

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

December 2020




					
A	10 January 2021	Hendra WINASTU	Wanidaporn RODE	Khamlar PHONSAVAT	Final
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TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	7
1 ENVIRONMENTAL MANAGEMENT MONITORING	9
1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)	9
1.2 COMPLIANCE MANAGEMENT	10
1.2.1 Site Inspection by the Environment Management Unit	12
1.2.2 Site Decommissioning and Rehabilitation	12
1.3 ENVIRONMENTAL QUALITY MONITORING.....	13
1.3.1 Effluent Discharge from Camps and Construction Sites	13
1.3.2 Ambient Surface Water Quality Monitoring.....	14
1.3.3 Groundwater Quality Monitoring.....	18
1.3.4 Gravity Fed Water Supply (GFWS) Quality Monitoring	19
1.3.5 Landfill Leachate Monitoring.....	20
1.4 DISCHARGE MONITORING	21
1.4.1 Main Reservoir – Water Level, Inflow and Discharge.....	21
1.4.2 Re-regulation Reservoir – Discharge	22
1.4.3 Nam Ngiep Downstream Water Depth Monitoring	23
1.5 PROJECT WASTE MANAGEMENT	23
1.5.1 Solid Waste Management	23
1.5.2 Hazardous Materials and Waste Management	24
1.6 COMMUNITY WASTE MANAGEMENT	25
1.6.1 Community Recycling Programme	25
1.6.2 Community Solid Waste Management.....	25
2 WATERSHED AND BIODIVERSITY MANAGEMENT	26
2.1 WATERSHED MANAGEMENT	26
2.1.1 Implementation of Annual Implementation Plan (AIP) 2020	26
2.1.2 Preparation of Annual Implementation Plan (AIP) 2021.....	27
2.2 BIODIVERSITY OFFSET MANAGEMENT.....	27
2.2.1 Engagement of Biodiversity Service Provider (BSP).....	27
2.2.2 Implementation of BOMP Annual Implementation Plan (AIP) 2019 and 2020.....	27
2.2.3 BOMP Annual Implementation Plan (AIP) 2021	31
3 FLOATING DEBRIS REMOVAL.....	31
4 FISHERY MONITORING.....	31

ANNEX A: RESULTS OF WATER QUALITY MONITORING	37
ANNEX B: RESULTS OF EFFLUENT ANALYSES.....	48

TABLE OF TABLES

TABLE 1-1: ENVIRONMENTAL MANAGEMENT SYSTEM WORK PLAN.....	9
TABLE 1-2: SS-ESMMP AND DOCUMENT REVIEW STATUS IN DECEMBER 2020	10
TABLE 1-3: SUMMARY OF ONCS AND NCRS	10
TABLE 1-4: SUMMARY OF THE ONCS AND NCRS THAT ARE UNSOLVED AND EXCEEDING DEADLINES	11
TABLE 1-5: STATUS OF CORRECTIVE ACTIONS FOR NON-COMPLIANCES AT WWTSS IN DECEMBER 2020	13
TABLE 1-6: RESULTS OF SURFACE WATER QUALITY MONITORING FOR DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M, NATIONAL WATER QUALITY STANDARD: >6.0 MG/L	17
TABLE 1-7: RESULTS OF SURFACE WATER QUALITY MONITORING FOR TOTAL SUSPENDED SOLIDS (MG/L).....	17
TABLE 1-8: RESULTS OF SURFACE WATER QUALITY MONITORING FOR BOD ₅ (MG/L) - WATER QUALITY STANDARD: < 1.5 MG/L	18
TABLE 1-9: GROUNDWATER QUALITY MONITORING RESULTS IN SOMSUEN, NAM PA, THONGNOY AND POU VILLAGES.....	19
TABLE 1-10: RESULTS OF THE GRAVITY FED WATER SUPPLY QUALITY MONITORING	20
TABLE 1-11: RESULTS OF THE LANDFILL LEACHATE MONITORING	20
TABLE 1-12: AMOUNTS OF RECYCLABLE WASTE SOLD	24
TABLE 1-13: RECORD OF HAZARDOUS MATERIAL INVENTORY	24
TABLE 1-14: RECORD OF HAZARDOUS WASTE INVENTORY	24
TABLE 1-15: TYPES AND AMOUNTS OF RECYCLABLE WASTE TRADED AT THE COMMUNITY RECYCLE WASTE BANK	25
TABLE 4-1: FISH SPECIES DOMINATING THE FISH CATCH IN NOVEMBER 2020	31
TABLE 4-2: THREATENED SPECIES OF NOVEMBER 2020 FISH CATCH.....	32
TABLE 4-3: TOTAL FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS FOR THE MONTH OF NOVEMBER FROM 2015 TO 2020.....	32
TABLE 4-4: MEDIAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR FOR THE MONTH OF NOVEMBER FROM 2015 TO 2020	34
TABLE 4-5: MEDIAN DAILY FISH CATCH PER HOUSEHOLD FOR THE MONTH OF NOVEMBER FROM 2015 TO 2020	35

TABLE OF FIGURES

FIGURE 1-1: REVEGETATION AND DEFECT CORRECTIONS.....	13
FIGURE 1-2: SURFACE WATER AND RE-REGULATION RESERVOIR WATER QUALITY MONITORING STATIONS	16
FIGURE 1-3: CONCENTRATION OF DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M SINCE SEPTEMBER 2019 TO DECEMBER 2020.....	17
FIGURE 1-4: WATER LEVEL, INFLOW AND DISCHARGE FOR THE MAIN RESERVOIR.....	22
FIGURE 1-5: DISCHARGE MONITORING AT THE RE-REGULATION DAM IN SEPTEMBER TO DECEMBER 2020	23
FIGURE 1-6: WASTE MANAGEMENT ACTIVITIES DURING DECEMBER 2020	26
FIGURE 2-1: MAP OF THREATS RECORDED BY PATROLLING TEAMS IN NOVEMBER 2020	29
FIGURE 2-2: HUNTING CAMP FOUND AND DESTROYED BY TEAM 1 AT NAM HOUNG	29
FIGURE 2-3: FISHING CAMP FOUND AND DESTROYED BY TEAM 1 AT NAM HOUNG	29
FIGURE 2-4: HUNTING CAMP FOUND BY TEAM 2 AT EASTERN OF NAM SONE	30
FIGURE 2-5: CARCASS OF INDOCHINESE SEROW FOUND BY TEAM 2 AT NAM SONE	30
FIGURE 4-1: TOTAL MONTHLY FISH CATCH JULY 2015 – NOVEMBER 2020	32
FIGURE 4-2: TOTAL FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS FOR THE MONTH OF NOVEMBER FROM 2015 TO 2020.....	33
FIGURE 4-3: NUMBER OF FISHING HOUSEHOLDS INVOLVED IN THE FISH CATCH MONITORING PROGRAMME.....	33
FIGURE 4-4: MEDIAN MONTHLY HOUSEHOLD FISH CATCH WITHOUT ZONE 2LR.....	34
FIGURE 4-5: MEDIAN DAILY FISH CATCH PER HOUSEHOLD.....	35

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
EC OCD	EGAT Construction Obligation Commencement Date
EDL	Electricite du Laos
EDL PPA	Power Purchase Agreement between NNP1PC and EDL
EGAT	Electricity Generating Authority of Thailand
EGATi	EGAT International Company Limited
EIA	Environmental Impact Assessment
EMMR	Environmental Management and Monitoring Reports
EMO	Environmental Management Office of ESD within NNP1PC
EMU	Environmental Monitoring Unit
EMWC	Electrical-Mechanical Works Contract
EPF	Environmental Protection Fund

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

NTFP	Non-Timber Forest Products
NT2	Nam Theun 2 Hydropower Project
OC	Obayashi Corporation
ONC	Observation of Non-Compliance
PAFO	Provincial Department of Agriculture and Forestry
PAP	Project Affected People
PD	Property Damage
PONRE	Provincial Department of Natural Resource and Environment, MONRE
PPA	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

A joint ADB and IAP virtual mission were conducted during 07 to 11 December 2020 and the work progress of NNP1PC Environmental Management Office (EMO) was shared during the mission. The queries raised by ADB were addressed and EMO is preparing additional data and explanations in response to some of the issues.

Since the service contract with SGS (Lao) Sole Co., Ltd. was signed in November 2020 for ISO 14001:2015 training and certification audit, three ISO training modules were completed: (i) Requirements and Interpretation of ISO14001:2015 (21 participants); (ii) Organization Context and Risk Assessment; and (iii) Documented Information (25 participants including one staff from EGATi).

During December 2020, no documents were submitted to EMO for review and approval.

A total of 32 revegetation sites were continually monitored in December 2020. The percentage of vegetation cover has been maintained but as would be expected in the dry season, the green cover has decreased compared with the previous months.

The bidding process for wastewater treatment systems (WWTSS) improvement and modification was started by public advertising for interested bidders on 17 December 2020 and a pre-bidding meeting including site visit attended by three interested bidders was organized on 24 December 2020 at NNP1PC Site Office and Village (OSO1). The deadline for submission of proposals was scheduled on 15 January 2021 and the selection process is expected to be completed by the end of January 2021. The consultancy contract of the wastewater treatment expert expired on 31 December 2020 and will be extended until the end of June 2021 to provide technical support during the construction and commissioning of the Sequencing Batch Reactor system (SBR) in OSO2 in Q1 - Q2 2021.

During the month, Dissolved Oxygen (DO) levels at the surface of the main reservoir were generally between 4 and 9 mg/L. In the re-regulation reservoir, the DO levels were below 5 mg/L which was slightly higher than last month.

The discharge from the re-regulation dam mainly went through the turbine and occasionally combination of gate and turbine. The DO levels were less than 6 mg/L at the stations in Nam Ngiep immediately downstream of the Re-regulation Dam and thus were non-compliant with the GOL Standard. No dead fish was observed in Nam Ngiep downstream during this monitoring period. NNP1PC is in the process of collecting information to assist in developing measures to improve the DO levels downstream.

A total of 17.6 m³ of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 0.2 m³ compared with November 2020. A total of 14.6 m³ of solid waste from Phouhomxay, Thaheua and Hat Gniun Villages was disposed of at Houay Soup Landfill. No recycle waste trade activities in the community waste bank during the reporting period.

Bolikhamxay Provincial WRPO commenced forest patrolling between 21-30 December 2020 while the reservoir patrolling will resume after the boat engine is fixed by the supplier. The fund under the approved AIP2020 of Xaysomboun provincial WRPO totalling 1,633,492,000 LAK was transferred to DOF-MAF on 18 December 2020. NNP1PC-EMO handed over the SMART system

equipment to Xaysomboun Provincial WRPO on 10 December 2020 while the handover to Bolikhamxay Provincial WRPO is scheduled in January 2021.

Biodiversity offset related activities under the components of law enforcement and conservation linked livelihood continued in December 2020.

The fish catch monitoring for November 2020 in Nam Ngiep watershed was dominated by *Channa striata* and *Clarias batrachus* and species groups of Hampala, Poropuntius and Barbonymus and Hypsibarbus that are classified as Least Concern (LC) according to the IUCN Red List.

1 ENVIRONMENTAL MANAGEMENT MONITORING

1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

Since the service contract with SGS (Lao) Sole Co., Ltd. was signed for ISO 14001:2015 training and certification audit, three ISO training modules were completed. A training on Requirements and Interpretation of ISO14001:2015 for 21 NNP1PC staff was conducted on 30 November and 01 December 2020 (2 days). Another two trainings on Organization Context and Risk Assessment (1 day) and Documented Information (2 days) for 24 NNP1PC staffs and one EGAT staff were conducted on 21-23 December 2020. An ISO14001:2015 Internal Audit is scheduled on February 2021.

