1 & 2

Figure 4.2-3: Replacing New Gasket for Inspection Window of Turbine Guide Bearing Oil Reservoir for Units 1 & 2

Figure 4.2-4: Setting up the Data Recording Instrument for Analysing the Guide Vane Deviation for Units 1 & 2

Figure 4.2-5: Inspection before Re-assembly Work of Runner Cone

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 %). NNP1PC issued the Taking Over Certification for the main powerhouse and the re-regulation powerhouse, which was dated on 31 March 2019 for the main powerhouse and 16 March 2019 for the re-regulation powerhouse, to IIS on 30 September 2019 and 16 August 2019, respectively.

2.4 230 KV 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 actual work progress of the Transmission Line Works at the end of July 2018 was 100 %, the same as planned progress. NNP1PC issued the Taking Over Certification, which was dated on 31 July 2018, to Loxley on 6 November 2018. The Defects Notification Period for this Contract expired on 31 July 2019.

3. ENVIRONMENTAL MANAGEMENT MONITORING

3.1 COMPLIANCE MANAGEMENT

In October 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received a single location Site Decommissioning and Rehabilitation Plan for review and approval.

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

Title	Date Received	Status
The Taking Over the Areas Occupied for Temporary Facility and Work (Document Ref. PCL 05181)	21 October 2019	No objection with comment on 25 October 2019
Site Specific Decommissioning and Rehabilitation Plan for Civil Works Contractor (Obayashi) Camp.	23 August 2019 (1st submission)	No objection with comments on 30 September 2019
	24 October 2019 *(2nd submission document Ref. PCL 05188 contained only a response to the EMO comments. No submission of full document revision)*	Written comments provided to the PCL 05188 on 31 October 2019. The contractor needs to submit the full revision of the Site-Specific Decommissioning and Rehabilitation Plan within 10 days following receipt of the comments.

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 below.

TABLE 3-2: SUMMARY OF ONC AND NCR

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from September 2019	5	0	0	0
Newly Opened in October 2019	2	0	0	0
Total in October 2019	**7**	**0**	**0**	**0**
Resolved in October 2019	5	0	0	0
Carried over to November 2019	2	0	0	0
Unsolved Exceeding Deadlines	**3**	**0**	**0**	**0**

3.1.1 INSPECTION BY ENVIRONMENT MANAGEMENT UNIT

A monthly site visit by the Bolikhan District EMU was not carried out in the period and was rescheduled to November 2019.

3.2 ENVIRONMENTAL QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), 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 October 2019 indicate that the results of ammonia nitrogen and total nitrogen continue to fluctuate over the month and comply with the relevant effluent standards for some camps. The results for the former IHI Camp [EF14] which was taken over by NNP1PC (Environmental and Social Division) in August 2019 did not comply with the Standards. In addition, non-compliances for total coliform and faecal coliform were recorded at the ESD Camp [EF14], Song Da 5 Camp No.1 [EF07] and V&K Camp [EF10] on first fortnightly sampling.

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 below

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 total nitrogen.	ADM prepared for improving the second wetland pond by this dry season.
Obayashi Camp	EF02	Non-compliance for total nitrogen.	The Contractor was instructed to harvest reeds and clean up the wetland ponds.
Song Da 5 Camp No. 1	EF07	Non-compliance for total nitrogen, faecal coliform and total coliform (first fortnight). No effluent camp sampling due to no outflow from wetland.	The Contractor was instructed to adjust the chlorine dosage rate and clean up all the wetland ponds and repair the wastewater circulation system.
V&K Camp	EF10	Non-compliance for total coliform (first fortnight).	The chlorine dripping pipeline/valve was clogged and could not work properly. The Contractor was instructed to replace these.
HM Hydro Main Camp (WWTS)	EF13	Non-compliance for BOD and COD in the first fortnight sampling, and ammonia nitrogen and total nitrogen in both fortnight sampling.	Insufficient capacity. As a possible solution, it will be proposed to NNP1PC management to combine the system with the existing OC camp's WWTS that has a larger capacity of wetland ponds and chlorination tanks equipped with a mixing pump.
ESD Camp (former IHI Camp)	EF14	Non-compliance for faecal coliform and total coliform in the first fortnight sampling, and total nitrogen and ammonia nitrogen in both fortnight sampling.	- Inconsistent chlorine dosing since early October 2019. The Site Inspection Report (SIR) was issued to the ADM to include the WWTS operation as part of their routine work and improve chlorine dripping valve and pipe (ONC_AM_0002 dated 01 October 2019). - As with the HM Hydro Main Camp WWTS, it will be proposed to combine the ESD

Site	Sampling ID	Status	Corrective Actions
			Camp WWTS with the OC Camp's WWTS.
Lilama 10 Camp	EF17	The site has been decommissioned.	This site will be omitted next month.
Main Powerhouse	EF19	Non-compliance for total nitrogen, ammonia nitrogen and total phosphorus. No discharge during the second fortnight sampling.	The system consists of septic, biofilm and chlorination tanks, but no wetland pond is set up due to limited space.
CVC Plant	DS03	The site has been decommissioned.	This site will be omitted by next month
Spoil Disposal Area No.2	DS04	Full compliance.	None
Upstream Spoil Disposal Area No.2	DS04-US	Full compliance.	None

3.2.2 AMBIENT SURFACE WATER QUALITY MONITORING

The ambient surface water quality monitoring programme comprises five monitoring stations in the main reservoir (R1-R5), two stations in the re-regulation reservoir (R6 and R7), five stations in the mainstream Nam Ngiep (NNG01 and NNG05 to NNG08) and four 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 been 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 below

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.

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Wednesday and Friday (Intensive Monitoring)	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C) and Turbidity (NTU)	- R5, main reservoir immediately upstream the main dam; - Tailrace main dam; - Re-regulation reservoir: R6 and R7; - Tailrace re-regulation dam; - Nam Ngiep at the bridge; - NNG05, Nam Ngiep downstream of 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; - Nam Ngiep downstream: NNG05, NNG06, NNG07 and NNG08; - Tributaries: Nam Phouan [NPH01], Nam Xao [NXA01] and Nam Houay Soup [NHS01].
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 coliform (MPN/100 ml) and Hydrogen sulphide (mg/l)	All stations

The monitoring results for key parameters (DO, TSS and BOD5) during October 2019 are presented in ***Table 3-5, 3-6 and 3-7.*** The full set of data for October 2019 is attached in ***Annex A***. In addition, the results for DO are presented as line graphs in ***Figure 3-2***

Main Reservoir

During October 2019, the water level in the main reservoir decreased from El. 319.08 m asl. to El. 316.20 m asl.

At R5, the DO level in the upper 7 m was generally between 5 mg/L and 8 mg/L, and the entire water column below 10.0 m had a DO level less than 0.9 mg/L.

At R4, the DO level in the upper 5.5 m was between 6 mg/L and 7 mg/L, and the entire water column below 9.0 m had DO levels below 1 mg/L.

The DO concentrations at R3 were recorded between 5 mg/L and 8 mg/L in the upper 5.0 m. The concentration of DO in the water column below 7.0 m was generally less than 1 mg/L, however, with some occasional spikes at 11 m to 13 m depth of 3 mg/L to 5 mg/L.

The DO concentrations at R2 were generally recorded between 5 mg/L and 8 mg/L in the upper 3 m. The concentration of DO in the water column below 5.0 m generally fluctuated between 0.08 mg/L and 3.27 mg/L.

And at R1, the DO level was generally between 4 mg/L and 8 mg/L in the entire water column.

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 of 5 mg/L compared to high flow season means of about 100 mg/L to 250 mg/L and low flow season means of 20 mg/L to 50 mg/L.

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

Re-regulation Reservoir

In October 2019, the turbine discharge from the main dam was generally about 200 m^3/s interrupted by night-time periods with no discharge during the second half of the month. There was only one short period of 8 hours with spillway discharge (32 m^3/s).

The DO measurements at R6 and R7 representing turbine discharges from the main dam generally had DO concentrations in upper 1.5 m were between 0.26 mg/L and 4.25 mg/L, and in the water column below 2.0 m DO concentration less than 2 mg/L.

Downstream

The discharge from the re-regulation dam alternated between discharges from the gate and occasionally combined with discharge over the labyrinth weir, which aerated the water to DO concentration above 6 mg/L. Thus, during October 2019, all DO measurements in the downstream stations complied with the National Standard.