Table 1-1: Environmental Management System Work Plan

Item	ISO14001:2015 Work Plan	Year 2020		Year 2021			
		Q3	Q4	Q1	Q2	Q3	Q4
1	Continue to prepare EMS documents (8 Standard Operating Procedures are completed)						
2	NNP1PC Environmental Policy announcement						
3	NNP1PC ISO Committee establishment						
4	Training relevant staff on: - Requirement and Interpretation of ISO14001:2015 - Organization Context and Risk Management for ISO14001 - ISO14001:2015 Document Information - ISO14001:2015 Internal Audit						
5	Implement the EMS procedures and processes						
6	ISO14001:2015 Internal Audit						
7	Implement the corrective actions and preventive actions according to the Internal Audit						
8	Management Review by NNP1PC Management						
9	ISO 14001:2015 Assessment and Certification Audit – 1st Stage (remote audit on the documentation review)						
10	Implement the corrective actions and preventive actions according to the 1 st Stage Audit						
11	ISO 14001:2015 Assessment and Certification Audit – 2nd Stage (on-site audit)						
12	Implement the corrective actions and preventive actions according to the 2 nd Stage Audit						
13	Certify of ISO14001:2015 upon successful completion of the audit						

1.2 COMPLIANCE MANAGEMENT

In December 2020, Environmental Management Office (EMO) of NNP1PC received no documents for review and approval. However, there are two pending Detail Work Program and Site-Specific Environmental Monitoring and Management Plans to be resubmitted by the contractor after NNP1PC EMO reviewed the 2nd submission documents with no objection with comments. The status of document reviews is presented in **Table 1-2**.

TABLE 1-2: SS-ESMMP AND DOCUMENT REVIEW STATUS IN DECEMBER 2020

Title	Date Received	Status
DWP and SS-ESMMP for Geotechnical Investigation at the Main Dam Downstream Right Bank Slope Area	30 October 2020 (2 nd submission)	No objection with comments on 04 November 2020. <i>Pending resubmission from the contractor.</i>
DWP and SS-ESMMP for Construction of Suspension Bridge in 2UR	25 November 2020 (2 nd submission)	No objection with comments on 26 November 2020 for the SS-ESMMP part. <i>Pending resubmission from the contractor.</i>

There was one Observations of Non-Compliance issued during December 2020. The status of compliance reports (Observation of Non-Compliance or ONC, Non-Compliance Report or NCR) issued by NNP1PC is summarized in **Table 1-3** and the status of the ONCs and NCRs that are unsolved exceeding deadlines are presented in

Table 1-4.

TABLE 1-3: SUMMARY OF ONCs AND NCRs

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from November2020	2	2	0	0
Newly Opened in December 2020	1	0	0	0
Total in December 2020	3	2	0	0
Resolved in December 2020	0	0	0	0
Carried over to January 2021	3	2	0	0

Unsolved Exceeding Deadlines	2	2	0	0
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TABLE 1-4: SUMMARY OF THE ONCS AND NCRs THAT ARE UNSOLVED AND EXCEEDING DEADLINES

Document Number/ Date of Issue	Subject Description	Current Status at the end of November 2020
ONC_AM-0003 / 28 Feb 2020	<p>Issued to ADM to improve the second wetland pond similarly to the first wetland pond.</p> <p>(Based on the LTA's recommendation made during the mission in August 2019 to improve the OSOV's WWTS)</p>	<p>NNP1PC and the WWTS Consultant have completed the conceptual report and proposal for WWTS improvement for management review and approval.</p> <p>The bidding process for wastewater treatment systems (WWTSs) improvement and modification was started by public advertising seeking interested bidders on 17 December 2020 and a pre-bidding meeting including site visit attended by three interested bidders was organized on 24 December 2020 at NNP1PC Site Office and Village (OSOV1. The deadline for submission of proposal was scheduled on 15 January 2021 and the selection process is expected to be completed by the end of January 2021.</p>
ONC_OC-0349 / 24 Mar 2020	Instructed the OC Contractor to use only the approved tree species for revegetation and dead plant replacement.	<p>The contractor is continuing routine inspection combined with revegetation and maintenance of perimeter fence as necessary.</p> <p><i>The ONC will be closed by the end of the contractor's liability period (January 2021).</i></p>

Document Number/ Date of Issue	Subject Description	Current Status at the end of November 2020
NNP1-ESD-EMO-NCR-VSP-0001 / 13 Jul 2020 (NCR Level 1)	Non-Compliance with site rehabilitation at the Spoil Disposal Area for the construction of the irrigation canal	The site was partially covered with a thin green of sown RUZI grass seed germination. <i>The NCR1 will be closed when the revegetation has been successfully completed.</i>
NNP1-ESD-EMO-NCR-HM-0007 / 06 Apr 2020 (NCR Level 1)	Non-Compliance with the site revegetation requirements at HM Hydro's Labour Camp No.2 (LILAMA10 Camp).	The corrective action was completed on 08 September 2020 by HM Hydro Contractor. This revegetated site was monitored by NNP1-EMO until the end of the rainy season 2020. The first joint site inspection and evaluation of the revegetation will be conducted three months after completion of the re-vegetation. <i>The NCR1 will be closed when the revegetation has been successfully completed.</i>

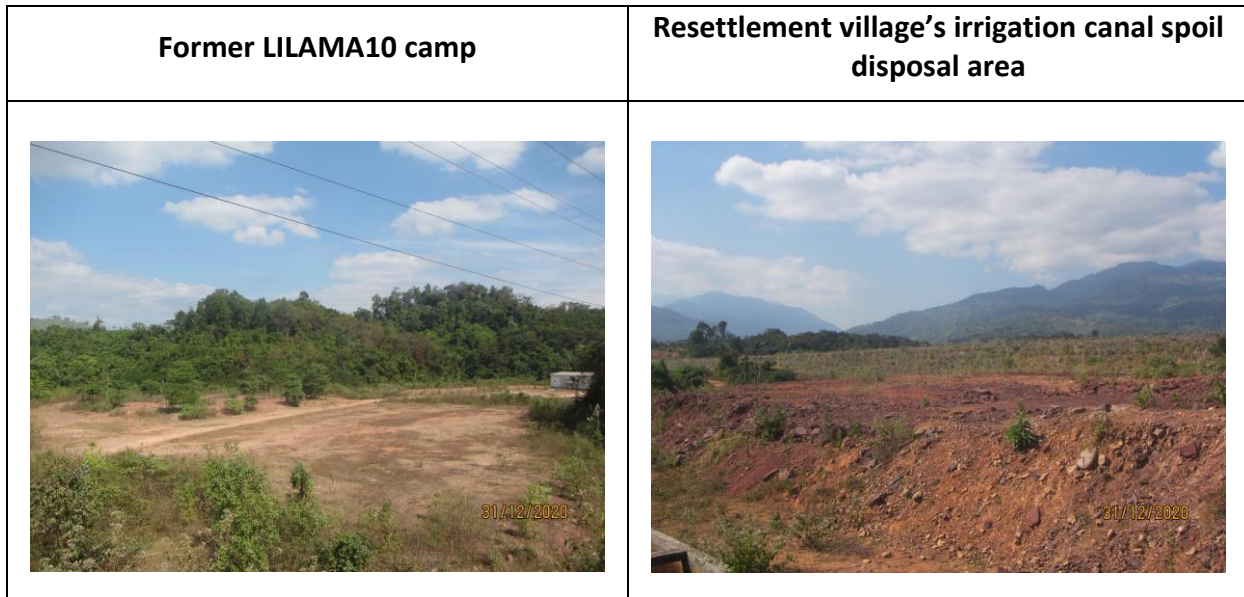
1.2.1 Site Inspection by the Environment Management Unit

The monthly site visit by the Bolikhan District EMU (Bolikhamxay Province) and the quarterly mission of EMU Xaysomboun Province were not carried out in December 2020.

1.2.2 Site Decommissioning and Rehabilitation

During December 2020, EMO continually monitored the revegetated sites for grass seed germination and vegetation cover as well as site stability. The percentage of vegetation-cover has generally been maintained at 23 out of a total of 32 sites, but as would be expected in the dry season, the green cover has decreased compared with the previous months due to no rain during the dry season.

Overall, it is assessed that the percentage of revegetation coverage meets expectations for 30 sites out of a total of 32 decommissioned and rehabilitated sites. The two sites that still do not meet the targets are the former LILAMA10 camp and the Phouhomxay Resettlement Village's Irrigation Canal Spoil Disposal Area. These two sites were newly re-vegetated during the latter part of the 2020 wet season. The current status of revegetation is shown in **FIGURE 1-1**.

Figure 1-1: Revegetation and Defect Corrections

1.3 ENVIRONMENTAL QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD₅), Faecal Coliform Bacteria, Total Coliform Bacteria and E. coli 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/>.

1.3.1 Effluent Discharge from Camps and Construction Sites

Detailed monitoring results are provided in the **Annex B** of this Report. The monitoring results for the camp effluents in December 2020 indicate non-compliances for some parameters in OSOV2 (EF13) and the Main Powerhouse (EF19).

The status of implementation of the corrective actions addressing non-compliances at the camps and key project facilities are summarized in **Table 1-5**.

Table 1-5: Status of Corrective Actions for Non-Compliances at WWTSSs in December 2020

Site	Sampling ID	Status	Corrective Actions
OSOV1	EF01	Fully compliance	The design of the WWTSSs improvement and modification at OSOV2 and the Main
OSOV2	EF13	Non-compliance for Ammonia-Nitrogen and	

Site	Sampling ID	Status	Corrective Actions
		Total nitrogen in second fortnightly sampling.	Powerhouse has been completed and the tender for the construction work is ongoing. The modification work is expected to be completed and fully operated within Q2 2021.
Main Powerhouse	EF19	Non-compliance for TSS (first fortnightly sampling), Ammonia Nitrogen, Total Nitrogen and Total Phosphorus.	

1.3.2 Ambient Surface Water Quality Monitoring

The ambient surface water quality monitoring programme comprises five monitoring stations in the main reservoir (R01-R05), two stations in the Re-regulation reservoir (R06 and R07), 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 undertaken since 18 September 2018 for stations located in the Re-regulation and main reservoirs. The locations of the monitoring stations are shown in **FIGURE 1-2**.

The monitoring results for key parameters (DO, TSS and BOD₅) during December 2020 are presented in **Table 1-6**, **Table 1-7** and **Table 1-8**. The full set of data for December 2020 is attached in **Annex A**. In addition, the results for DO are presented as line graphs in **Figure 1-3**.

Main Reservoir

From 01 to 31 December 2020, the water level in the main reservoir decreased from El. 314.09 m asl to El. 312.55 m asl.

Thermal stratification, oxycline and anoxic condition were observed in the main reservoir at all stations except R01 at the upstream end of the reservoir where the reservoir behaves more like a river than a lake and therefore does not exhibit thermal stratification. In general, over the course of the month, the thermocline deepened causing the oxycline to deepen correspondingly.

At R05, during December 2020, the DO level in the upper 20 m was generally between 4 and 6 mg/L, and an oxycline had formed at a depth between 28 and 34 m corresponding to El. 279 m asl to 292 m asl with DO levels less than 3 mg/L immediately below the oxycline gradually decreasing to less than 0.5 mg/L (anoxic condition) at depths of 36 m to bottom.

At R04, the DO level in the upper 18 m was generally between 4 and 6 mg/L and an oxycline occurred in the depth between 19 and 30 m with anoxic conditions in the entire water column below 45 m.

The DO level at R03 was recorded between 4 and 9 mg/L in the upper 12 m and fluctuated at depths of about 13 m to bottom, with a peak showing DO levels of 3 to 4 mg/L appearing at depth between 32 and 40 m. This is thought to be due to inflow from the right bank tributary, Nam

Phouan where the DO rich water at this time of year is about 5°C colder than in the upper layers of the reservoir and therefore would create a deep flow-path with higher DO levels than in the immediate overlying water.

At R02, the DO concentrations in the entire water column fluctuated between 3 and 6 mg/L, except on 02 December 2020 at the depths between 13 and 16 m where anoxic conditions were recorded.