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

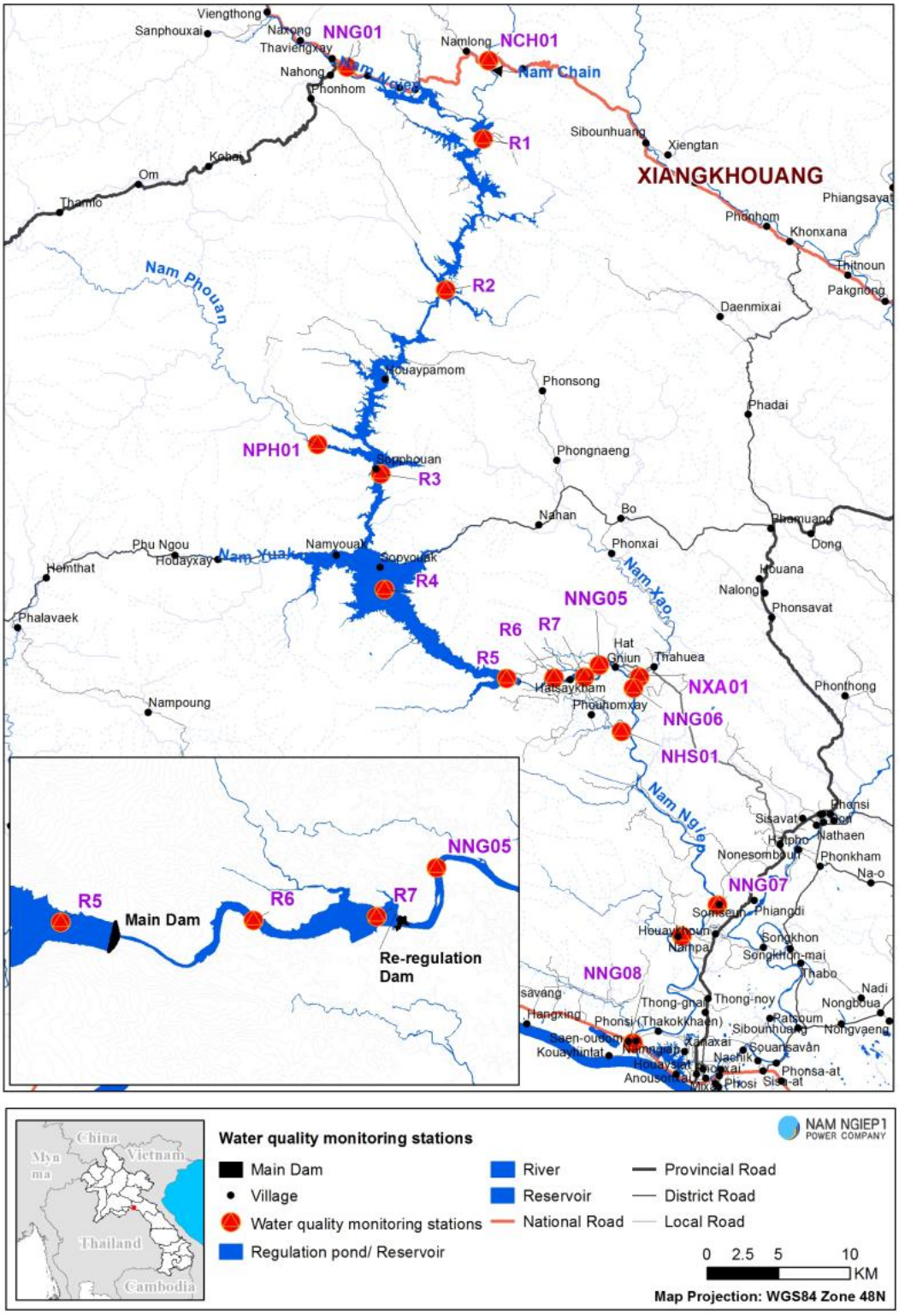


FIGURE 3-2: CONCENTRATION OF DISSOLVED OXYGEN IN THE UPPER 0.2 M SINCE THE START OF IMPOUNDING

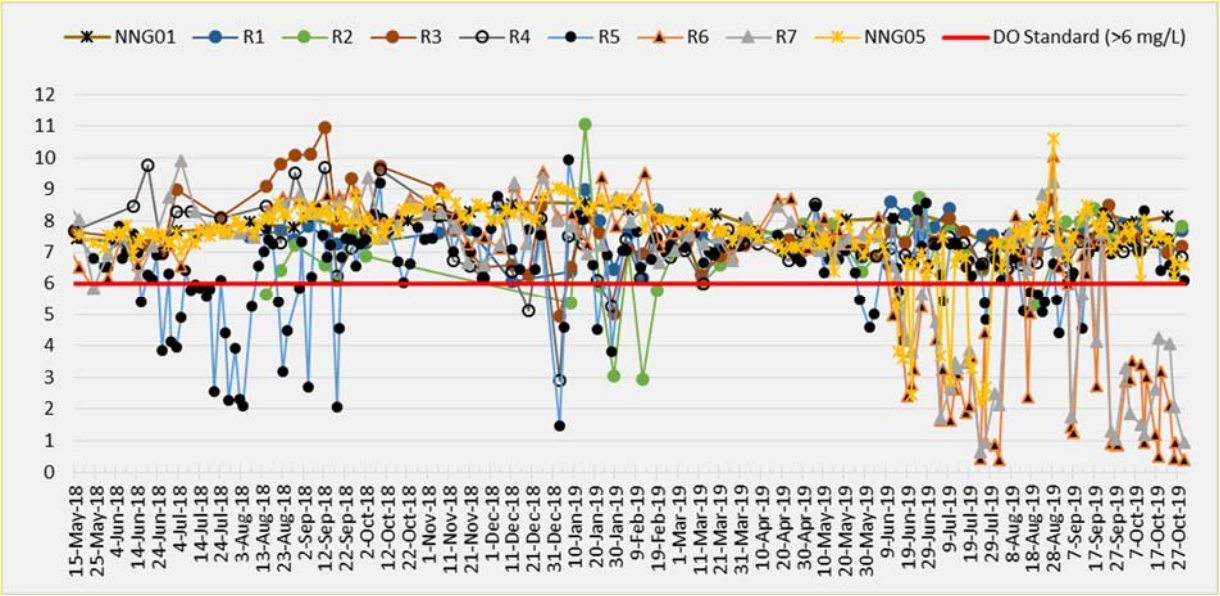


TABLE 3-5: *RESULTS OF SURFACE WATER QUALITY MONITORING FOR DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M, WATER QUALITY STANDARD: >6.0 MG/L*

DO (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
01-Oct-19		7.88	7.72	7.48	7.03											
02-Oct-19						7.79	2.88	3.29	7.75	7.66	7.11	6.61			7.03	7.08
04-Oct-19						7.9	2.94	1.84	7.43	7.43					7.4	7.08
5-Oct-19						7.35	3.5		7.81							
7-Oct-19	7.95												8.33			
8-Oct-19		7.87	7.03	7.45	7.09											
9-Oct-19						7.07	3.4	1.48	6.1	7.37	6.97	6.69			7.24	7.4
11-Oct-19						8.31	0.92	1.18	8.03	8.66					7.74	
12-Oct-19						7.63	3.01		7.65							
16-Oct-19						7.3	1.17	2.62	7.32	7.38	7.2	7.04			7.23	6.97
18-Oct-19						7.4	0.52	4.25	7.54	7.96					7.39	
19-Oct-19						6.42	3.2		7.49							
22-Oct-19	8.14	7.31	7.37	6.97	7.42								8.05			
23-Oct-19						6.59	2.11	4.08	7.36	7.48	7.11	6.9			7.02	6.6
25-Oct-19						6.31	0.43	2.05	6.27	6.34					5.47	
26-Oct-19						6.48	0.95		6.67							
29-Oct-19		7.67	7.84	7.19	6.85											
30-Oct-19						6.09	0.41	0.92	6.59	7.01	6.76	6.73			6.99	6.64

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
7-Oct-19	60.19												19.01			
8-Oct-19		<5	5.69	<5	<5											
9-Oct-19						<5	<5	<5	<5	<5	6	17.92			<5	<5
16-Oct-19						<5	<5	<5	<5							
23-Oct-19						<5	<5	5.1	<5							

TABLE 3-7: *RESULTS OF SURFACE WATER QUALITY MONITORING FOR BOD_5 (MG/L) - WATER QUALITY STANDARD: < 1.5 MG/L*

BOD_5 (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
2-Oct-19						<1.0	2.94	1.49	<1.0							
7-Oct-19	<1.0												<1.0			
8-Oct-19		1.2	<1.0	1.49	<1.0											
9-Oct-19						<1.0	3.54	2.77	1.14	<1.0	<1.0	<1.0			<1.0	<1.0
16-Oct-19						<1.0	7.46	7.9	<1.0							
23-Oct-19						<1.0	6.4	8.04	<1.0							

3.2.3 GROUNDWATER QUALITY MONITORING

During October 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 faecal coliform and E.Coli bacteria in Somseun, Thong Noy and NamPa Villages as per below Table.

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	7.16	6.96	7.18	7.22
Sat. DO (%)		85.3	89.5	89.7	91.8
DO (mg/l)		6.7	7.12	7.09	6.92

Parameter (Unit)	Site Name	Somseun Village	NamPa Village	ThongNoy Village	Pou Village
	Station	GSXN01	GNPA01	GTHN01	GPOU01
	Guideline				
Conductivity (µS/cm)		318	333	297	69.1
TDS (mg/l)		159	166.5	148.5	34.55
Temperature (°C)		26.5	26.1	26.5	27.7
Turbidity (NTU)	<20	1.13	1.22	1.35	2.31
Fecal coliform (MPN/100 ml)	0	2	2	130	0
E.Coli Bacteria (MPN/100 ml)	0	2	0	130	0

3.2.4 GRAVITY FED WATER SUPPLY (GFWS) QUALITY MONITORING

During October 2019, water samples from water taps at Hat Gniun Village and Phouhomxay Village were analysed. Station WPHX01 represents raw water in the header tank before the filtration system.

The results of the water quality analyses are presented in ***Table 3-9***. All parameters complied with the National Drinking Water Standards except for faecal coliforms and E.Coli at WTHH02, WHGN02, WPHX01 (intake), WPHX02 (tap water at the primary school in Phouhomxay Village) and WPHX03 (tap water at a house in Phouhomxay Village). The villagers generally use tap water for washing and cleaning. They were informed about the results and were encouraged to boil the water before drinking.

TABLE 3-9: RESULTS OF THE GRAVITY FED WATER SUPPLY QUALITY MONITORING

Date	Parameter (Unit)	Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
		Guideline					
21-Oct-19	pH	6.5 - 8.6	7.9	8.0	8.4	8.6	8.5
21-Oct-19	Sat. DO (%)		101.2	98.0	98.0	99.6	100.2
21-Oct-19	DO (mg/l)		7.8	7.5	7.8	7.6	7.8
21-Oct-19	Conductivity (µS/cm)	<1,000	38.6	56.3	5.6	5.5	7.0
21-Oct-19	TDS (mg/l)	<600	19.3	28.1	2.3	2.7	3.0
21-Oct-19	Temperature (°C)	<35	27.7	27.5	25.3	28.3	27.4
21-Oct-19	Turbidity (NTU)	<10	1.5	2.4	1.5	1.4	1.5

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
21-Oct-19	Faecal Coliform (MPN/100 ml)	0	17	13	350	34	220
21-Oct-19	E.coli Bacteria (MPN/100 ml)	0	11	13	350	34	220

3.2.5 LANDFILL LEACHATE MONITORING

During October 2019, landfill leachate monitoring was carried out at the NNP1 Project Landfill (Last pond - LL4) and at Houay Soup Solid Waste Landfill (Last pond - LL6).

The results indicated that NNP1 Project Landfill did not comply with the total coliform and Houay Soup Landfill did not comply with the standard for faecal coliform and total coliform. However, the leachate was contained in the leachate ponds without discharging to the environment. EMO will continue to monitor the results during the next MPR. The landfill leachate monitoring results for October 2019 can be found in Table below.

***Table 3-10*: RESULTS OF THE LANDFILL LEACHATE MONITORING**

		Site Name	NNP1 Landfill Leachate Monitoring					Houay Soup Landfill Leachate Monitoring	
		Location	Pond No.01	Pond No.02	Pond No.03	Pond No.04	Discharge Point	Last pond	Discharge Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
3-Oct-19	pH	6.0-9.0				8.4		7.8	
3-Oct-19	Sat. DO (%)					107		156	
3-Oct-19	DO (mg/l)					7.7		11.1	
3-Oct-19	Conductivity (µS/cm)					380		63	
3-Oct-19	TDS (mg/l)					190		32	
3-Oct-19	Temperature (°C)					31		31	
3-Oct-19	Turbidity (NTU)					15		5	
3-Oct-19	BOD_5 (mg/l)	<30				5		6	
3-Oct-19	COD (mg/l)	<125				35		93	

		Site Name	NNP1 Landfill Leachate Monitoring					Houay Soup Landfill Leachate Monitoring	
		Location	Pond No.01	Pond No.02	Pond No.03	Pond No.04	Discharge Point	Last pond	Discharge Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
3-Oct-19	Faecal Coliform (MPN/100 ml)	<400				540		79	
3-Oct-19	Total Coliform (MPN/100 ml)	<400				1,600		540	

3.2.6 Dust Monitoring

The results indicate that the dust levels at all monitoring stations comply with the National Standard during the monitored period in October 2019. The results were shared internally with NNP1PC Technical Department as a reference for following-up inspection to ensure proper establishment of health and safety procedures.

3.2.7 Noise Monitoring

During October 2019, there was no noise monitoring due to equipment failure. Unfortunately, the equipment representative in Vietnam informed that they would not be able to provide maintenance services. The equipment will be sent to the supplier in the USA for maintenance in early 2020. Regardless, noise was not a major issue at the village after all the construction activities were completed in August 2019.