At R01, similar to previous month, the DO levels were generally between 5.7 and 9.2 mg/L in the entire water column.

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 with the high flow season means of about 100 – 250 mg/L and low flow season means of 20 - 50 mg/L.

The BOD₅ measurements at R03, R04 and R05 in the epilimnion were less than 1 mg/L, but in the hypolimnion, BOD₅ was recorded at less than 1 mg/L (2.5 m above the bottom level), 7.41 mg/L (2.5 m above the bottom level) and 6.09 mg/L (at a depth 100 m) respectively.

Re-regulation Reservoir

In December 2020, the turbine discharges from the main powerhouse varied between 27 and 240 m³/s usually interrupted by night-time periods with no discharge.

The DO measurements at R06 and R07 representing turbine discharges from the main dam generally had DO concentrations below 4.5 mg/L in the entire water column.

The BOD₅ concentrations in R06 and R07 were 1.74 mg/L and 1.18 mg/L respectively.

Downstream

During December 2020, the discharge from the re-regulation dam mainly went through the turbine and occasionally combined with discharge through the gate. The DO levels were less than 6 mg/L at the stations in Nam Ngiep immediately downstream of the Re-regulation Dam and thus were non-compliant with the GOL Standard. No dead fish was observed in Nam Ngiep downstream during this monitoring period. NNP1PC is in the process of collecting information to assist in developing measures to improve the DO levels downstream.

The BOD₅ in the downstream station (NNG05) was less than 1 mg/L and complied with the national surface water quality standard.

Figure 1-2: Surface Water and Re-Regulation Reservoir Water Quality Monitoring Stations

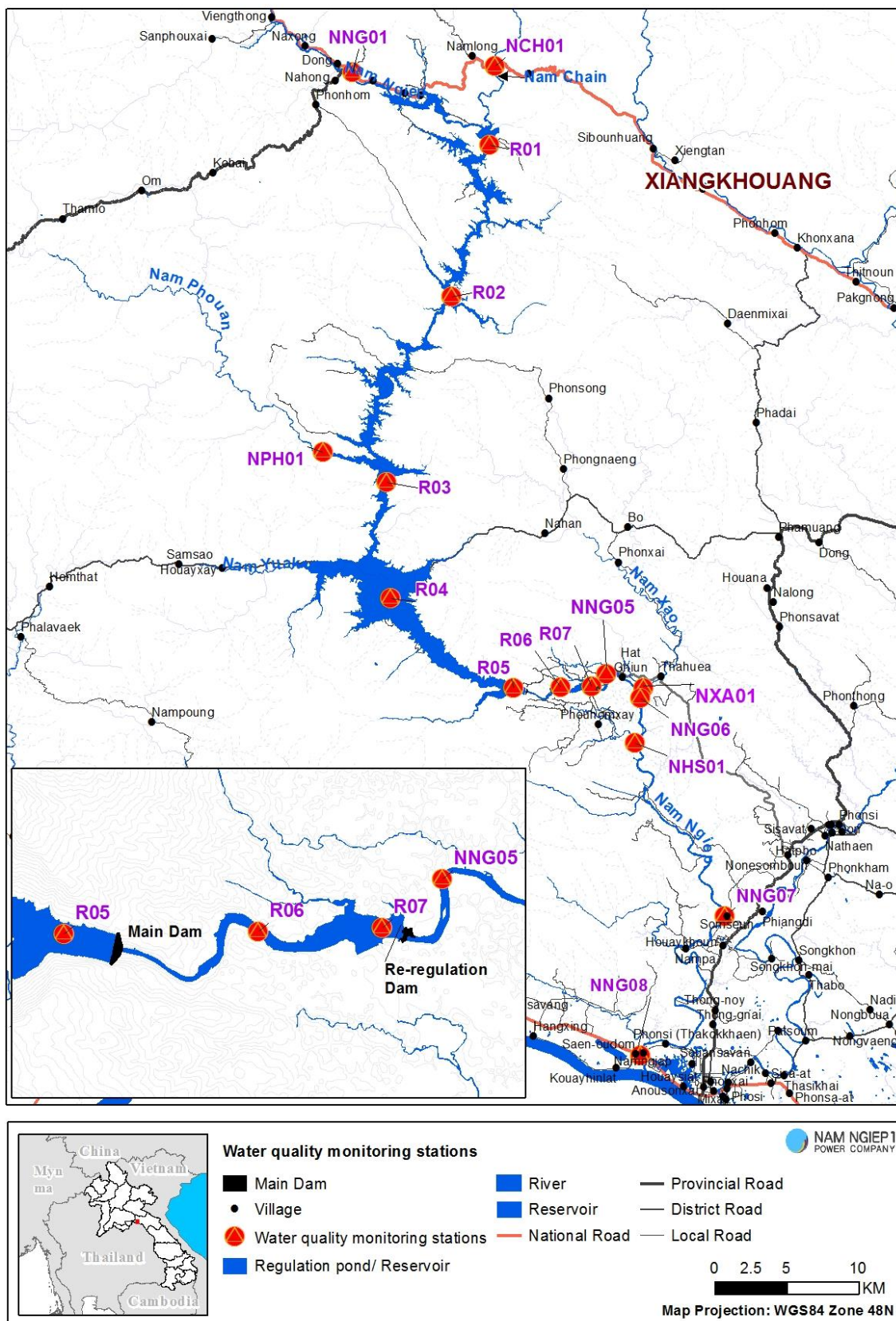


Figure 1-3: Concentration of Dissolved Oxygen (mg/L) in the upper 0.2 m since September 2019 to December 2020

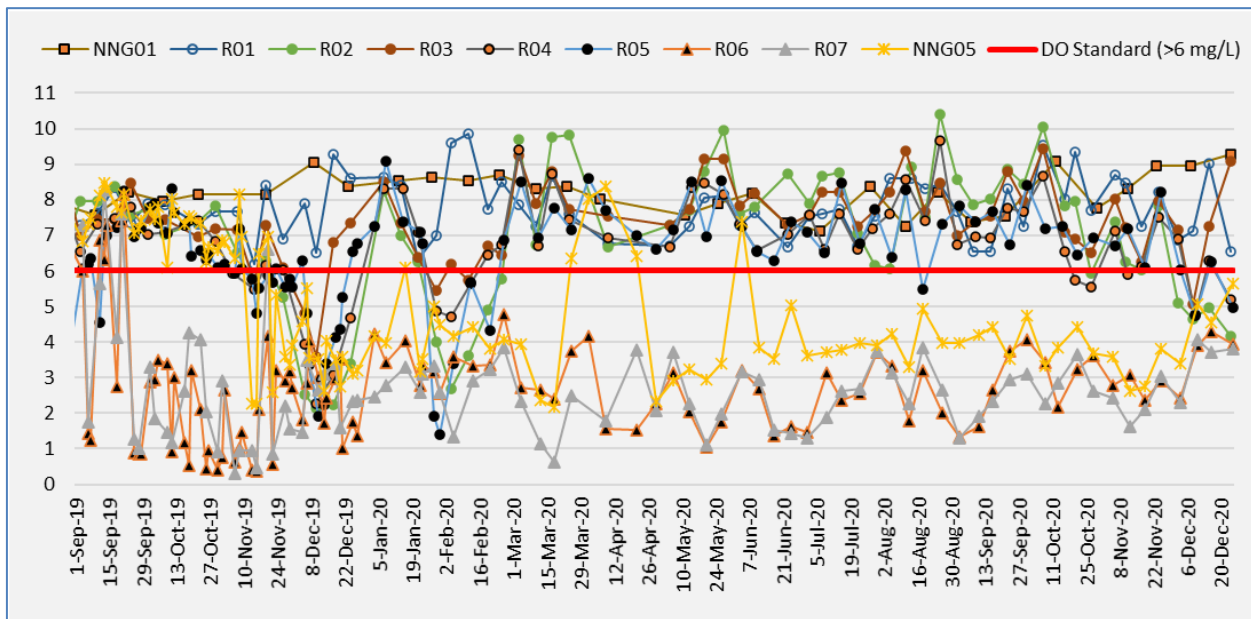


Table 1-6: Results of Surface Water Quality Monitoring for Dissolved Oxygen (mg/L) in the upper 0.2 m, National Water Quality Standard: >6.0 mg/L

DO (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
2-Dec-20		6.87	5.11	7.15	6.9											
3-Dec-20						6.02	2.42	2.29	3.38	4.01	6.11	6.57			7.25	7.33
7-Dec-20	8.96												8.52			
8-Dec-20		7.11	4.64	5.06										9.34		
9-Dec-20					4.78	4.76										
10-Dec-20							3.91	4.07	5.08	5.19	6.52	6.73			8.3	7.98
15-Dec-20		9.01	4.96	7.25	6.28											
16-Dec-20						6.27	4.31	3.7	4.55	4.91	6.41	7.48			8.19	8.71
24-Dec-20	9.29	6.54	4.17	9.1	5.18								9.26			
25-Dec-20						4.98	3.93	3.82	5.63	5.77	6.47	6.8			6.26	6.7

Table 1-7: Results of Surface Water Quality Monitoring for Total Suspended Solids (mg/L)

Total Suspended Solids (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
7-Dec-20	<5												<5			
8-Dec-20		<5		<5										<5		
8-Dec-20 Hypolimnion				28.57												

Total Suspended Solids (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
9-Dec-20					<5	<5									<5	<5
9-Dec-20 Hypolimnion					23.65	11.01										
10-Dec-20							<5	<5	<5	<5	<5	6.2				

Table 1-8: Results of Surface Water Quality Monitoring for BOD₅ (mg/L) - Water Quality
Standard: < 1.5 mg/L

BOD ₅ (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
7-Dec-20	1.14												1.12			
8-Dec-20		<1		<1										<1		
8-Dec-20 Hypolimnion				<1												
9-Dec-20					<1	<1										
9-Dec-20 Hypolimnion					7.41	6.09										
10-Dec-20							1.74	1.18	<1	<1	<1	<1			<1	<1

1.3.3 Groundwater Quality Monitoring

During December 2020, community groundwater quality analyses were carried out for six wells located in Somseun Village, Nam Pa Village, Thong Noy Village, Pou Village and Phouhomxay Village. The community groundwater samples were taken from households' water taps.

The results indicate that two newly installed wells in Phouhomxay Village, one well in Somsuen and one well in Pou Village comply fully with the groundwater quality standards.

Faecal Coliform and *E. coli* Bacteria are still present in the well of Thong Noy Village. The villagers were advised to boil water before drinking. This advice is in accordance with the Law on Hygiene, Disease Prevention and Health Promotion No 01/NA of 10 April 2001, which states that domestic water supply for daily use is not required to be readily drinkable but would normally have to be boiled or otherwise treated before it would be suitable for drinking. The villagers generally use tap water for washing and cleaning. They were informed about the monitoring results and recommended to carry out the operation and maintenance improvement as well as were encouraged to boil water before drinking. The groundwater quality monitoring results are presented in **TABLE 1-9**.

Table 1-9: Groundwater Quality Monitoring Results in Somsuen, Nam Pa, Thongnoy and Pou Villages

	Site Name	Phouhomxay Village		Somseun Village	Nampa Village	Thongnoy Village	Pou Village
Parameter (Unit)	Station	GPHX01	GPHX02	GSXN01	GNPA01	GTHN01	GPOU01
	Guideline						
pH	6.5 - 9.2	7.33	7.4	7.5	7.64	7.55	7.96
Sat. DO (%)		48.7	29.6	58.9	95.8	43.5	85.5
DO (mg/L)		4.08	2.53	4.69	7.56	3.44	6.96
Conductivity (µS/cm)		199	407	229	296	274	17.84
Temperature (°C)		24.73	23.6	25.8	26.3	26.2	23.9
Turbidity (NTU)	<20	3.2	1.59	1.42	1.65	1.34	2.84
Fecal Coliform (MPN/100mL)	0	0	0	0	0	540	0
E. coli (MPN/100mL)	0	0	0	0	0	540	0

1.3.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

Surface water from Houay Soup Stream is no longer used as water supply source for Phouhomxay Village since the two new groundwater boreholes (*GPHX01 and GPHX02* - **TABLE 1-9**) were connected to the existing water supply tanks on 21 October 2020, and as mentioned in Section 1.3.3, these groundwater samples complied with the GOL Drinking Water Standards for all parameters.

The results of the water supply quality analyses are presented in **TABLE 1-10**.

Faecal Coliform and *E. coli* exceeded the standards in the water supply of Phouhomxay (WPHX02 – primary school's water tap, and WPHX03 – household's water tap), Thaheua (WTHH02) and Hat Gnuin Villages (WHGN02). The root cause of bacterial contamination in Phouhomxay's water supply system will be investigated in January 2021. The villagers were advised to boil water before drinking. This advice is in accordance with the Law on Hygiene, Disease Prevention and Health Promotion No 01/NA of 10 April 2001, which states that domestic water supply for daily use is not required to be readily drinkable but would normally have to be boiled or otherwise treated before it would be suitable for drinking. The villagers generally use tap water for washing and cleaning. They were informed about the monitoring results and were encouraged to boil water before drinking.

Table 1-10: Results of the Gravity Fed Water Supply Quality Monitoring

	Site Name	Thaheua Village	Hat Gnuin Village	Phouhomxay Village (Groundwater Sources)	
	Station	WTHH02	WHGN02	WPHX02 – Primary School Water Tap	WPHX03 – Household Water Tap
Parameter (Unit)	Guideline				
pH	6.5 - 8.6	8.02	7.78	7.85	7.69
Sat. DO (%)		91.1	89.4	79.2	77.4
DO (mg/L)		7.82	7.79	6.74	6.56
Conductivity (µS/cm)	<1,000	55	97	117	99
Temperature (°C)	<35	23	22.18	23.5	23.66
Turbidity (NTU)	<10	1.75	2.26	1.42	1.56
Faecal Coliform (MPN/100 mL)	0	8	280	49	27
E. coli Bacteria (MPN/100 mL)	0	8	280	49	27

1.3.5 Landfill Leachate Monitoring

During December 2020, the landfill leachate monitoring was conducted at NNP1 Project Landfill (Last pond – LL4) and at Houay Soup Solid Waste Landfill (Last pond - LL6).

The results indicate that both NNP1 Project Landfill and Houay Soup Landfill fully complied with the standards. The landfill leachate monitoring results for December 2020 is presented in **Table 1-11**.

Table 1-11: Results of the Landfill Leachate Monitoring

	Site Name	NNP1 Landfill Leachate					Houay Soup Landfill	
	Location	Pond No.01	Pond No.02	Pond No.03	Pond No.04	Discharge Point	Last pond	Discharged Point
	Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline						
2-Dec-20	pH	6.0-9.0			8.76		8.74	
2-Dec-20	Sat. DO (%)				106.9		109.2	
2-Dec-20	DO (mg/L)				8.42		8.59	
2-Dec-20	Conductivity (µS/cm)				46.6		126.2	

		Site Name	NNP1 Landfill Leachate					Houay Soup Landfill	
		Location	Pond No.01	Pond No.02	Pond No.03	Pond No.04	Discharge Point	Last pond	Discharged Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
2-Dec-20	Temperature (°C)					26.3		26.3	
2-Dec-20	Turbidity (NTU)					4.02		21.24	
2-Dec-20	BOD5 (mg/L)	<30				<6		18	
2-Dec-20	COD (mg/L)	<125				36.1		67.8	
2-Dec-20	Faecal Coliform (MPN/100mL)	<400				0		4	
2-Dec-20	Total Coliform (MPN/100mL)	<400				23		17	
2-Dec-20	Total nitrogen (mg/L)	<10				0.81		1.06	
2-Dec-20	Lead (mg/L)	<0.2				<0.01		<0.01	
2-Dec-20	Copper (mg/L)					<0.006		<0.006	
2-Dec-20	Iron (mg/L)					0.118		1.16	
2-Dec-20	Ammonia nitrogen (mg/L)	<10				<2		<2	

1.4 DISCHARGE MONITORING

1.4.1 Main Reservoir – Water Level, Inflow and Discharge

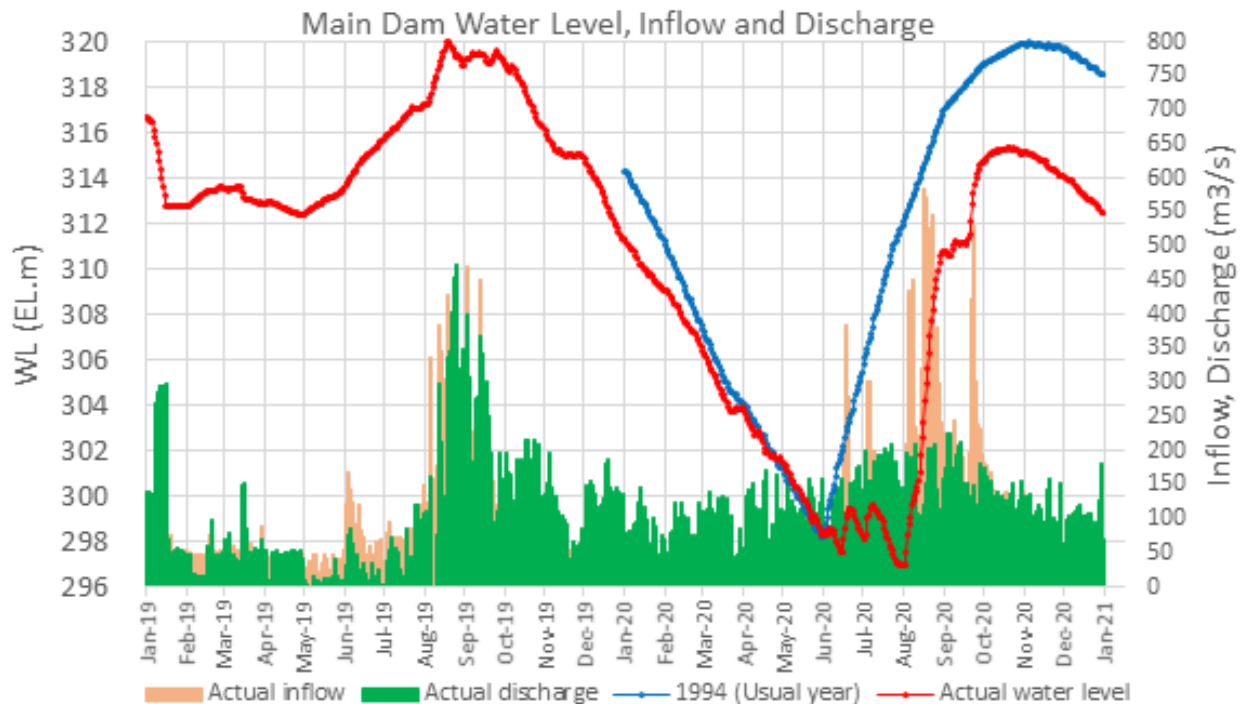
The water level in the main reservoir, inflow to the reservoir and discharge from the reservoir have been monitored since the start of the impounding on 15 May 2018. The graph in

FIGURE 1-4 presents the values recorded since 01 January 2019.

During December 2020, the mean inflow to the main reservoir was 63 m³/s. The minimum and maximum inflows were 44 (on 21 December 2020) and 80 m³/s (on 11 December 2020) respectively.

From 01 to 31 December, the water level of the main reservoir slightly decreased by 1.54 m from El. 314.09 m asl to El. 312.55 m asl.

In December 2020, the turbine discharges from the Main Powerhouse varied between 27 and 240 m³/s usually interrupted by night-time periods with no discharge.

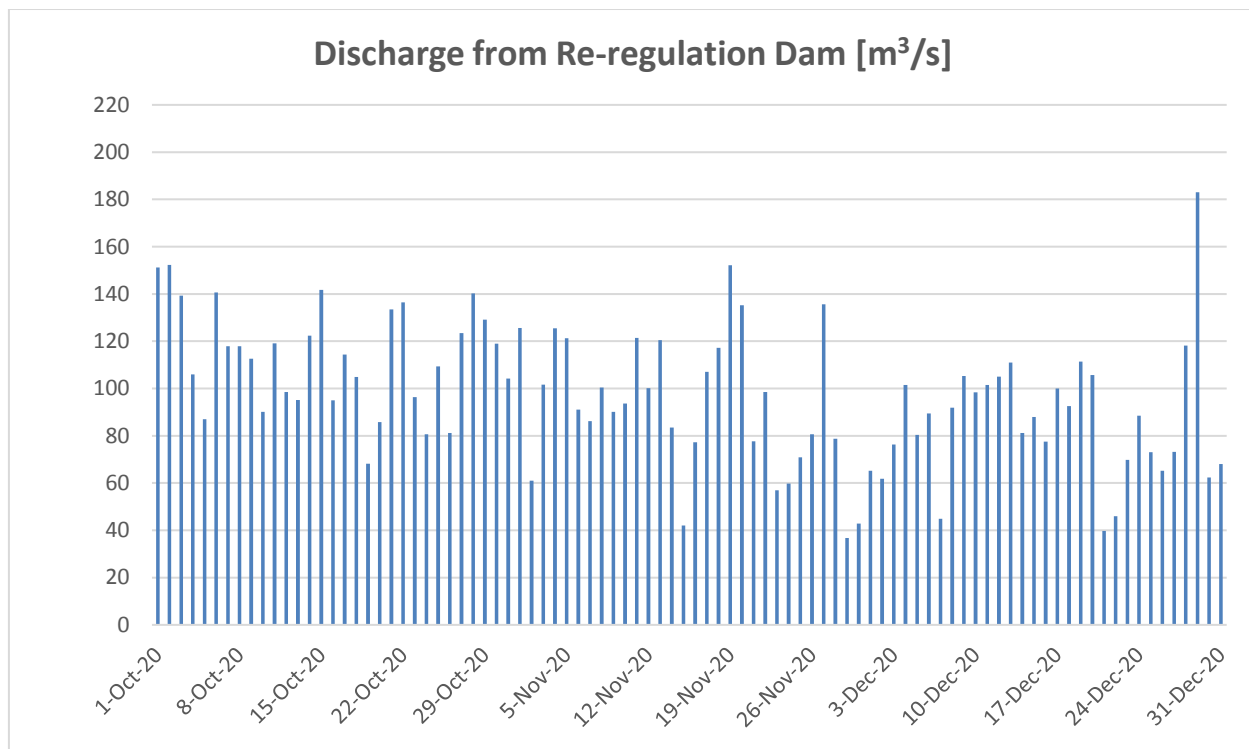
Figure 1-4: Water Level, Inflow and Discharge for the Main Reservoir

1.4.2 Re-regulation Reservoir – Discharge

The discharge monitoring data for the re-regulation dam during October to December 2020 is presented in **FIGURE 1-5**.

During December 2020, the mean discharge from the Re-regulation Dam was about 86 m³/s with turbine discharges varying between 28 m³/s and 160 m³/s, combined with gate discharge varying between 27 m³/s and 220 m³/s. The discharge was kept above the minimum flow requirement of 27 m³/s at all times.

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 1-5: Discharge Monitoring at the Re-regulation Dam in September to December 2020

1.4.3 Nam Ngiep Downstream Water Depth Monitoring

In December 2020, 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 sites have been identified with potential shallow water depths and only one of the sites (on December 2020 with the lowest discharge rate of 27 m³/s) was recorded having a water depth less than 0.5 m.

1.5 PROJECT WASTE MANAGEMENT

1.5.1 Solid Waste Management

In December 2020, a total of 17.6 m³ of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 0.2 m³ compared with November 2020.