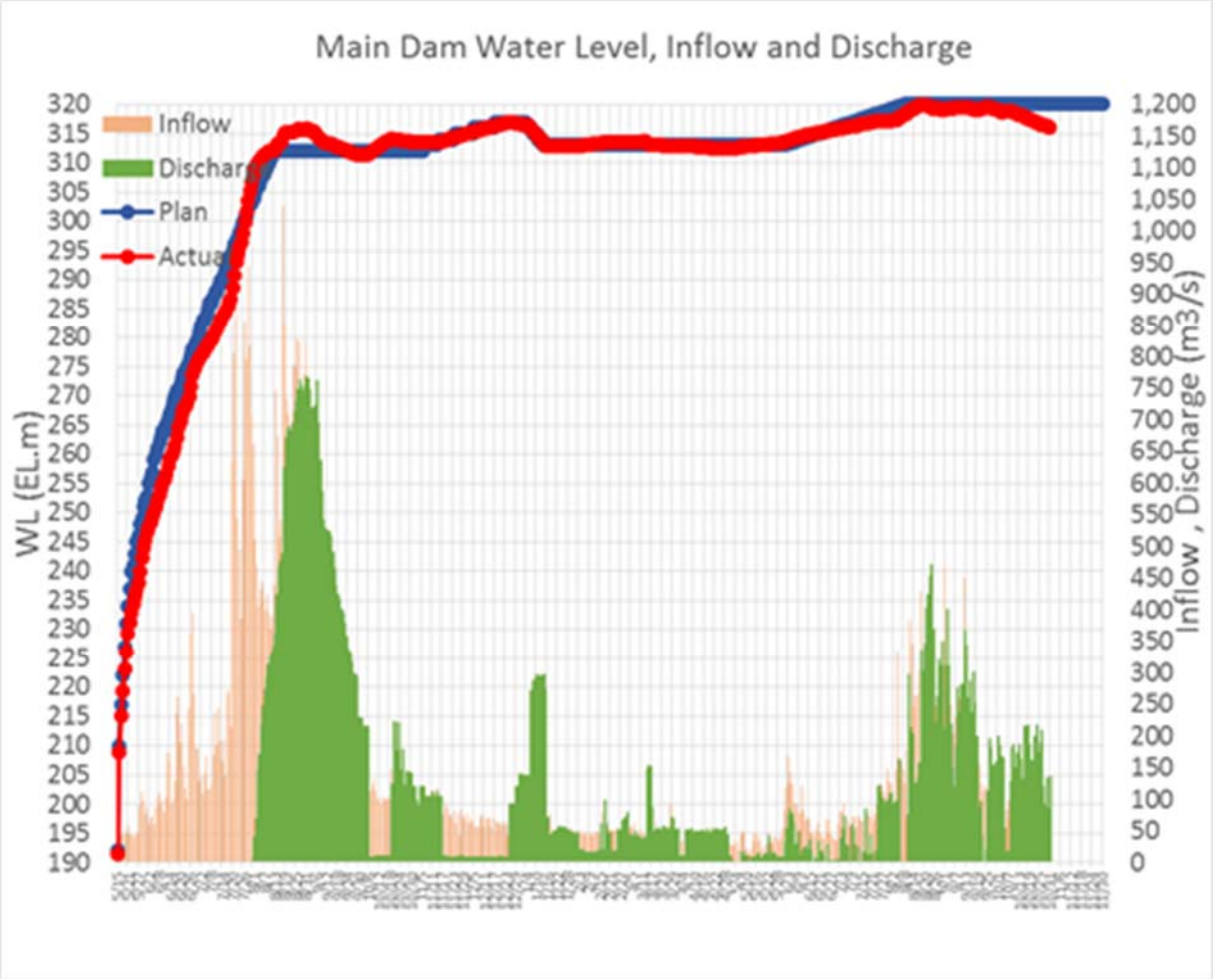
3.2.8 Discharge Monitoring

The water level in the main reservoir, inflow to the reservoir and discharge from the reservoir since the start of the impounding on 15 May 2018 is presented in the graph in Figure 3-3.

During October 2019, the mean inflow to the main reservoir was about 82 m3/s with decreasing trend towards the end of the month as the wet season draws to an end. The water level in the main reservoir gradually dropped 2.7 m from El. 319.0 m asl to and El. 316.3 m asl.

In October 2019, the turbine generation from both units with a total discharge of roughly 200 m3/s was only interrupted by usually night-time periods with no discharge.

FIGURE 3-3: PROGRESS OF IMPOUNDING THE MAIN RESERVOIR



The discharge monitoring data for the re-regulation dam (September and October 2019) is presented in Figure below;

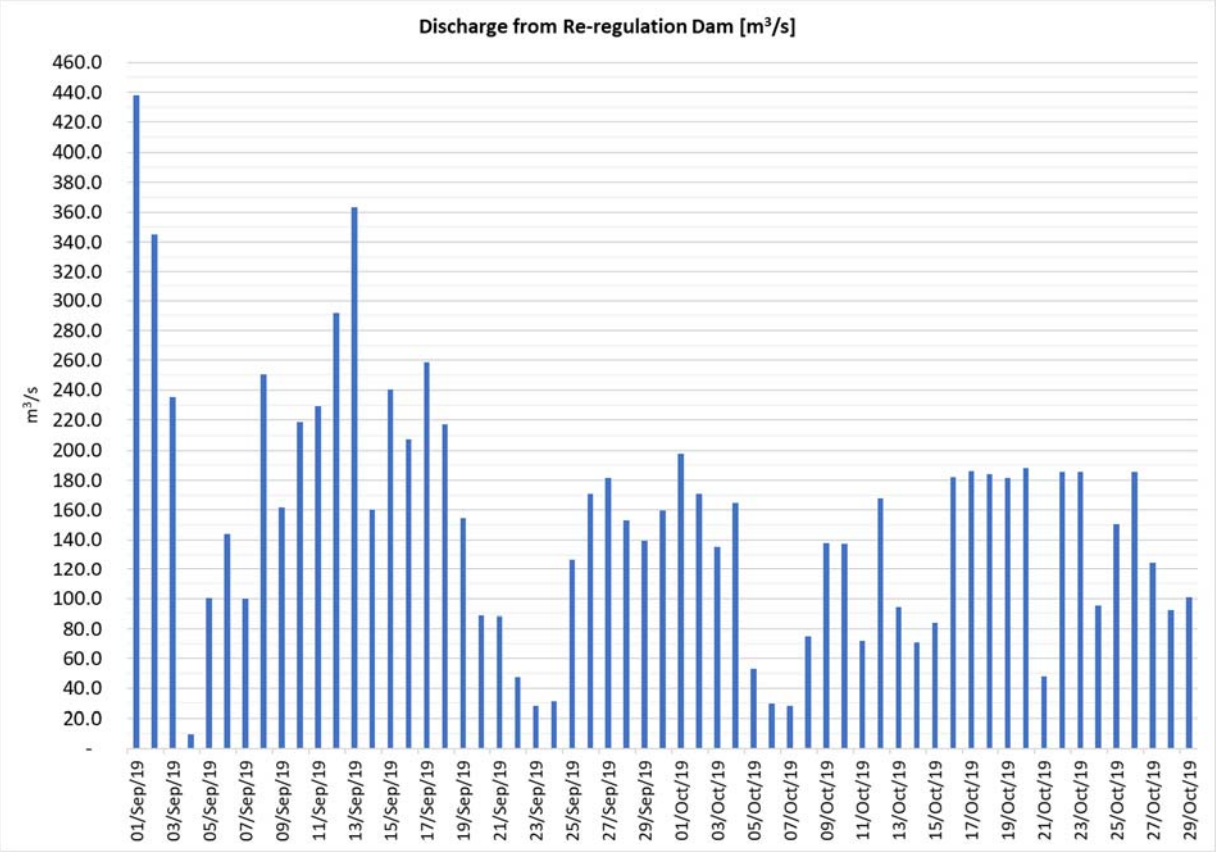
During October 2019, all discharges from the re-regulation dam went through the gate and, or over the labyrinth weir. The turbine at the re-regulation powerhouse is under repair and there has therefore not been any turbine discharge during October 2019.

The discharge from the re-regulation dam has generally varied between 145 m^3/s and 185 m^3/s only interrupted by short periods usually during weekends with discharges from 30 m^3/s to 70 m^3/s.

The discharge from the re-regulation dam has been kept above the minimum flow requirement of 27 m^3/s at all times since start of commercial operations on 05-Sep-19.

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 SEPTEMBER AND OCTOBER 2019



3.2.9 NAM NGIEP DOWNSTREAM WATER DEPTH MONITORING

In October 2019, EMO carried out five boat missions to monitor the water depth in the Nam Ngiep downstream of the re-regulation dam. A total of 19 locations have been identified with potential shallow water depths. Out of the 19 locations monitored, none of these sites were difficult to navigate. The increased discharge from the re-regulation dam mentioned in Section 3.2.8 above.

3.3 PROJECT WASTE MANAGEMENT

3.3.1 SOLID WASTE MANAGEMENT

In October 2019, a total of 64.2 m^3 of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 9.2 m^3 compared to September 2019. During October 2019, EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and camps. Mixed waste inside the waste bins continued to be found at the Song Da 5 Camp No.1, OC Contractor Camp, V&K Camp, RCC Plant and CVC Plant as part of their decommissioning activities. NNP1PC issued ONC and instructed the supervisors of all concerned Contractors and subcontractors to improve and ensure proper waste management practices.

A total of 5,162.5 kg of recyclable waste was sold to Khounmixay Processing Factory. The remaining scrap metal is expected to be sold or transported off site by the Contractor later next month.

TABLE 3-11: AMOUNTS OF RECYCLABLE WASTE SOLD

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 31st October 2019
Construction Activity				
1	Scrap metal	kg	5,000	0
Sub-Total 1		**kg**	**5,000**	**0**
Camp Operations				
2	Glass bottles	kg	125	331
3	Plastic bottles	kg	17	162
4	Paper/Cardboard	kg	15	151
5	Aluminium cans	kg	5.5	62
Sub-Total 2		**kg**	**162.5**	**706**
Grand Total 1+2		**kg**	**5,162.5**	**706**

The villagers of Phouhomxay Village collected a total of 2,776 kg of food waste from selected camps for animal feed in October 2019, a decrease of 94 kg compared to September 2019 as a result of GFE, Zhefu, 276 and LILAMA 10 Camp decommissioning and a reduction in the number of construction workers at the 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. 1	kg	507
2	Obayashi Corporation Camp	kg	946
3	Owner's Village and Site Office (OSOV)	kg	953
4	Lilama 10 Camp	kg	370
Total		**kg**	**2,776**

3.3.2 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

The types and amounts of hazardous waste stored on site for treatment and final disposal at Khounmixay Processing Factory in October 2019 are shown below.

TABLE 3-13: RESULTS OF HAZARDOUS MATERIAL INVENTORY

No.	Hazardous Waste Type	Unit	Total in October 2019 (A)	Disposed (B)	Remainder (A - B)
1	Used hydraulic and engine oil	litre	4,652	1,692	2,960
2	Ink cartridge	unit	203	0	203

No.	Hazardous Waste Type	Unit	Total in October 2019 (A)	Disposed (B)	Remainder (A - B)
3	Used tyre	piece	238	97	141
4	Used oil filters	piece	156	56	100
5	Contaminated soil, sawdust and concrete	bag	398	353	45
6	Empty used chemical drum/container	drum (200 L)	65	23	42
7	Lead acid batteries	unit	22	0	22
8	Empty contaminated bitumen drum/container	drum (200 L)	20	0	20
9	Empty used oil drum/container	drum (20 L)	26	9	17
10	Clinic Waste	kg	14	0	14
11	Halogen/fluorescent bulbs	unit	10	0	10
12	Contaminated textile and material	kg	17	10	7
13	Lithium-ion batteries	unit	7	0	7
14	Empty paint and spray cans	can	7	0	7
15	Used oil mixed with water	litre	200	200	0
16	Empty used oil drum/container	drum (200 L)	0	0	0

In addition, a total of 8 m3 of sewage sludge/black water from toilets of the CVC Plant was transported and disposed of at the Spoil Disposal Area No. 6 by following the NNP1PC Standard Operating Procedure (SOP) on Sewage/Black Water Disposal.

3.4 Community Waste Management

3.4.1 Community Recycling Programme

In October 2019, the Community Waste Bank received 232.5 kg of recyclable waste making a total of 2,793.5 kg of recyclable waste remaining in the Bank.

Table 3-14: *Types and Amounts of Recyclable Waste Traded at the Community Waste Bank*

Types of Waste	Unit	Remaining in September 2019	Additional in October 2019	Sold	Remaining in October 2019
Scrap metal	kg	2.5	7	0	9.5
Glass bottles	kg	2,362	83	735	1,710
Paper/cardboard	kg	825.5	98	0	923.5
Aluminium cans	kg	1	0.5	0	1.5
Plastic bottles	kg	105	44	0	149
Total	**kg**	**3,296**	**232.5**	**735**	**2,793.5**

3.4.2 COMMUNITY SOLID WASTE MANAGEMENT

In October 2019, a total of 55 m^3 of solid waste was collected from Phouhomxay, Thahuea and Hat Gnuin Villages. The solid waste was transported to Houay Soup Landfill, where recyclable materials were segregated before the waste was disposed of at the landfill.

During 08 to 09 October 2019, the local Contractor and NNP1PC EMO carried out waste management sessions with villagers of Hat Gniun, Thaheua and Phouhomxay Villages on waste collection, segregation, transportation and right disposal to the Houay Soup landfill by the local Contractor.

3.5 WATERSHED AND BIODIVERSITY MANAGEMENT

3.5.1 WATERSHED MANAGEMENT

3.5.1.1 IMPLEMENTATION OF ANNUAL IMPLEMENTATION PLAN (AIP) 2019

The budget summary of AIP2019 related to the No Net Loss from both Provinces was submitted to ADB on 25 September 2019. ADB provided comments on 15 October 2019 and the revised version with further clarification was re-submitted to ADB on 19 October 2019. ADB did not provide further comments yet until the end of October 2019.

NNP1PC EMO, together with a consultant, is preparing a Fishery Co-management Plan. The meeting with Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF) and Xaysomboun and Bolikhamxay Provincial WRPOs was organized in Longxan District on 31 October 2019. The meeting discussed the lessons learned from other hydropower projects, the vision and objectives of the Plan, the institutional arrangement for NNP1 main reservoir fishery co-management and the scope of key activities to be implemented. Further data collection through community meetings, field visits and assessment were scheduled to be carried out by mid-November 2019.

NNP1PC EMO is in the progress of recruiting a local consultant to conduct an assessment of options for sustainable livelihood opportunities focussing on nine villages in Xaysomboun Province comprising of Houayxay and Phu Ngou Villages in Hom District; Om, Korhai and Thamlo Villages in Anouvong District; Thaviengxay, Naxong, Nahong, and Phonehom Villages in Thathom District.

3.5.2 BIODIVERSITY OFFSET MANAGEMENT

3.5.2.1 APPROVAL OF BIODIVERSITY SERVICE PROVIDER (BSP)

ADB provided a confirmation in the first week of October 2019 to NNP1PC EMO and ESD management that the Biodiversity Service Provider (WCS Laos) is waiting for a 'Notice to Proceed' from ADB which is dependent on the No Objection letter being provided by the Government.

NNP1PC-EMO and ESD Management learned that ADB has submitted a letter to GOL on a separate TA Project to be funded by ADB. Thus, NNP1PC-ESD management has requested legal advice on the potential impacts from the approach used by ADB as it seems to have deviated from the earlier discussion with NNP1PC on the hiring of the BSP under the Biodiversity

Management and Offset Framework (BIMOF). There is no further confirmation from GOL on the proposed ADB TA Project to support GOL as of the end of October 2019.

3.5.2.2 IMPLEMENTATION OF BOMP ANNUAL IMPLEMENTATION PLAN (AIP) 2019

Progresses on the implementation of activities by Component are described below:

a. Component 1 - Spatial Planning and Regulation

The second round of consultation meetings was conducted in Na Gnang Village on 9 October 2019 to finalize the agreement on NC-NX TPZ boundary. The meeting was attended by the Vice District Governor of Viengthong District, high ranking provincial and district officials, NNP1PC EMO staff and key persons from village authorities and communities in Na Gnang Village. The main conclusion from the meeting can be summarized as below:

1. The meeting agreed with the proposed TPZ boundary in Na Gnang village.
2. The village can continue their agriculture practices at the existing land use area outside the agreed NC-NX TPZ boundary.
3. Patrolling teams can fully conduct the patrolling activity within the NC-NX offset site according to their strategy and plan.

Bolikhamxay Provincial BOMU team has finalized the map of TPZ boundary and submitted the report to BOMC in the last week of October 2019.

b. Component 2 – Law Enforcement

Four teams continued patrolling in October 2019.

Three teams focussed their patrolling efforts in the TPZ highest priority area covering Nam Xi, Nam Chang, Nam Poung, Nam Chang, Nam Sone, Houy Poung, Houy Xai Gnai, Houy Xai Noi, Nam Chang and Nam Sa. One team focused on Houy Tong, Houy Kamoud, Houy Ping, Nam Kha Gni and Nam Houng in the TPZ higher priority area as well as along the Lao-Vietnam border within Xaychamphone District.

The teams in the TPZ highest priority area spent an average of 16 days on forest and road access patrolling covering a distance between about 68 and 88 km. The teams made a total of 12 direct observations and 22 indirect observations of the following wildlife: red-shanked douc langur, macaque, wild pig, muntjac, sambar, otter, civet, bear, large-tooth ferret badger, black giant squirrel, phayre's leaf monkey, white-cheeked gibbon, Indochinese serow and green pigeon.

The teams encountered and destroyed three fishing camps at Nam Xi of more than one year old and one hunting camp at Nam San that is suspected to have been used for recent hunting activities upstream of Nam San based on tracks around the area. The teams also observed two rice paddy fields belonging to Vangphieng villagers close to the NC-NX TPZ boundary.

The team in the TPZ higher priority area spent 16 days on forest and road access patrolling covering a distance of 62 km. The team made a total of five direct observations and three indirect observations of the following wildlife: macaque, civet, otter, black giant squirrel, phayre's leaf monkey, indochinese serow, wild pig, and brush tailed porcupine.

The monthly patrolling meeting was organized on 10 October 2019 with the following key notes:

- The patrolling teams were advised to focus more on the key conservation species as described in the NC-NX BOMP.
- The local informants should be assessed further for their willingness to cooperate and to ensure that the provided information is reliable.
- Radio communicator installed at Nam Ma sub-station should be fixed to ease the communication between the teams in the field and BOMU office in Viengthong District. Necessary field equipment and tools such as cooking sets, drinking water filters and motorbike fixing tools should be considered to be purchased for the new teams.
- BOMU team has raised their concerns about the annual health check-up for the patrolling team members. However, NNP1PC EMO clarified that the annual health check-up and insurance for the field teams are not covered under the NC-NX BOMP budget to be paid by the Project and it was not practiced in other projects in Lao PDR too.
- One team will conduct a joint patrolling with Pu Mat National Park Team along the Lao-Viet border in Xaychamphone District sites and then continue patrolling together with the other two teams in Nam Houng higher priority area. One team will continue the patrolling at the TPZ highest priority area.

c. Component 4 – Conservation linked livelihood development

NNP1PC is in the process of recruiting a consultant to prepare a Community Development Plan (CDP) for the six NC-NX villages. An advertisement of the consultancy service started from 23 September 2019 until 07 October 2019. However, there were no qualified applicants and so the vacancy advertisement is extended for another round until end of November 2019.