During November 2020, the local Waste Collection Contractor continued the routine operation and maintenance activities of both landfills which included waste separation, waste covering and waste inventory, and clean-up of vegetation and scattered waste. In addition, the Contractor has also continued assisting on segregation of recyclable waste and clean-up in the community waste bank.

No recyclable waste was sold this month. The cumulative amounts are presented in **TABLE 1-12**.

Table 1-12: Amounts of Recyclable Waste Sold

Source and Type of Recycled Waste		Unit	Sold	Cumulative in total by December 2020
1	Plastic bottle	kg	0	96
2	Aluminium	kg	0	114
3	Paper/Cardboard	kg	0	63
4	Glass	kg	0	77
Total		Kg	0	350

The villagers from Phouhomxay Village collected a total of 482 kg of food waste from the OSOV1 canteen for animal feed in December 2020, a decrease of 23.5 kg compared with the previous month.

1.5.2 Hazardous Materials and Waste Management

The types and amounts of hazardous material and hazardous waste stored on site in December 2020 are shown in **Table 1-13** and **Table 1-14**.

TABLE 1-13: Record of Hazardous Material Inventory

No.	Type of Hazardous Material	Unit	Total in December 2020 (A)	Used (B)	Remaining (A – B)
1	Diesel	Litre	6,901	4,501	2,400
2	Gasoline	Litre	638	210	428
3	Lubricant (Turbine oil)	Litre	7,210	0	7,210
4	Colour Paint	Litre	266	0	266
5	Thinner	Litre	12	0	12
6	Grease Oil	Litre	725	0	725
7	Gear Oil	Litre	220	0	220
8	Chlorine Liquid	Litre	120	20	100
9	Chlorine Powder	Kg	65	0	65
10	SIKA	Litre	7	0	7

TABLE 1-14: Record of Hazardous Waste Inventory

No.	Hazardous Waste Type	Unit	Total in December 2020 (A)	Disposed (B)	Remaining (A – B)
1	Used Oil (Hydraulic and Engine)	Litre	272.3	0	272.3
2	Emptied 200 L drum of used oil	Unit	3	0	3
3	Contaminated soil, sawdust and textile material	m ³	0.46	0	0.46
4	Used tires	Piece	17	0	17

No.	Hazardous Waste Type	Unit	Total in December 2020 (A)	Disposed (B)	Remaining (A - B)
5	Empty 20L chemical drum	Drum	6	0	6
6	Lead battery	Unit	7	0	7
7	Empty paint and spray cans	Can	138	0	138
8	Halogen/fluorescent bulbs	Unit	228	0	228
9	Empty cartridge (Ink)	Unit	169	0	169
10	Clinic Waste	Kg	6.9	0	6.9

1.6 COMMUNITY WASTE MANAGEMENT

1.6.1 Community Recycling Programme

In December 2020, there was no trading of recyclable waste at the community waste bank. Due to the COVID-19 measures, many local recycling businesses and vendors have stopped coming on site to trade recyclable waste. In addition, there were also less trading activities in the project site and nearby communities due to reduced amounts of recyclable waste after the completion of project construction and decommissioning of the contractors' camps.

The total amount of recyclable waste in the waste bank is 2,689.5 kg – same as last month.





TABLE 1-15: Types and Amounts of Recyclable Waste Traded at the Community Recycle Waste Bank

Types of Waste	Unit	Remaining in November 2020	Additional in December 2020	Sold/dispose	Remaining in December 2020
Glass bottles	kg	2,358	0	0	2,358
Paper/cardboard	kg	296.5	0	0	296.5
Plastic bottles	kg	35	0	0	35
Aluminium cans	kg	0	0	0	0
Scrap metal	kg	0	0	0	0
Total	kg	2,689.5	0	0	2,689.5

1.6.2 Community Solid Waste Management

In December 2020, approximately 14.6 m³ of solid waste was collected from Phouhomxay Village and the host villages for disposal at Houay Soup landfill, a decrease of 1.1 m³ compared with the previous month.

Figure 1-6: Waste management activities during December 2020

Solid Waste Collection in Phouhomxay Village (Resettlement village)	Waste Disposal at NNP1 landfill
	
Daily waste covering at Houay Soup landfill	Recycle waste segregation at NNP1 landfill
	

2 WATERSHED AND BIODIVERSITY MANAGEMENT

2.1 WATERSHED MANAGEMENT

2.1.1 Implementation of Annual Implementation Plan (AIP) 2020

Xaysomboun Provincial WRPO and PAFO Fishery Section confirmed in the first week of December 2020 that they have no further comments on the final draft of Fishery Co-Management Plan (FCMP) in Lao language and will include the relevant activities in the XSB WMP AIP2021.

The report in Lao language of the Assessment on Sustainable Livelihood Opportunities for NNP1 watershed communities was finalized at the end of December 2020. The report will be shared to Xaysomboun Provincial WRPO for their reference to implement the activities under component 5 of NNP1 WMP – Livelihood Improvement.

Bolikhamxay Provincial WRPO commenced forest patrolling between 21-30 December 2020 while the reservoir patrolling will resume after the boat engine is fixed by the supplier and delivered back to the patrolling Team.

The process to change the bank account from USD to LAK by DOF-MAF was completed on 07 December 2020. The fund totalling 1,633,492,000 LAK (1,135,619,000 LAK under CA and 497,873,000 under NNL) was transferred from NNP1PC to DOF-MAF on 18 December 2020.

NNP1PC EMO handed over the SMART system equipment to Xaysomboun Provincial WRPO on 10 December 2020 while the equipment handover to Bolikhamxay Provincial WRPO is scheduled in January 2021.

A meeting on the design of Xaysomboun Provincial WRPO sub-office at Huayxay was organized on 25 December 2020 at Xaysomboun PAFO. The main conclusions are:

- NNP1PC-EMO will assist GOL in improving the design of the office and other facilities. The design of the office and other facilities should be ready and presented to WRPC for review and approval before 15 January 2021.
- The BOQ should be based on the agreement at the Meeting 16 July 2020 at XSB PAFO.

NNP1PC management planned to organize a meeting with all relevant parties, including DOF, to discuss the issues related to GOL financial policy affecting the field activities under watershed and biodiversity program.

2.1.2 Preparation of Annual Implementation Plan (AIP) 2021

Bolikhamxay Provincial WRPO is still improving their draft AIP2021 and the submission to NNP1PC-EMO is pending as of 31 December 2020.

Xaysomboun Provincial WRPO submitted their first draft of AIP2021 on 23 December 2020. The draft is being translated for further internal review by NNP1PC-EMO team.

The discussions on the draft AIP2021 between DOF-MAF, WRPOs, NNP1PC-EMO, and BSP is expected to be carried out in January 2021.

2.2 BIODIVERSITY OFFSET MANAGEMENT

2.2.1 Engagement of Biodiversity Service Provider (BSP)

The MOU between NNP1PC, ADB and WCS was finalized and agreed by all parties. The signed MOU by NNP1PC in December 2020 was sent to WCS and ADB for signing.

NNP1PC-EMO and the BSP continued to make progress on the preparation of a Law Enforcement Strategy (LES) document for NC-NX offset site, the overall biological monitoring program for NNP1 watershed and NC-NX offset site, community outreach program, and the conservation linked livelihood.

2.2.2 Implementation of BOMP Annual Implementation Plan (AIP) 2019 and 2020

The progress on the implementation of key activities by Component in December 2020 are described below:

a. Component 1 - Spatial Planning and Regulation

The dissemination and outreach activities on the TPZ boundary were re-scheduled to January 2021.

b. Component 2 – Law Enforcement

The four patrol teams continued the patrolling between 07 and 27 December 2020 with the focus on TPZ Highest priority area including Nam San, Nam Sone, Houy Pong and Nam Chang; Nam Ma TPZ High priority area including Nam Ma, Nam Phai, Nam Mong, Nam Plang and ridge of mountain; and Nam Houng TPZ High priority area including Na Kha Gna, Nam Tan and tributaries of Nam Tan in Viengthong District and Nam Lak, Nam Cham hang, Nam Kha Gni and Houy Ping in Xaychamphone District. The results the patrolling in December 2020 will be presented and discussed in January 2021 Monthly Report.

The results of patrolling activity in November 2020 are as follows:

Team	Patrolling Area/distance	Observations/Actions Taken
1	Nam Houng TPZ high priority area including Nam Houng, Nam Kha Gna, Nam Plang, Nam Kama, Nam Kapa, Nam Lak and upstream of Nam Somfard (16 days covering a distance of 76 km on forest patrolling)	The team encountered and destroyed one small fresh fishing camp and one small old hunting camp at Nam Houng.
2	TPZ highest priority including Nam san, Houy Payang, Houy Pong, Nam Chang and Nam Sone (16 days covering a distance of 93 km on forest patrolling and 16 km on road patrolling)	The team encountered and destroyed one small old hunting camp at the eastern of Nam Sone. The team also found carcasses of Indochinese Serow around the camp.
3	Nam Ma TPZ high priority area including Nam Ma and Nam Pang (16 days covering a distance of 89 km on forest patrolling)	The team did not encounter any threats during patrolling.
4	TPZ highest priority area including Nam San, Nam Chang, Nam Sone, Houy Xay Gnai, Houy Xay noi, Houy Pong and Nam Chouan (16 days covering a distance of 83 km on forest patrolling and 27 km on road patrolling)	The team did not encounter any threats during patrolling.

Figure 2-1: Map of Threats Recorded by Patrolling Teams in November 2020

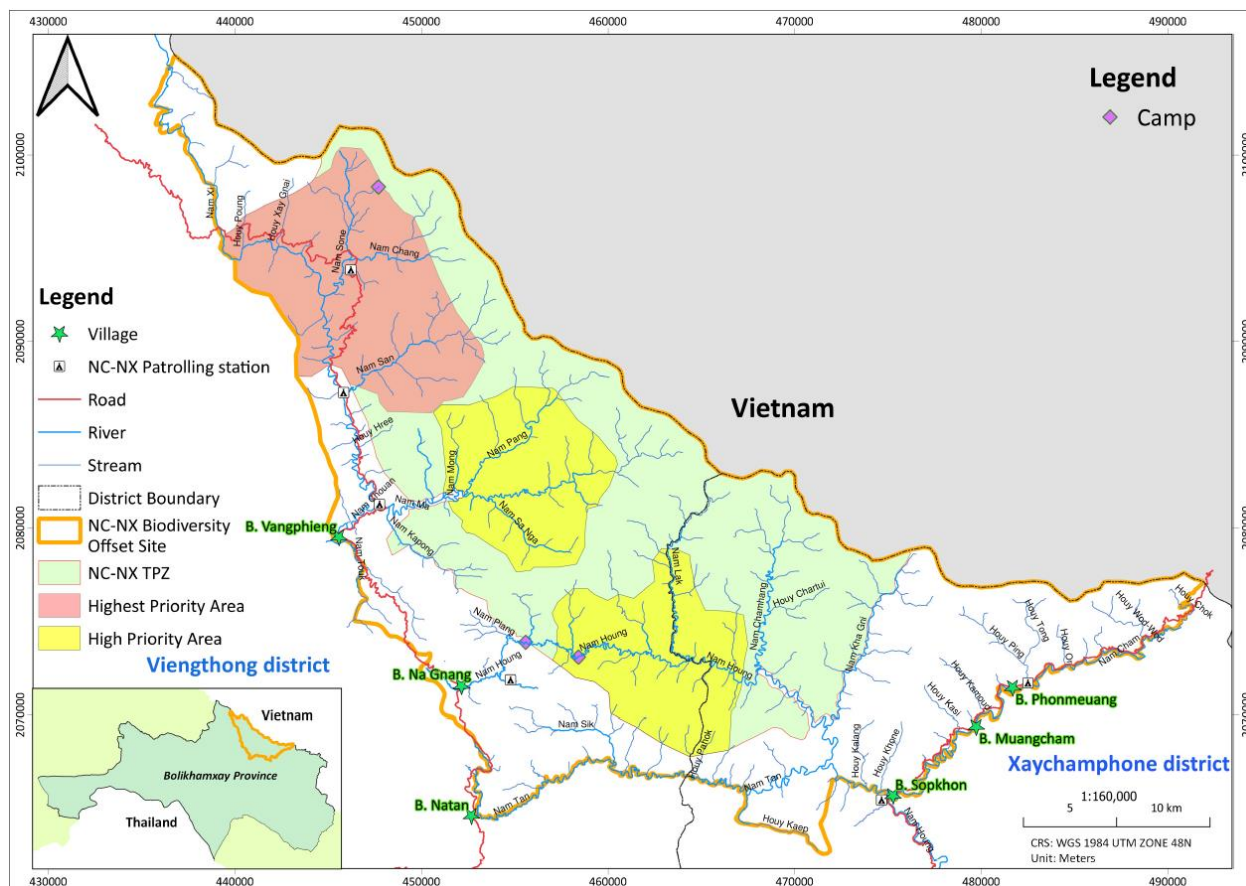


Figure 2-2: Hunting camp found and destroyed by Team 1 at Nam Houng



Figure 2-3: Fishing camp found and destroyed by Team 1 at Nam Houng



Figure 2-4: Hunting camp found by team 2 at eastern of Nam Sone**Figure 2-5: Carcass of Indochinese serow found by team 2 at Nam Sone**

c. Component 3 – Conservation Outreach

The pre-assessment of the target communities and schools was implemented between 11-21 November 2020. The results will be discussed during the BOMU monthly meeting in the first week of January 2021.