FIGURE 3-5 : MAP OF THREATS RECORDED BY TWO PATROLLING TEAMS IN SEPTEMBER-OCTOBER 2019

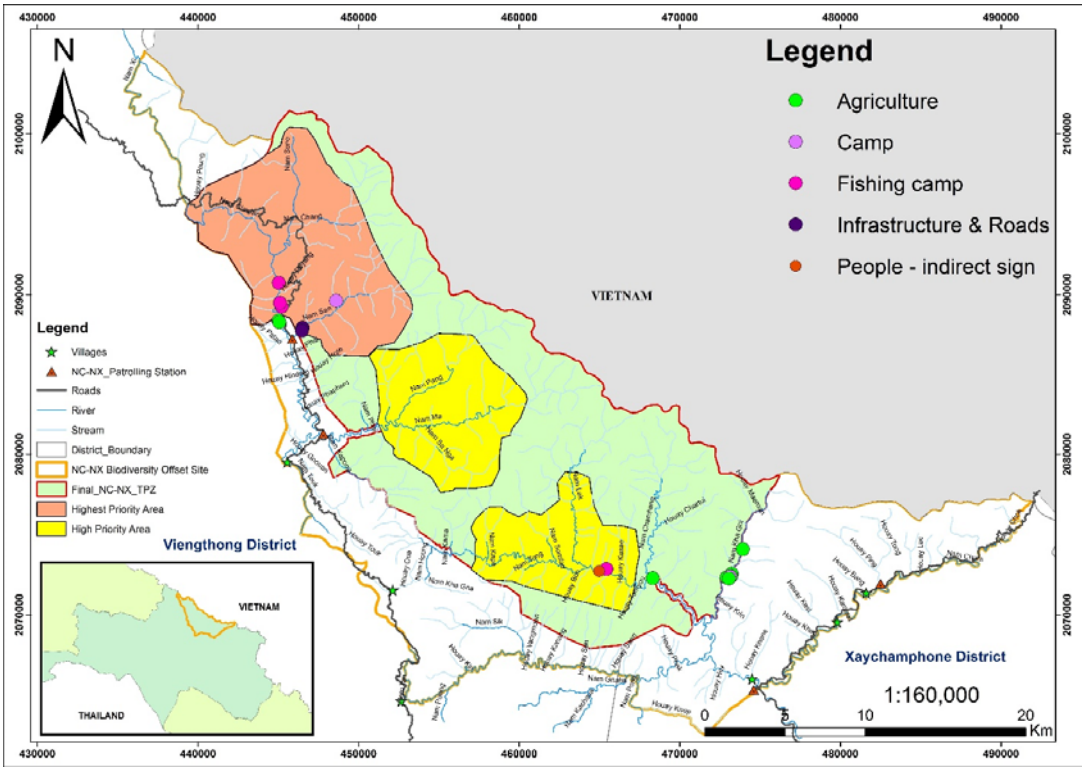


FIGURE 3-6 : MAP OF WILDLIFE SIGNS RECORDED BY TWO PATROLLING TEAMS IN SEPTEMBER-OCTOBER 2019

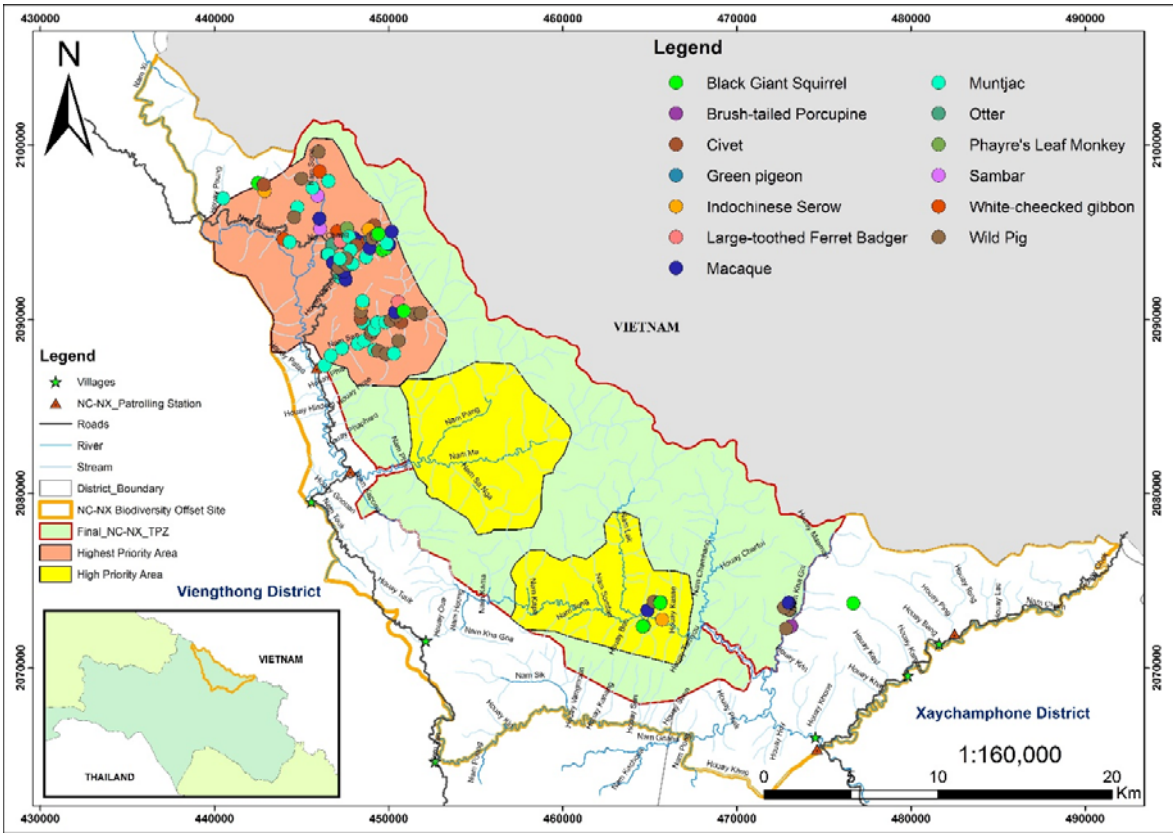


FIGURE 2-3 DEAD WILD PIG (UNKNOW DISEASE)

FIGURE 2-4 BEAR SCRATCH

FIGURE 2-5 HAIR OF BRUSHED TAILED PORCUPINE IN NAM KHA GNI

FIGURE 2-6 HUNTING CAMP IN NAM KHA GNI

3.6 FLOATING DEBRIS REMOVAL

As planned during the wet season, there was no cutting and burning during this reporting period. Work will be resumed from the middle of October or in November 2019. NNP1PC EMO conducted regular monitoring and removal of floating materials and logs from the temporary log-boom as necessary.

4. FISHERY MONITORING

Three species groups and two species dominated the fish catch by weight in September 2019 as listed in ***Table 4-1.*** These species are all classified as Least Concern (LC) according to the IUCN Red List of Threatenedc Species[1].

[1] 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.

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

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Poropuntius normani, Poropuntius laoensis,Poropuntius carinatus	ปาจาด	256.2	LC
Channa striata	ปาถ่ำ	161.4	LC
Hampala dispar, Hampala macrolepidota	ปาสูด	105.7	LC
Clarias batrachus	ปาดุก	105.5	LC
Mastacembelus armatus, Mastacembelus favus	ปาหาด	99.8	LC

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

TABLE 4-2: THREATENED SPECIES OF SEPTEMBER 2019 FISH CATCH

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Cyprinus carpio	ปาไน	4	VU
Laubuca caeruleostigmata	ปาຊິ่วหัวแข็ง	5	EN
Mekongina erythrospila	ปาสะอิ	0.5	NT
Neolissochilus stracheyi	ปาสอง	5.5	NT
Onychostoma gerlachi	ปาถิง	3.4	NT
Probarbus jullieni	ปาเอิน	11	EN
Scaphognathops bandanensis	ปาจวมไฟ/ปาป่วม	14.1	VU
Tor sinensis	ปาแดง	55.1	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 September 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.

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

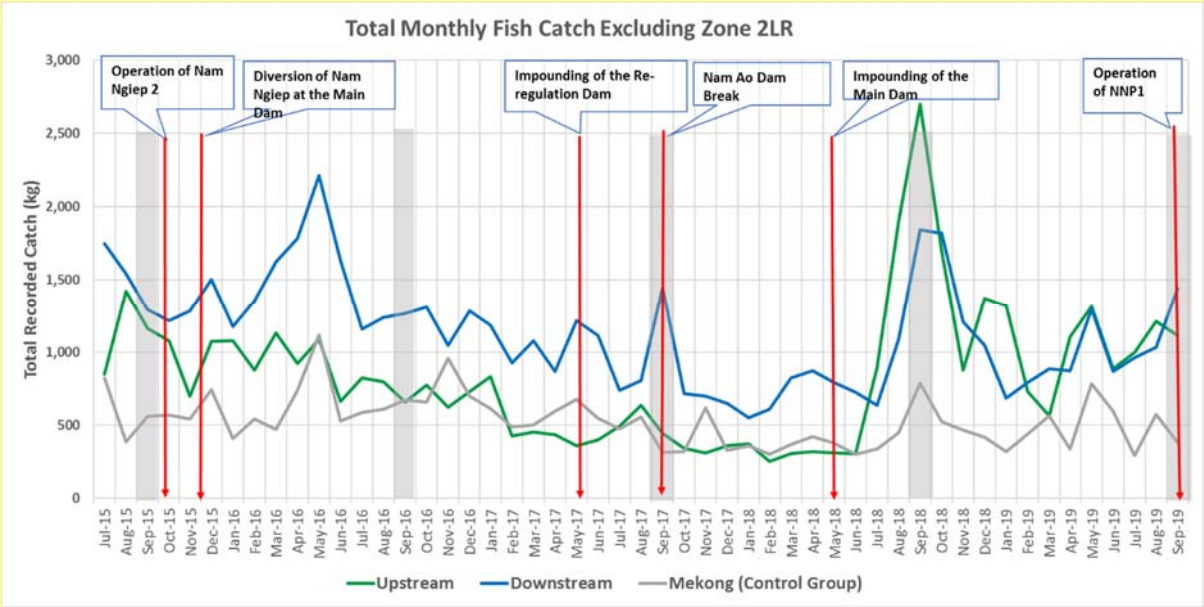
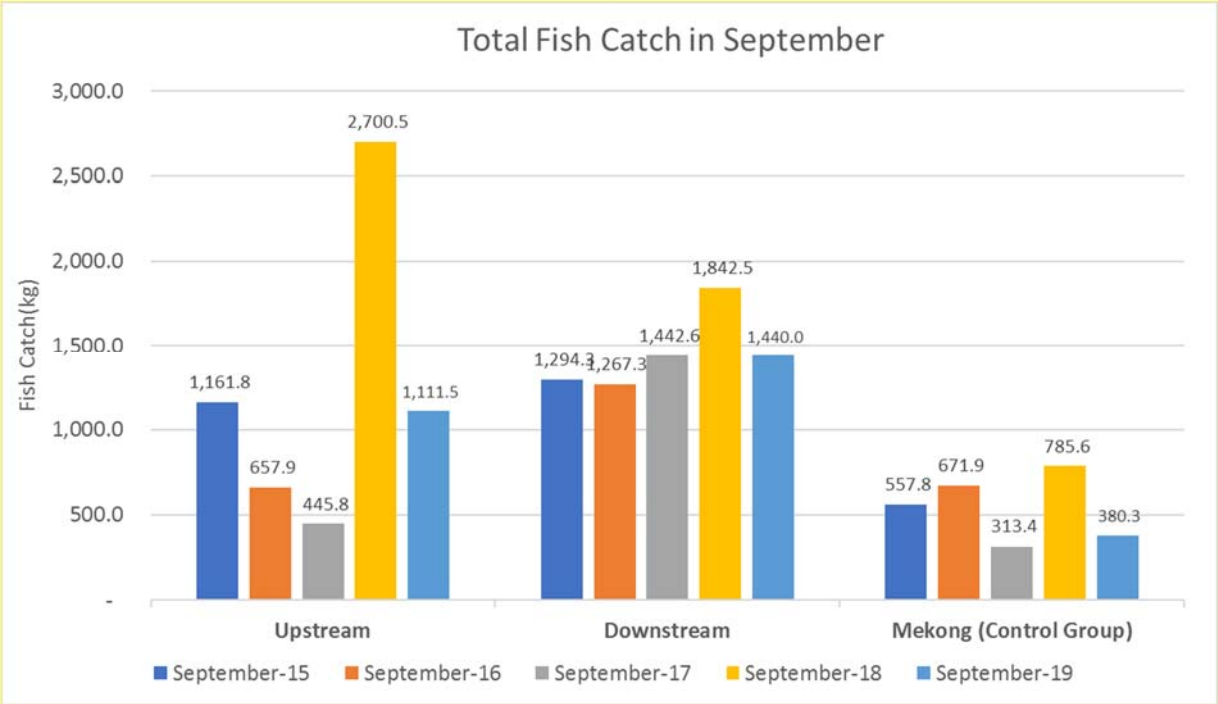


Table 4-2 and ***Figure 4-3*** show the total recorded fish catch for September 2015, September 2016, September 2017, September 2018 and September 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved fishing households.

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

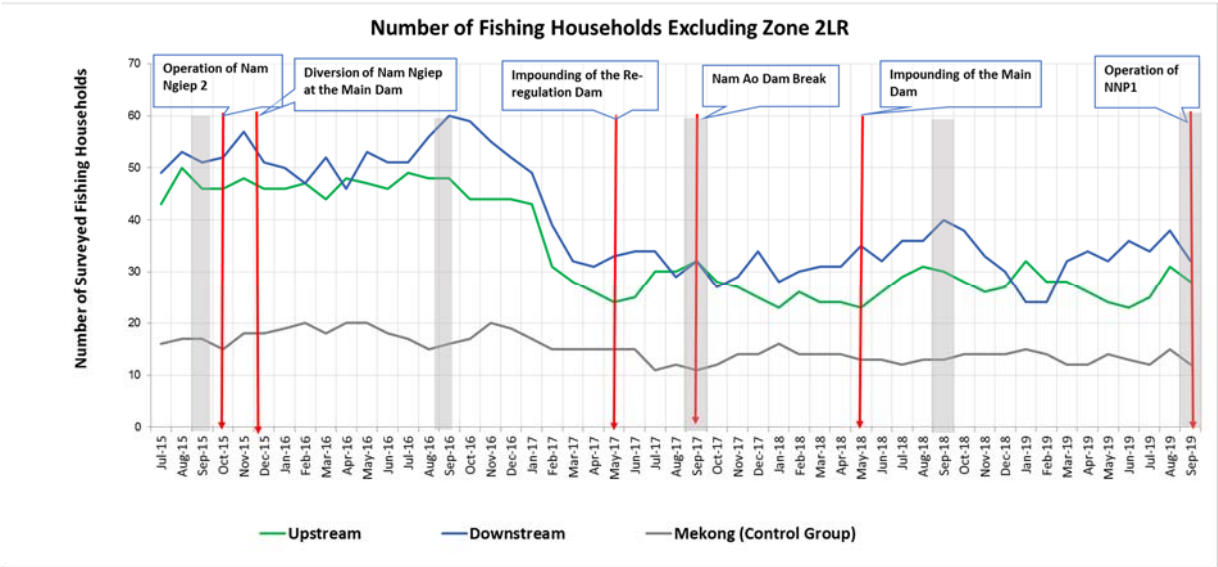
Fishing Zone	September 2015 (kg)	September 2016 (kg)	September 2017 (kg)	September 2018 (kg)	September 2019 (kg)
Upstream	1,161.8	657.9	445.8	2,700.5	1,111.5
Downstream	1,294.3	1,267.3	1,442.6	1,842.5	1,440.0
Mekong Control Group	557.8	671.9	313.4	785.6	380.3