d. Component 4 – Conservation linked livelihood development

The Consultant, NNP1PC-EMO, and BSP further improved the draft plan (English version) addressing the comments from ADB, IAP, and from the workshop with relevant GOL agencies. The revised version was submitted to ADB on 27 November 2020. ADB provided the compiled comments from ADB and IAP team on 18 December 2020. The improved final plan was re-submitted to ADB and IAP on 30 December 2020. The final lao version is expected to be finalized and submitted to Bolikhamxay Provincial BOMU after ADB and IAP review in January 2021. The activities are elaborated into the BOM AIP2021.

The Community Snare Removal Plan was further improved and discussed during monthly meeting on 05 November 2020. The plan was finalized and submitted to BOMU on 20 November 2020. The team establishment, the training and the first snare removal were re-scheduled to be held in January 2021.

e. Component 6 – Biological Monitoring

BSP and NNP1PC-EMO presented the improved biological monitoring matrix to NC-NX BOMU and Xaysomboun WRPO on 20 and 25 November 2020 respectively. BSP team is further improving the monitoring matrix elaborating the comments and recommendations from IAP and ADB during the mission between 09-10 December 2020.

NX-NX BOMU, NNP1PC-EMO, and BSP team installed a total of 100 camera traps at 56 target locations within NC-NX offset site during 27 October to 27 November 2020. All the cameras are expected to be retrieved in January 2021 after 50 days of recording.

2.2.3 BOMP Annual Implementation Plan (AIP) 2021

Bolikhamxay Provincial NC-NX BOMU is improving the draft plan addressing the comments and recommendation received during follow-up discussions with NNP1PC EMO and BSP on 11 December 2020. The draft plan in English is expected to be submitted to ADB in January 2021.

3 FLOATING DEBRIS REMOVAL

There were no trapped logs in the temporary log-boom during the reporting period. Starting from January 2021, NNP1PC EMO team will no longer conduct the biomass removal from the main reservoir and so the temporary log boom will be removed/demolished. NNP1PC EMO has prepared the budget for this and will execute the work in January 2021.

4 FISHERY MONITORING

Three species groups and two species dominated the fish catch by weight in November 2020 as listed in **Table 4-1**. All species are classified as Least Concern (LC) according to 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 November 2020

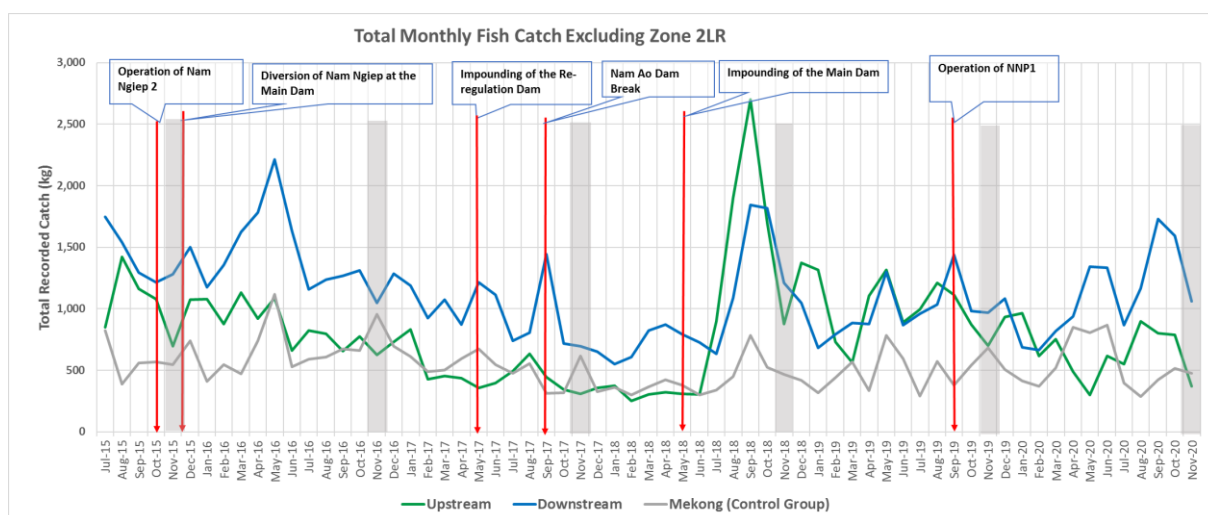
Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Hampala dispar</i> , <i>Hampala macrolepidota</i>	ປາສຸດ	187.8	LC
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	120.4	LC
<i>Channa striata</i>	ປາຄໍ້າ	72.5	LC
<i>Barbonymus gonionotus</i> , <i>Hypsibarbus malcomi</i> , <i>Hypsibarbus vernayi</i> , <i>Hypsibarbus wetmorei</i>	ປາປາກ	70	LC
<i>Clarias batrachus</i>	ປາດຸກ	61.8	LC

The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in November 2020 is presented in **Table 4-2**. The list includes one species that are classified as Endangered species (EN), three Vulnerable species (VU) and three Near Threatened species (NT).

Table 4-2: Threatened Species of November 2020 Fish Catch

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Cirrhinus molitorella</i>	ປາແກງ	10.5	NT
<i>Cyprinus carpio</i>	ປາໄມ	11	VU
<i>Neolissochilus stracheyi</i>	ປາສອງ	1.1	NT
<i>Onychostoma gerlachi</i>	ປາຄຶງ	4	NT
<i>Probarbus jullieni</i>	ປາເອີນ	6	EN
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປ່ຽນ	15.1	VU
<i>Tor sinensis</i>	ປາແດງ	54.6	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 November 2020 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.

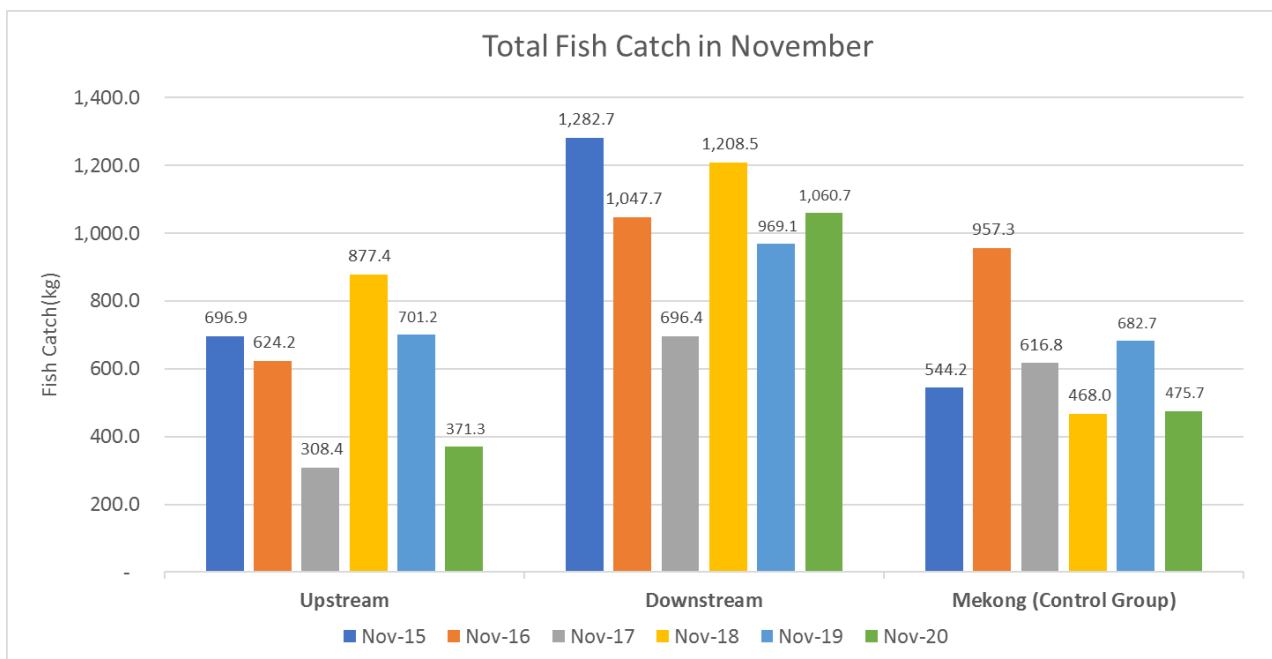
Figure 4-1: Total Monthly Fish Catch July 2015 – November 2020**Table 4-3 and****FIGURE 4-2****Figure 4-2: Total Fish Catch by Upstream (Excluding Zone 2LR), Downstream and Mekong Control Group Fishing Households for the month of November from 2015 to 2020**

show the total recorded fish catch for the month of November from 2015 to 2020 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 Fish Catch by Upstream (Excluding Zone 2LR), Downstream and Mekong Control Group Fishing Households for the month of November from 2015 to 2020

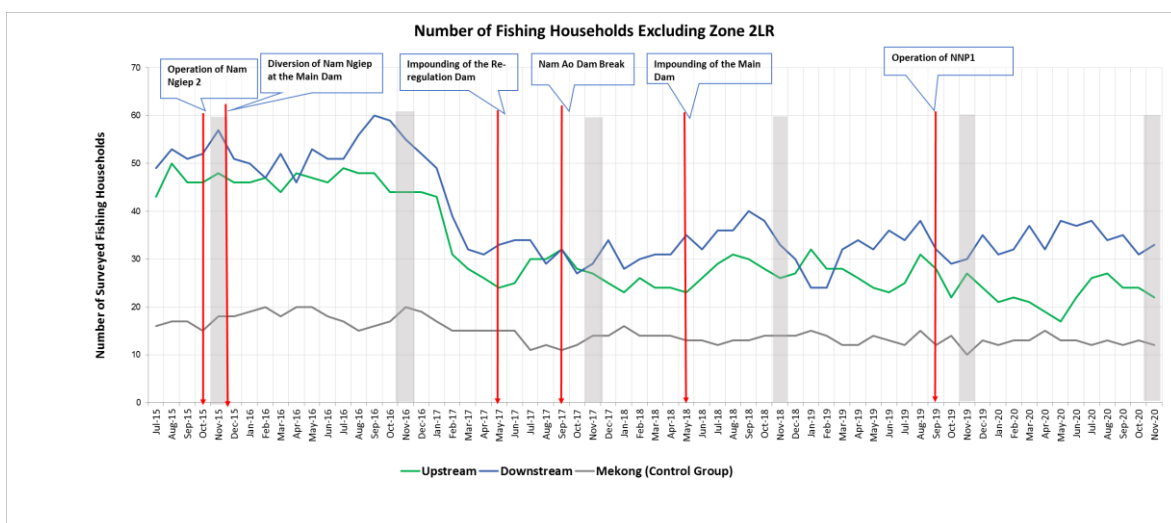
Fishing Zone	November 2015 (kg)	November 2016 (kg)	November 2017 (kg)	November 2018 (kg)	November 2019 (kg)	November 2020 (kg)
Upstream	696.9	624.2	308.4	877.4	701.2	371.3
Downstream	1,282.7	1,047.7	696.4	1,208.5	969.1	1,060.7
Mekong Control Group	544.2	957.3	616.8	468.0	682.7	475.7

Figure 4-2: Total Fish Catch by Upstream (Excluding Zone 2LR), Downstream and Mekong Control Group Fishing Households for the month of November from 2015 to 2020



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

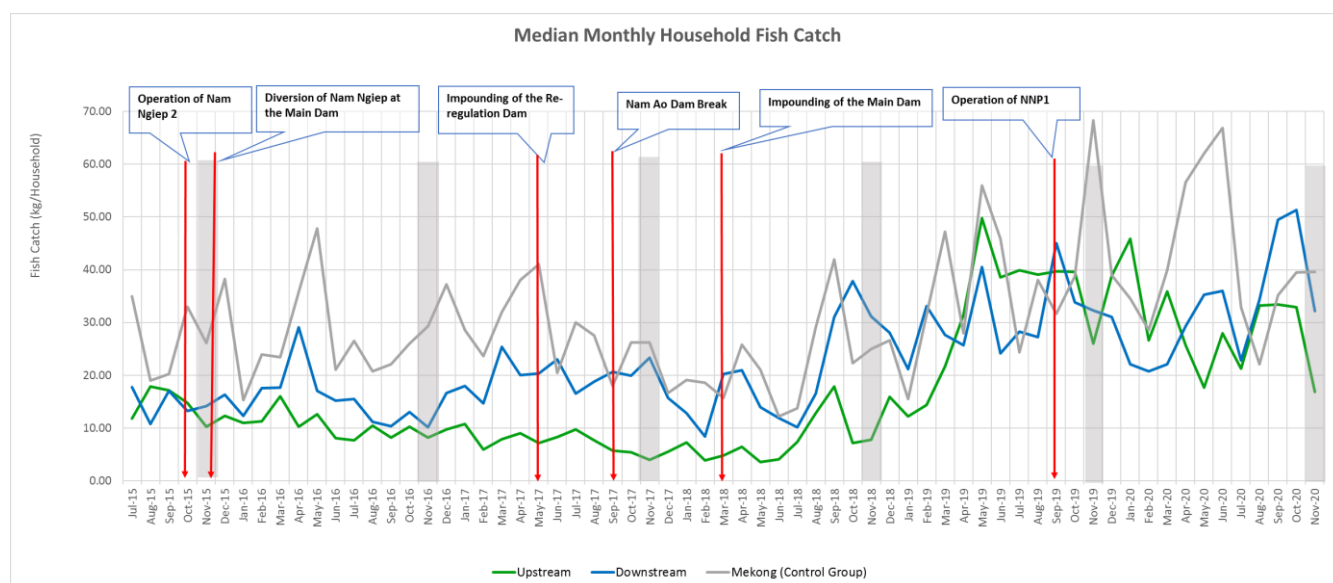
Figure 4-3: Number of Fishing Households Involved in the Fish Catch Monitoring Programme



The median monthly household fish catch of the month of November from 2015 to 2020 for the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are presented in

Figure 4-4.

Figure 4-4: Median Monthly Household Fish Catch without Zone 2LR



The median household fish catch for the month of November from 2015 to 2020 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group are displayed in

TABLE 4-4.

Table 4-4: Median Monthly Household Fish Catch in the Upstream and Downstream Communities Excluding Zone 2LR for the month of November from 2015 to 2020

Fishing Zone	November 2015 (kg)	November 2016 (kg)	November 2017 (kg)	November 2018 (kg)	November 2019 (kg)	November 2020 (kg)
Upstream	10.3	8.2	4.0	7.8	26.0	16.9

Fishing Zone	November 2015 (kg)	November 2016 (kg)	November 2017 (kg)	November 2018 (kg)	November 2019 (kg)	November 2020 (kg)
Downstream	14.2	10.2	23.3	31.2	32.3	32.1
Mekong Control Group	26.1	29.4	26.3	25.0	68.3	39.6

The median daily fish catch per household are displayed in

Figure 4-5, and the median fish catch per household per fishing day for the month of November from 2015 to 2020 are shown in **Table 4-5**.

Figure 4-5: Median Daily Fish Catch per Household

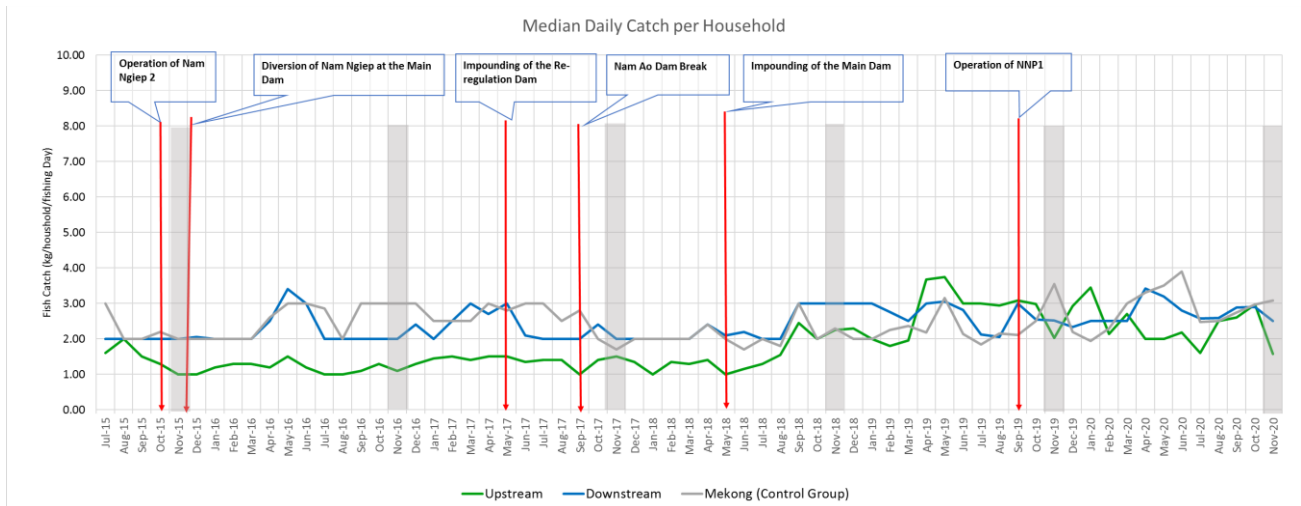


Table 4-5: Median Daily Fish Catch per Household for the month of November from 2015 to 2020

Fishing Zone	November 2015 (kg)	November 2016 (kg)	November 2017 (kg)	November 2018 (kg)	November 2019 (kg)	November 2020 (kg)
Upstream	1.00	1.10	1.50	2.25	2.02	1.58
Downstream	2.00	2.00	2.00	3.00	2.51	2.50
Mekong Control Group	2.00	3.00	1.70	2.30	3.54	3.08

ANNEXES

Annex A: Results of Water Quality Monitoring

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

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream			
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
2-Dec-20	pH	5.0 - 9.0		7.22	7.16	6.92	6.88							
3-Dec-20	pH	5.0 - 9.0						6.78	6.72	6.84				
7-Dec-20	pH	5.0 - 9.0	7.62											
8-Dec-20	pH	5.0 - 9.0		6.89	6.72	6.65								
9-Dec-20	pH	5.0 - 9.0					6.41	6.57						
10-Dec-20	pH	5.0 - 9.0							6.94	6.98	6.85	7.15	7.19	7.29
15-Dec-20	pH	5.0 - 9.0		6.96	6.44	6.55	6.85							
16-Dec-20	pH	5.0 - 9.0						6.43	6.51	6.6	6.34	6.84	7.26	7.15
24-Dec-20	pH	5.0 - 9.0	7.37	6.81	6.88	6.79	6.69							
25-Dec-20	pH	5.0 - 9.0						6.55	6.92	6.95	7.16	6.63	7.77	7.68
2-Dec-20	Sat. DO (%)			86.1	63.5	88.5	85.1							
3-Dec-20	Sat. DO (%)							73.6	28.8	27.4	40.5	47.8	73.1	79.2
7-Dec-20	Sat. DO (%)		106.5											
8-Dec-20	Sat. DO (%)			87	56.8	61.9								

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir					Within / Re-regulation Reservoir		Downstream				
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
9-Dec-20	Sat. DO (%)						58.1	57.7						
10-Dec-20	Sat. DO (%)								46.4	48.1	60.6	61.3	78	80.8
15-Dec-20	Sat. DO (%)			110.3	60.6	88.4	75.9							
16-Dec-20	Sat. DO (%)							75.6	51.2	44.1	54.7	58.2	76.5	90.5
24-Dec-20	Sat. DO (%)		113	78.1	50.4	93.6	62.2							
25-Dec-20	Sat. DO (%)							59.5	46.3	45.2	68.8	70.8	81.1	86.7
2-Dec-20	DO (mg/L)	>6.0		6.87	5.11	7.15	6.9							
3-Dec-20	DO (mg/L)	>6.0						6.02	2.42	2.29	3.38	4.01	6.11	6.57
7-Dec-20	DO (mg/L)	>6.0	8.96											
8-Dec-20	DO (mg/L)	>6.0		7.11	4.64	5.06								
9-Dec-20	DO (mg/L)	>6.0					4.78	4.76						
10-Dec-20	DO (mg/L)	>6.0							3.91	4.07	5.08	5.19	6.52	6.73
15-Dec-20	DO (mg/L)	>6.0		9.01	4.96	7.25	6.28							
16-Dec-20	DO (mg/L)	>6.0						6.27	4.31	3.7	4.55	4.91	6.41	7.48
24-Dec-20	DO (mg/L)	>6.0	9.29	6.54	4.17	9.1	5.18							
25-Dec-20	DO (mg/L)	>6.0						4.98	3.93	3.82	5.63	5.77	6.47	6.8
2-Dec-20	Conductivity (µs/cm)			74	72	63	61							
3-Dec-20	Conductivity (µs/cm)							59	74	71	71	72	81	72
7-Dec-20	Conductivity (µs/cm)		65.3											
8-Dec-20	Conductivity (µs/cm)			75	74	64								
9-Dec-20	Conductivity (µs/cm)						61	61						
10-Dec-20	Conductivity (µs/cm)								70	68	68	70	69	68