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



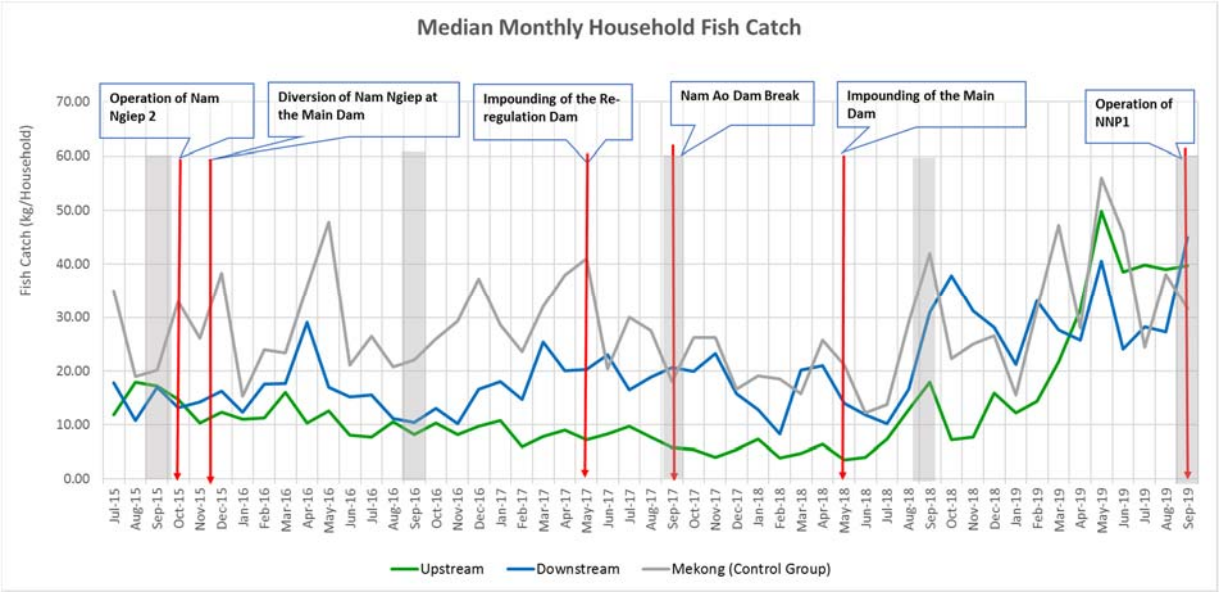
The numbers of fishing households involved in the fish catch monitoring programme are displayed in ***Figure 4-3***.

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



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

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



The median household fish catch for September 2015, September 2016, September 2017, September 2018 and September 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group are displayed in Table below;

TABLE 4-3: MEDIAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR

Fishing Zone	September 2015 (kg)	September 2016 (kg)	September 2017 (kg)	September 2018 (kg)	September 2019 (kg)
Upstream	17.2	8.2	5.8	17.9	39.7
Downstream	17.0	10.4	20.7	31.0	45.0
Mekong Control Group	20.2	22.1	18.0	42.0	31.7

The median daily fish catch per household are displayed in ***Figure 4-5***, and the median fish catch per household per fishing day in September 2015, September 2016, September 2017, September 2018 and September 2019 are shown in Table below;

FIGURE 4-5: MEDIAN DAILY FISH CATCH PER HOUSEHOLD

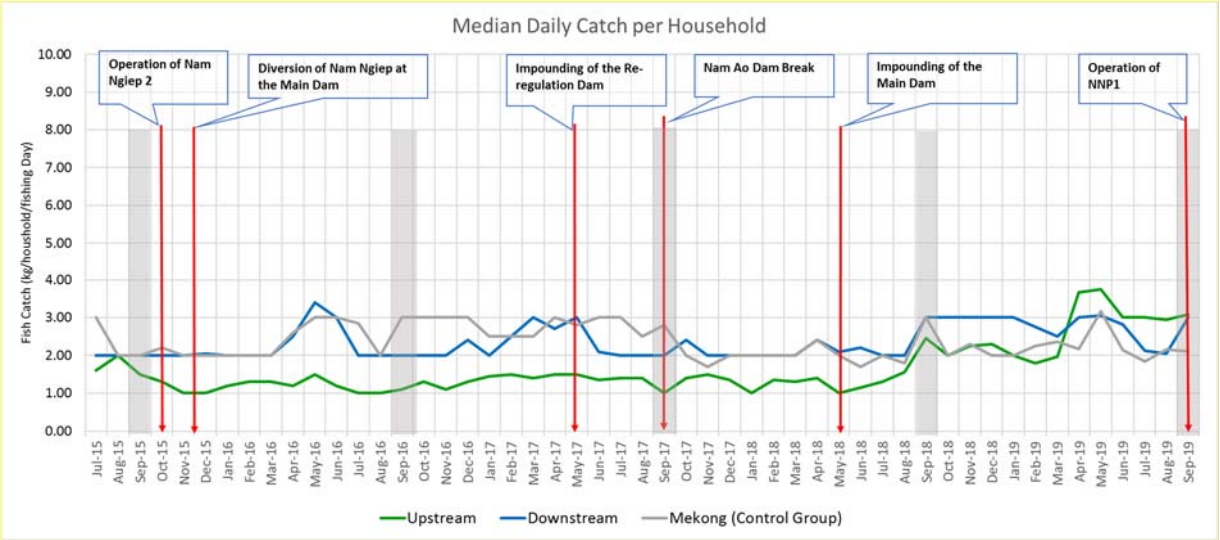


TABLE 4-4: MEDIAN DAILY FISH CATCH PER HOUSEHOLD IN SEPTEMBER 2019

Fishing Zone	September 2016 (kg)	September 2016 (kg)	September 2017 (kg)	September 2018 (kg)	September 2019 (kg)
Upstream	1.50	1.10	1.00	2.45	3.09
Downstream	2.00	2.00	2.00	3.00	3.00
Mekong (Control Group)	2.00	3.00	2.80	3.00	2.11

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	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**											
1-Oct-19	pH	5.0 - 9.0		7.54	7.24	7.21	7.67						
2-Oct-19	pH	5.0 - 9.0						7.11	6.7	6.56	6.77	7.03	6.97	7.09
4-Oct-19	pH	5.0 - 9.0						6.65	6.43	6.72	6.63	6.11		
5-Oct-19	pH	5.0 - 9.0						7.03	6.96		7.14			
7-Oct-19	pH	5.0 - 9.0	7.81											
8-Oct-19	pH	5.0 - 9.0		7.76	7.45	7.88	7.74							
9-Oct-19	pH	5.0 - 9.0						7.5	7	7.01	7.06	7.12	6.81	6.74
11-Oct-19	pH	5.0 - 9.0						7.35	6.63	6.56	6.69	7.06		
12-Oct-19	pH	5.0 - 9.0						7.04	6.36		6.41			
16-Oct-19	pH	5.0 - 9.0						7.28	6.8	6.66	6.22	6.29	7.94	7.77
18-Oct-19	pH	5.0 - 9.0						7.65	7.01	6.98	7.03	7.5		
19-Oct-19	pH	5.0 - 9.0						7.95	7.1		7.16			
22-Oct-19	pH	5.0 - 9.0	7.8	7.52	7.68	7.6	7.38							
23-Oct-19	pH	5.0 - 9.0						7.19	7.17	7.36	7.26	7.36	7.77	7.81
25-Oct-19	pH	5.0 - 9.0						7.82	7.33	6.93	7.41	7.52		
26-Oct-19	pH	5.0 - 9.0						7.58	7.4		7.46			
29-Oct-19	pH	5.0 - 9.0		7.68	7.36	7.86	7.78							
30-Oct-19	pH	5.0 - 9.0						7.96	7.45	7.34	7.33	6.17	6.18	6.3
1-Oct-19	Sat. DO (%)			108.7	102.6	99.3	92.1							
2-Oct-19	Sat. DO (%)							101.6	27.6	26.5	93.6	91.9	87.5	81.5
4-Oct-19	Sat. DO (%)							102.4	34.1	22.1	94.9	94.5		
5-Oct-19	Sat. DO (%)							94	41.8		94.6			
7-Oct-19	Sat. DO (%)		102.1											
8-Oct-19	Sat. DO (%)			106.3	94.8	98.5	92.9							
9-Oct-19	Sat. DO (%)							91.4	37.3	16.2	73.8	94.8	89.6	85.8
11-Oct-19	Sat. DO (%)							108	10.6	13.4	97.8	103.6		
12-Oct-19	Sat. DO (%)							105.8	38.3		93.6			
16-Oct-19	Sat. DO (%)							98.3	17.1	26.4	93.8	94.7	91.4	89
18-Oct-19	Sat. DO (%)							95.8	6.1	51.2	91.1	95.9		
19-Oct-19	Sat. DO (%)							83.1	38.2		89.8			
22-Oct-19	Sat. DO (%)		104.8	99.3	98.2	92.3	96.7							
23-Oct-19	Sat. DO (%)							85.1	23	48	96.2	95.7	92.6	88.3
25-Oct-19	Sat. DO (%)							82.8	5	24.8	77.2	78.1		
26-Oct-19	Sat. DO (%)							83.6	11.1		81.8			

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
29-Oct-19	Sat. DO (%)			104	105.2	94.7	90							
30-Oct-19	Sat. DO (%)							78.6	4.8	11.1	90.1	89.8	85.8	85.4
1-Oct-19	DO (mg/L)	>6.0		7.88	7.72	7.48	7.03							
2-Oct-19	DO (mg/L)	>6.0						7.79	2.88	3.29	7.75	7.66	7.11	6.61
4-Oct-19	DO (mg/L)	>6.0						7.9	2.94	1.84	7.43	7.43		
5-Oct-19	DO (mg/L)	>6.0						7.35	3.5		7.81			
7-Oct-19	DO (mg/L)	>6.0	7.95											
8-Oct-19	DO (mg/L)	>6.0		7.87	7.03	7.45	7.09							
9-Oct-19	DO (mg/L)	>6.0						7.07	3.4	1.48	6.1	7.37	6.97	6.69
11-Oct-19	DO (mg/L)	>6.0						8.31	0.92	1.18	8.03	8.66		
12-Oct-19	DO (mg/L)	>6.0						7.63	3.01		7.65			
16-Oct-19	DO (mg/L)	>6.0						7.3	1.17	2.62	7.32	7.38	7.2	7.04
18-Oct-19	DO (mg/L)	>6.0						7.4	0.52	4.25	7.54	7.96		
19-Oct-19	DO (mg/L)	>6.0						6.42	3.2		7.49			
22-Oct-19	DO (mg/L)	>6.0	8.14	7.31	7.37	6.97	7.42							
23-Oct-19	DO (mg/L)	>6.0						6.59	2.11	4.08	7.36	7.48	7.11	6.9
25-Oct-19	DO (mg/L)	>6.0						6.31	0.43	2.05	6.27	6.34		
26-Oct-19	DO (mg/L)	>6.0						6.48	0.95		6.67			
29-Oct-19	DO (mg/L)	>6.0		7.67	7.84	7.19	6.85							
30-Oct-19	DO (mg/L)	>6.0						6.09	0.41	0.92	6.59	7.01	6.76	6.73
1-Oct-19	Conductivity (µs/cm)			82	82	74	72							
2-Oct-19	Conductivity (µs/cm)							72	94	90	94	90	87	83
4-Oct-19	Conductivity (µs/cm)							71	94	89	63.3	61.8		
5-Oct-19	Conductivity (µs/cm)							77	98		88			
7-Oct-19	Conductivity (µs/cm)		81.5											
8-Oct-19	Conductivity (µs/cm)			82	84	73	73							
9-Oct-19	Conductivity (µs/cm)							72	92	83	90	61.8	60.1	59.5
11-Oct-19	Conductivity (µs/cm)							72	93	92	93	85		
12-Oct-19	Conductivity (µs/cm)							86.1	62.2		63.6			
16-Oct-19	Conductivity (µs/cm)							72	90	89	64.1	60.4	70.3	69.5
18-Oct-19	Conductivity (µs/cm)							73	92	83	86	87		
19-Oct-19	Conductivity (µs/cm)							72	90		88			
22-Oct-19	Conductivity (µs/cm)		80.4	85	82	75	74							

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
23-Oct-19	Conductivity (µs/cm)							72	89	88	90	69.8	56	59
25-Oct-19	Conductivity (µs/cm)							72	88	85	86	89		
26-Oct-19	Conductivity (µs/cm)							76	89		90			
29-Oct-19	Conductivity (µs/cm)			83	83	76	75							
30-Oct-19	Conductivity (µs/cm)							72	86	85	57.7	59	57.7	56.9
1-Oct-19	TDS (mg/L)			41	41	37	36							
2-Oct-19	TDS (mg/L)							36	47	45	47	45	43.5	41.5
4-Oct-19	TDS (mg/L)							35.5	47	44.5	31.65	30.9		
5-Oct-19	TDS (mg/L)							38.5	49		44			
7-Oct-19	TDS (mg/L)		40.75											
8-Oct-19	TDS (mg/L)			41	42	36.5	36.5							
9-Oct-19	TDS (mg/L)							36	46	41.5	45	30.5	30	29.4
11-Oct-19	TDS (mg/L)							36	46.5	46	46.5	42.5		
12-Oct-19	TDS (mg/L)							43.05	31.1		31.8			
16-Oct-19	TDS (mg/L)							36	45	44.5	32.05	30.2	35.15	34.75
18-Oct-19	TDS (mg/L)							36.5	46	41.5	43	43.5		
19-Oct-19	TDS (mg/L)							36	45		44			
22-Oct-19	TDS (mg/L)		40.2	42.5	41	37.5	37							
23-Oct-19	TDS (mg/L)							36	44.5	44	45	34.9	28	29.5
25-Oct-19	TDS (mg/L)							36	44	42.5	43			
26-Oct-19	TDS (mg/L)							38	44.5		45			
29-Oct-19	TDS (mg/L)			41.5	41.5	38	37.5							
30-Oct-19	TDS (mg/L)							36	43	42.5	28.9	29	28.5	28.4
1-Oct-19	Temperature (°C)			31.67	30.56	30.7	29.98							
2-Oct-19	Temperature (°C)							28.87	24.26	24.91	24.84	25.13	25.91	26.02
4-Oct-19	Temperature (°C)							28.97	24.19	24.94	26.6	26.1		
5-Oct-19	Temperature (°C)							28.09	24.9		24.91			
7-Oct-19	Temperature (°C)		26.2											
8-Oct-19	Temperature (°C)			31.09	30.9	29.88	29.48							
9-Oct-19	Temperature (°C)							28.73	24.39	26.12	24.93	26.8	26.8	26.8
11-Oct-19	Temperature (°C)							28.95	24.04	24.87	21.94	24.76		

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
12-Oct-19	Temperature (°C)							30.3	26.2		24.4			
16-Oct-19	Temperature (°C)							29.59	24.55	24.82	26.9	26.4	26.4	26.2
18-Oct-19	Temperature (°C)							28.71	24.31	25.29	24.76	24.68		
19-Oct-19	Temperature (°C)							28.7	24.96		24.39			
22-Oct-19	Temperature (°C)		26	31.49	30.16	29.63	29.06							
23-Oct-19	Temperature (°C)							28.55	24.51	24.99	22.26	26.3	28.1	26.5
25-Oct-19	Temperature (°C)							29.57	24.63	25.63	25.93	25.38		
26-Oct-19	Temperature (°C)							28.58	24.81		25.6			
29-Oct-19	Temperature (°C)			31.47	30.7	29.97	29.55							
30-Oct-19	Temperature (°C)							28.55	24.71	25.18	27.5	26.6	26.3	26.4
1-Oct-19	Turbidity (NTU)			1.48	2.57	1.5	1.69							
2-Oct-19	Turbidity (NTU)							1.29	1.55	3.64	4.04	4.51	5.62	6.65
4-Oct-19	Turbidity (NTU)							1.25	1.73	3.61	4.89	6.62		
5-Oct-19	Turbidity (NTU)							1.66	7.73		6.7			
7-Oct-19	Turbidity (NTU)		12											
8-Oct-19	Turbidity (NTU)			1.64	2.27	1.4	1.47							
9-Oct-19	Turbidity (NTU)							1.37	2.06	8.64	5.08	4.81	7.73	8.44
11-Oct-19	Turbidity (NTU)							1.29	1.37	2.15	5.85	6.46		
12-Oct-19	Turbidity (NTU)							1.5	4.7		5.54			
16-Oct-19	Turbidity (NTU)							1.4	1.38	1.96	9.19	10.22	13.62	16.88
18-Oct-19	Turbidity (NTU)							1.4	1.19	10.44	7.13	7.48		
19-Oct-19	Turbidity (NTU)							3.23	4.26		5.1			
22-Oct-19	Turbidity (NTU)		6.53	2.18	2.8	1.59	1.31							
23-Oct-19	Turbidity (NTU)							1.6	1.88	4.58	5.72	7.22	6.67	8.25
25-Oct-19	Turbidity (NTU)							1.57	1.54	4.15	4.87	7.21		

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
26-Oct-19	Turbidity (NTU)							1.78	2.69		5.19			
29-Oct-19	Turbidity (NTU)			2.35	2.73	1.71	1.63							
30-Oct-19	Turbidity (NTU)							1.41	1.48	4.09	7.78	7.92	8.62	8.87
7-Oct-19	TSS (mg/L)		60.19											
8-Oct-19	TSS (mg/L)			<5	5.69	<5	<5							
9-Oct-19	TSS (mg/L)							<5	<5	<5	<5	<5	6	17.92
16-Oct-19	TSS (mg/L)							<5	<5	<5	<5			
23-Oct-19	TSS (mg/L)							<5	<5	5.1	<5			
2-Oct-19	BOD_5 (mg/L)	<1.5						<1.0	2.94	1.49	<1.0			
7-Oct-19	BOD_5 (mg/L)	<1.5	<1.0											
8-Oct-19	BOD_5 (mg/L)	<1.5		1.2	<1.0	1.49	<1.0							
9-Oct-19	BOD_5 (mg/L)	<1.5						<1.0	3.54	2.77	1.14	<1.0	<1.0	<1.0
16-Oct-19	BOD_5 (mg/L)	<1.5						<1.0	7.46	7.9	<1.0			
23-Oct-19	BOD_5 (mg/L)	<1.5						<1.0	6.4	8.04	<1.0			
7-Oct-19	COD (mg/L)	<5.0	7.1											
8-Oct-19	COD (mg/L)	<5.0		10.4	13.8	6	8							
9-Oct-19	COD (mg/L)	<5.0						7.2	6.4	<5.0	5	5.6	5.8	<5.0
7-Oct-19	NH_3-N (mg/L)	<0.2	<0.2											
8-Oct-19	NH_3-N (mg/L)	<0.2		<0.2	<0.2	<0.2	<0.2							
9-Oct-19	NH_3-N (mg/L)	<0.2						<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
7-Oct-19	NO_3-N (mg/L)	<5.0	<0.02											
8-Oct-19	NO_3-N (mg/L)	<5.0		<0.02	<0.02	<0.02	<0.02							
9-Oct-19	NO_3-N (mg/L)	<5.0						<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04
2-Oct-19	Faecal coliform (MPN/100 ml)	<1,000						22	13	22	33			
7-Oct-19	Faecal coliform (MPN/100 ml)	<1,000	1,600											
8-Oct-19	Faecal coliform (MPN/100 ml)	<1,000		79	13	22	17							
9-Oct-19	Faecal coliform (MPN/100 ml)	<1,000						11	8	79	70	22	49	79
16-Oct-19	Faecal coliform	<1,000						0	7	14	2			

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
	(MPN/100 ml)													
23-Oct-19	Faecal coliform (MPN/100 ml)	<1,000						0	0	0	0			
2-Oct-19	Total Coliform (MPN/100 ml)	<5,000						110	33	240	350			
7-Oct-19	Total Coliform (MPN/100 ml)	<5,000	1,600											
8-Oct-19	Total Coliform (MPN/100 ml)	<5,000		79	49	79	170							
9-Oct-19	Total Coliform (MPN/100 ml)	<5,000						33	140	1,700	1,600	220	920	1,600
16-Oct-19	Total Coliform (MPN/100 ml)	<5,000						79	70	1,600	240			
23-Oct-19	Total Coliform (MPN/100 ml)	<5,000						12	11	33	110			
8-Oct-19	TOC (mg/L)			2.93	4.34	2.41	2.17							
9-Oct-19	TOC (mg/L)							2.21	1.59	1.62				
8-Oct-19	Phytoplankton Biomass (g dry wt/m³)			2.4	1.6	1	1.4							
9-Oct-19	Phytoplankton Biomass (g dry wt/m³)							0.8	4	4.2				
8-Oct-19	Total Phosphorus (mg/L)			<0.01	<0.01	<0.01	<0.01							
9-Oct-19	Total Phosphorus (mg/L)							<0.01	<0.01	<0.01				
8-Oct-19	Total Dissolved Phosphorus (mg/L)			<0.01	<0.01	<0.01	<0.01							
9-Oct-19	Total Dissolved							<0.01	<0.01	<0.01				

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
	Phosphorus (mg/L)													
9-Oct-19	Hydrogen Sulfide (mg/L)							<0.02		<0.02	<0.02			

TABLE A-2: ***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**				
2-Oct-19	pH	5.0 - 9.0			7.01	6.86
4-Oct-19	pH	5.0 - 9.0			6.09	
7-Oct-19	pH	5.0 - 9.0	7.15			
9-Oct-19	pH	5.0 - 9.0			7.02	7.03
11-Oct-19	pH	5.0 - 9.0			6.98	
16-Oct-19	pH	5.0 - 9.0			6.18	6.44
18-Oct-19	pH	5.0 - 9.0			7.24	
22-Oct-19	pH	5.0 - 9.0	7.95			
23-Oct-19	pH	5.0 - 9.0			7.1	7.88
25-Oct-19	pH	5.0 - 9.0			7.71	
30-Oct-19	pH	5.0 - 9.0			6.24	6.26
2-Oct-19	Sat. DO (%)				91	90.7
4-Oct-19	Sat. DO (%)				96.9	
7-Oct-19	Sat. DO (%)		103.2			
9-Oct-19	Sat. DO (%)				96.2	97.1
11-Oct-19	Sat. DO (%)				99.1	
16-Oct-19	Sat. DO (%)				94.2	89.7
18-Oct-19	Sat. DO (%)				94.2	
22-Oct-19	Sat. DO (%)		100.2			
23-Oct-19	Sat. DO (%)				94.6	87.5
25-Oct-19	Sat. DO (%)				71.8	
30-Oct-19	Sat. DO (%)				89.1	83.9
2-Oct-19	DO (mg/L)	>6.0			7.03	7.08
4-Oct-19	DO (mg/L)	>6.0			7.4	7.08
7-Oct-19	DO (mg/L)	>6.0	8.33			
9-Oct-19	DO (mg/L)	>6.0			7.24	7.4
11-Oct-19	DO (mg/L)	>6.0			7.74	
16-Oct-19	DO (mg/L)	>6.0			7.23	6.97
18-Oct-19	DO (mg/L)	>6.0			7.39	
22-Oct-19	DO (mg/L)	>6.0	8.05			
23-Oct-19	DO (mg/L)	>6.0			7.02	6.6
25-Oct-19	DO (mg/L)	>6.0			5.47	
30-Oct-19	DO (mg/L)	>6.0			6.99	6.64

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**				
2-Oct-19	Conductivity (µs/cm)				108	28
4-Oct-19	Conductivity (µs/cm)				79.8	
7-Oct-19	Conductivity (µs/cm)		50.7			
9-Oct-19	Conductivity (µs/cm)				83.3	22.8
11-Oct-19	Conductivity (µs/cm)				112	
16-Oct-19	Conductivity (µs/cm)					
18-Oct-19	Conductivity (µs/cm)				117	
22-Oct-19	Conductivity (µs/cm)		38			
23-Oct-19	Conductivity (µs/cm)				88.2	23.2
25-Oct-19	Conductivity (µs/cm)				122	
30-Oct-19	Conductivity (µs/cm)				90	30
2-Oct-19	TDS (mg/L)				54	14
4-Oct-19	TDS (mg/L)				39.9	
7-Oct-19	TDS (mg/L)		25.35			
9-Oct-19	TDS (mg/L)				41.6	11.4
11-Oct-19	TDS (mg/L)				56	
16-Oct-19	TDS (mg/L)				42.1	10.8
18-Oct-19	TDS (mg/L)				58.5	
22-Oct-19	TDS (mg/L)		19			
23-Oct-19	TDS (mg/L)				44.1	11.6
25-Oct-19	TDS (mg/L)					
30-Oct-19	TDS (mg/L)				45	15
2-Oct-19	Temperature (°C)				28.78	28.09
4-Oct-19	Temperature (°C)				27.8	
7-Oct-19	Temperature (°C)		23.9			
9-Oct-19	Temperature (°C)				28.6	28
11-Oct-19	Temperature (°C)				28.17	
16-Oct-19	Temperature (°C)				27.7	27
18-Oct-19	Temperature (°C)				28.26	
22-Oct-19	Temperature (°C)		23.9			
23-Oct-19	Temperature (°C)				29.2	28.3
25-Oct-19	Temperature (°C)				29.55	
30-Oct-19	Temperature (°C)				26.4	25.8
2-Oct-19	Turbidity (NTU)				5.13	2.92
4-Oct-19	Turbidity (NTU)				6.65	
7-Oct-19	Turbidity (NTU)		12.04			
9-Oct-19	Turbidity (NTU)				3.85	3.62
11-Oct-19	Turbidity (NTU)				3.96	
16-Oct-19	Turbidity (NTU)				6.35	4.56
18-Oct-19	Turbidity (NTU)				4.34	
22-Oct-19	Turbidity (NTU)		44.72			
23-Oct-19	Turbidity (NTU)				5.67	4.43
25-Oct-19	Turbidity (NTU)				6.19	
30-Oct-19	Turbidity (NTU)				4.27	5.38
7-Oct-19	TSS (mg/L)		19.01			
9-Oct-19	TSS (mg/L)				<5	<5
7-Oct-19	BOD_5 (mg/L)	<1.5	<1.0			

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**				
9-Oct-19	BOD_5 (mg/L)	<1.5			<1.0	<1.0
9-Oct-19	COD (mg/L)	<5.0			5.6	5.4
9-Oct-19	NH_3-N (mg/L)	<0.2			<0.2	<0.2
7-Oct-19	NO_3-N (mg/L)	<5.0	0.04			
9-Oct-19	NO_3-N (mg/L)	<5.0			0.03	0.04
2-Oct-19	Faecal coliform (MPN/100 ml)	<1,000				
7-Oct-19	Faecal coliform (MPN/100 ml)	<1,000	170			
9-Oct-19	Faecal coliform (MPN/100 ml)	<1,000			34	280
7-Oct-19	Total Coliform (MPN/100 ml)	<5,000	1,600			
9-Oct-19	Total Coliform (MPN/100 ml)	<5,000			540	1,600

ANNEX B: RESULTS OF EFFLUENT ANALYSES

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

	Site Name	Owner's Site Office and Village		Obayashi Camp		SongDa5 Camp No.1	
	Station Code	EF01		EF02		EF07	
	Date	03-Oct-19	17-Oct-19	03-Oct-19	17-Oct-19	03-Oct-19	17-Oct-19
Parameters (Unit)	**Guideline**						
pH	6.0 - 9.0	7.0	6.9	7.1	7.0	7.1	No samples due to no inflow to chlorination tank
Sat. DO (%)		40.6	54.5	67.2	61.9	67.2	
DO (mg/l)		3.0	4.2	4.9	5.0	4.9	
Conductivity (µs/cm)		346	299	394	331	394	
TDS (mg/l)		173	149	197	165.5	197	
Temperature (°C)		30.2	28.2	30.3	28.9	30.3	
Turbidity (NTU)		1.47	1.72	2.71	2.05	2.71	
TSS (mg/l)	<50	<5	<5	<5	<5	<5	
BOD_5 (mg/l)	<30	<6	7.47	<6	<6	<6	
COD (mg/l)	<125	<25	<25	<25	<25	29.4	
NH_3-N (mg/l)	<10.0	9.5	4.9	6.4	4.2	6.5	
Total Nitrogen (mg/l)	<10.0	19	15.7	10.4	11.5	20.4	
Total Phosphorus (mg/l)	<2	1.2	1.06	0.62	0.52	0.59	
Oil & Grease (mg/l)	<10.0	<1		<1		<1	
Total coliform (MPN/100ml)	<400	350	240	170	0	16,000	
Faecal Coliform (MPN/100ml)	<400	130	22	79	0	540	
Effluent Discharge Volume (L/mn)			12	5	12	5	
Chlorination Dosing Rate (ml/mn)		n/a	n/a	115	260	115	
Residual Chlorine (mg/l)	<1.0	n/a	n/a	0.32	0.25	0.32	

	Site Name	V&K Camp		HM Main Camp		ESD Camp		Main Powerhouse	
	Station Code	EF10		EF13		EF14		EF19	
	Date	03-Oct-19	17-Oct-19	03-Oct-19	17-Oct-19	03-Oct-19	04-Oct-19	16-Oct-19	
Parameters (Unit)	**Guideline**								
pH	6.0 - 9.0	6.72	6.19	6.92	7.08	6.91	7.32	8.15	
Sat. DO (%)		91.8	92.6	59	42.8	26.6	42.6	21.9	
DO (mg/l)		6.95	7.19	4.39	3.25	1.93	3.26	1.58	

	Site Name	V&K Camp		HM Main Camp		ESD Camp		Main Powerhouse	
	Station Code	EF10		EF13		EF14		EF19	
	Date	03-Oct-19	17-Oct-19	03-Oct-19	17-Oct-19	03-Oct-19	04-Oct-19	16-Oct-19	
Parameters (Unit)	**Guideline**								
Conductivity (µs/cm)		260	322	551	569	469	762	1337	
TDS (mg/l)		130	161	275.5	284.5	234.5	381	668.5	
Temperature (°C)		28.3	26.8	29.2	28.2	30.7	27.8	32.72	
Turbidity (NTU)		3.62	5.42	36.75	37.15	7.87	1.03	5.53	
TSS (mg/l)	<50	5.8	9.0	25.1	33.3	18.6	56	18.1	
BOD5 (mg/l)	<30	<6	<6	33	<6	19.74	<6	<6	
COD (mg/l)	<125	<25	30	128	63.2	36.5	53.6	55.8	
NH3-N (mg/l)	<10.0	<2	<2	14.5	17.9	14.9	20	44.4	
Total Nitrogen (mg/l)	<10.0	6.02	0.84	21.3	22.2	22.5	23.8	53.2	
Total Phosphorus (mg/l)	<2	0.13	0.24	1.24	1.62	1.46	1.93	5.4	
Oil & Grease (mg/l)	<10.0	<1		5		<1		<2	
Total coliform (MPN/100ml)	<400	1,600	0	33	0	16,000	0	0	
Faecal Coliform (MPN/100ml)	<400	220	0	5	0	1,400	0	0	
Effluent Discharge Volume (L/mn)		3	0.5	5	6	3	3.6	1800	
Chlorination Dosing Rate (ml/mn)		20	27	6		0	1.8	500	
Residual Chlorine (mg/l)	<1.0	0.09	2.16	0.6	1.2	0.02	1.03	1	

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

	Site Name	Upstream Spoil Disposal Area No.2			
	Station Code	DS04 - US			
	Date	03-Oct-19	10-Oct-19	17-Oct-19	24-Oct-19
Parameter (Unit)	**Guideline**				
pH	6.0 - 9.0	6.9	7.62	7.18	6.96
Sat. DO (%)		97.5	98.1	101.1	84.1
DO (mg/L)		7.58	7.61	8.09	6.7
Conductivity (µs/cm)		10.72	10.7	12.31	14
TDS (mg/l)		5.36	5.35	6.1	7
Temperature (°C)		26.8	26.9	25.1	26.79
Turbidity (NTU)		2.33	1.39	2.1	1.67
TSS (mg/L)	<50	1.16	0.6	1.95	1.2
Oil & Grease (mg/L)	<10	<1			

	Site Name	Spoil Disposal Area No.2			
	Station Code	DS04			
	Date	03-Oct-19	10-Oct-19	17-Oct-19	24-Oct-19
Parameter (Unit)	**Guideline**				
pH	6.0 - 9.0	6.1	6.83	7.93	6.54
Sat. DO (%)		59.5	74.9	74.6	76.7
DO (mg/L)		4.7	5.87	5.94	6.23
Conductivity (µs/cm)		20.93	23.5	28.7	48
TDS (mg/l)		10.46	11.75	14.3	24
Temperature (°C)		25.9	26.3	26	26.02
Turbidity (NTU)		6.68	3.88	4.44	3.39
TSS (mg/L)	<50	6.16	3.2	3.8	3.4
Oil & Grease (mg/L)	<10	<1			

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	07-Oct-19 18:00	08-Oct-19 18:01	09-Oct-19 18:01
End Time	08-Oct-19 18:00	09-Oct-19 18:00	10-Oct-19 18:00
Average Data Record in 24h (mg/m^3)	0.054	0.033	0.024
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	21-Oct-19 18:00	22-Oct-19 18:01	23-Oct-19 18:01
End Time	22-Oct-19 18:00	23-Oct-19 18:00	24-Oct-19 18:00
Average Data Record in 24h (mg/m^3)	0.068	0.071	0.073
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 OCTOBER 2019

Song Da5 Camp No.2 - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	01-Oct-19 18:00
End Time	02-Oct-19 18:00
Average Data Record in 24h (mg/m3)	0.079
Guideline Average in 24h (mg/m3)	***0.12***

Lilama10 Camp - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	28-Oct-19 18:00
End Time	29-Oct-19 18:00
Average Data Record in 24h (mg/m3)	0.027
Guideline Average in 24h (mg/m3)	***0.12***

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

Main Dam - Dust Emission Average in 24 hours	
Period	**24 Hours**
Start Time	**30-Oct-19 18:00**
End Time	**31-Oct-19 18:00**
Average Data Record (mg/m^3) -24h	**0.028**
Guideline Average (mg/m^3) - 24h	***0.12***

Main Powerhouse - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	02-Oct-19 18:30
End Time	03-Oct-19 18:00
Average Data Record in 24h (mg/m3)	0.017
Guideline Average in 24h (mg/m3)	***0.12***