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir					Within / Re-regulation Reservoir		Downstream				
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
15-Dec-20	Conductivity (µs/cm)			74	74	65	62							
16-Dec-20	Conductivity (µs/cm)							62	72	70	69	71	71	70
24-Dec-20	Conductivity (µs/cm)		61.2	76	75	78	62							
25-Dec-20	Conductivity (µs/cm)							63	74	70	69	66	64	62
2-Dec-20	Temperature (°C)			27.02	26.46	26.32	25.99							
3-Dec-20	Temperature (°C)							25.67	24.28	24.3	24.41	24.19	24.48	24.7
7-Dec-20	Temperature (°C)		22											
8-Dec-20	Temperature (°C)			25.86	25.94	25.42								
9-Dec-20	Temperature (°C)						25.1	25.12						
10-Dec-20	Temperature (°C)								24.1	24.08	24.23	23.86	24.34	24.56
15-Dec-20	Temperature (°C)			26.19	25.62	25.4	24.99							
16-Dec-20	Temperature (°C)							24.78	24.17	24.13	24.35	24.14	24.23	24.9
24-Dec-20	Temperature (°C)		22.8	24.45	24.96		24.48							
25-Dec-20	Temperature (°C)							24.27	23.63	23.75	24.5	24.6	24.8	25.2
2-Dec-20	Turbidity (NTU)			2.29	2.05	2.15	1.97							
3-Dec-20	Turbidity (NTU)							1.69	2.15	2.54	2.32	2.46	2.49	3.84
7-Dec-20	Turbidity (NTU)		3.42											
8-Dec-20	Turbidity (NTU)			1.82	1.43	2.3								
8-Dec-20	Turbidity (NTU)-Hypolimnion					13.3								
9-Dec-20	Turbidity (NTU)						2.01	1.77						

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream			
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
9-Dec-20	Turbidity (NTU)-Hypolimnion						3.8	2.44						
10-Dec-20	Turbidity (NTU)								2.27	2.38	1.9	1.66	2.81	3.43
10-Dec-20	Turbidity (NTU)-Hypolimnion								<5	<5	<5	<5	<5	6.2
15-Dec-20	Turbidity (NTU)			1.85	2.27	1.85	1.77							
16-Dec-20	Turbidity (NTU)							1.85	2.83	3.08	3.01	3.59	3.03	3.23
24-Dec-20	Turbidity (NTU)		2.95	3.12	2.46	2.2	1.97							
25-Dec-20	Turbidity (NTU)							1.37	1.66	2.02	2.31	2.57	2.78	3.89
7-Dec-20	TSS (mg/L)		<5											
8-Dec-20	TSS (mg/L)			<5		<5								
8-Dec-20	TSS (mg/L)-Hypolimnion					28.57								
9-Dec-20	TSS (mg/L)						<5	<5						
9-Dec-20	TSS (mg/L)-Hypolimnion						23.65	11.01						
10-Dec-20	TSS (mg/L)								<5	<5	<5	<5	<5	6.2
7-Dec-20	BOD ₅ (mg/L)	<1.5	1.14											
8-Dec-20	BOD ₅ (mg/L)	<1.5		<1		<1								
8-Dec-20	BOD ₅ (mg/L)-Hypolimnion					<1								

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream			
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
9-Dec-20	BOD ₅ (mg/L)	<1.5					<1	<1						
9-Dec-20	BOD ₅ (mg/L)-Hypolimnion						7.41	6.09						
10-Dec-20	BOD ₅ (mg/L)	<1.5							1.74	1.18	<1	<1	<1	<1
7-Dec-20	COD (mg/L)	<5.0	7.7											
8-Dec-20	COD (mg/L)	<5.0												
10-Dec-20	COD (mg/L)	<5.0							8	<5	8.6	6.8	7.6	11
7-Dec-20	NH ₃ -N (mg/L)	<0.2	<0.2											
8-Dec-20	NH ₃ -N (mg/L)	<0.2	<0.2											
8-Dec-20	NH ₃ -N (mg/L)	<0.2		<0.2		<0.2								
8-Dec-20	NH ₃ -N (mg/L)-Hypolimnion					<0.2								
9-Dec-20	NH ₃ -N (mg/L)	<0.2												
9-Dec-20	NH ₃ -N (mg/L)	<0.2					<0.2	<0.2						
9-Dec-20	NH ₃ -N (mg/L)-Hypolimnion						<0.2	<0.2						
7-Dec-20	NO ₃ -N (mg/L)	<5.0	0.06											
8-Dec-20	NO ₃ -N (mg/L)	<5.0		<0.02		0.03								
8-Dec-20	NO ₃ -N (mg/L)-Hypolimnion					<0.02								
9-Dec-20	NO ₃ -N (mg/L)-Hypolimnion						0.04	<0.02						

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream			
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
7-Dec-20	Faecal coliform (MPN/100 mL)	<1,000	33											
8-Dec-20	Faecal coliform (MPN/100 mL)	<1,000		23		0								
9-Dec-20	Faecal coliform (MPN/100 mL)	<1,000					0	0						
10-Dec-20	Faecal coliform (MPN/100 mL)	<1,000							0	0	2	34	33	79
7-Dec-20	Total Coliform (MPN/100 mL)	<5,000	1,600											
8-Dec-20	Total Coliform (MPN/100 mL)	<5,000		110		0								
9-Dec-20	Total Coliform (MPN/100 mL)	<5,000					0	49						
10-Dec-20	Total Coliform (MPN/100 mL)	<5,000							110	33	33	170	170	540
7-Dec-20	TKN		<1.5											
8-Dec-20	TKN			<1.5		<1.5								
8-Dec-20	TKN-Hypolimnion					<1.5								
9-Dec-20	TKN						<1.5	<1.5						
9-Dec-20	TKN-Hypolimnion						<1.5	<1.5						
7-Dec-20	TOC (mg/L)		5.98											
8-Dec-20	TOC (mg/L)													

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream			
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
10-Dec-20	TOC (mg/L)							1.22	1.3	1.15	1.07	1.18	1.26	
8-Dec-20	Phytoplankton Biomass (g dry wt/m³)			0.8		0.6								
8-Dec-20	Phytoplankton Biomass (g dry wt/m³)-Hypolimnion					1								
9-Dec-20	Phytoplankton Biomass (g dry wt/m³)					0.2	0.4							
9-Dec-20	Phytoplankton Biomass (g dry wt/m³)-Hypolimnion					1.4	1.6							
7-Dec-20	Total Phosphorus (mg/L)		<0.01											
8-Dec-20	Total Phosphorus (mg/L)			<0.01		<0.01								
8-Dec-20	Total Phosphorus (mg/L)-Hypolimnion					<0.01								
9-Dec-20	Total Phosphorus (mg/L)						<0.01	<0.01						
9-Dec-20	Total Phosphorus (mg/L)-Hypolimnion						<0.01	<0.01						
7-Dec-20	Total Dissolved Phosphorus (mg/L)		<0.01											

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream			
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
8-Dec-20	Total Dissolved Phosphorus (mg/L)			<0.01		<0.01								
8-Dec-20	Total Dissolved Phosphorus (mg/L)-Hypolimnion					<0.01								
9-Dec-20	Total Dissolved Phosphorus (mg/L)						<0.01	<0.01						
9-Dec-20	Total Dissolved Phosphorus (mg/L)-Hypolimnion						<0.01	<0.01						
8-Dec-20	Hydrogen Sulfide (mg/L)			<0.02		<0.02								
8-Dec-20	Hydrogen Sulfide (mg/L)-Hypolimnion					0.02								
9-Dec-20	Hydrogen Sulfide (mg/L)						<0.02	<0.02						
9-Dec-20	Hydrogen Sulfide (mg/L)-Hypolimnion						<0.02	0.02						

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

		River Name	Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites			
			Tributaries Upstream		Tributaries Downstream	
		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
2-Dec-20	pH	5.0 - 9.0				
3-Dec-20	pH	5.0 - 9.0				
7-Dec-20	pH	5.0 - 9.0	8.07			
8-Dec-20	pH	5.0 - 9.0		6.99		
9-Dec-20	pH	5.0 - 9.0				
10-Dec-20	pH	5.0 - 9.0			7.52	7.66
15-Dec-20	pH	5.0 - 9.0				
16-Dec-20	pH	5.0 - 9.0			7.12	7.25
24-Dec-20	pH	5.0 - 9.0	8.31			
25-Dec-20	pH	5.0 - 9.0			7.41	6.48
2-Dec-20	Sat. DO (%)					
3-Dec-20	Sat. DO (%)				84.2	82.9
7-Dec-20	Sat. DO (%)		100.1			
8-Dec-20	Sat. DO (%)			100.6		
9-Dec-20	Sat. DO (%)					
10-Dec-20	Sat. DO (%)				91.2	87.8
15-Dec-20	Sat. DO (%)					
16-Dec-20	Sat. DO (%)				95.4	99.6
24-Dec-20	Sat. DO (%)		108.8			
25-Dec-20	Sat. DO (%)				76.9	81.4
2-Dec-20	DO (mg/L)	>6.0				
3-Dec-20	DO (mg/L)	>6.0			7.25	7.33
7-Dec-20	DO (mg/L)	>6.0	8.52			
8-Dec-20	DO (mg/L)	>6.0		9.34		
9-Dec-20	DO (mg/L)	>6.0				
10-Dec-20	DO (mg/L)	>6.0			8.3	7.98
15-Dec-20	DO (mg/L)	>6.0				
16-Dec-20	DO (mg/L)	>6.0			8.19	8.71
24-Dec-20	DO (mg/L)	>6.0	9.26			
25-Dec-20	DO (mg/L)	>6.0			6.26	6.7
2-Dec-20	Conductivity (µs/cm)					
3-Dec-20	Conductivity (µs/cm)				112	42
7-Dec-20	Conductivity (µs/cm)		32.8			
8-Dec-20	Conductivity (µs/cm)			74		
9-Dec-20	Conductivity (µs/cm)					
10-Dec-20	Conductivity (µs/cm)				114	38
15-Dec-20	Conductivity (µs/cm)					

		River Name	Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites			
			Tributaries Upstream		Tributaries Downstream	
		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
16-Dec-20	Conductivity (µs/cm)				114	44
24-Dec-20	Conductivity (µs/cm)		24.4			
25-Dec-20	Conductivity (µs/cm)				112	40
2-Dec-20	Temperature (°C)					
3-Dec-20	Temperature (°C)					
7-Dec-20	Temperature (°C)		21.1			
8-Dec-20	Temperature (°C)			18.97		
9-Dec-20	Temperature (°C)					
10-Dec-20	Temperature (°C)				19.99	19.28
15-Dec-20	Temperature (°C)					
16-Dec-20	Temperature (°C)				23	21.92
24-Dec-20	Temperature (°C)		21			
25-Dec-20	Temperature (°C)				24.7	24.1
2-Dec-20	Turbidity (NTU)					
3-Dec-20	Turbidity (NTU)				3.69	3.09
7-Dec-20	Turbidity (NTU)		3.64			
8-Dec-20	Turbidity (NTU)			3.64		
9-Dec-20	Turbidity (NTU)					
10-Dec-20	Turbidity (NTU)				3.29	2.79
15-Dec-20	Turbidity (NTU)					
16-Dec-20	Turbidity (NTU)				5.21	3.41
24-Dec-20	Turbidity (NTU)		5.14			
25-Dec-20	Turbidity (NTU)				2.72	4.17
7-Dec-20	TSS (mg/L)		<5			
8-Dec-20	TSS (mg/L)			<5		
9-Dec-20	TSS (mg/L)				<5	<5
10-Dec-20	TSS (mg/L)					
7-Dec-20	BOD ₅ (mg/L)	<1.5	1.12			
8-Dec-20	BOD ₅ (mg/L)	<1.5		<		
9-Dec-20	BOD ₅ (mg/L)	<1.5				
10-Dec-20	BOD ₅ (mg/L)	<1.5			<1	<1
7-Dec-20	COD (mg/L)	<5.0	8.4			
8-Dec-20	COD (mg/L)	<5.0		9.2		
10-Dec-20	COD (mg/L)	<5.0			8.4	7.8
7-Dec-20	NH ₃ -N (mg/L)	<0.2	<0.2			
8-Dec-20	NH ₃ -N (mg/L)	<0.2				
8-Dec-20	NH ₃ -N (mg/L)	<0.2		<0.2		
9-Dec-20	NH ₃ -N (mg/L)	<0.2				
9-Dec-20	NH ₃ -N (mg/L)	<0.2				
7-Dec-20	NO ₃ -N (mg/L)	<5.0	0.08			

		River Name	Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites			
			Tributaries Upstream		Tributaries Downstream	
		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
8-Dec-20	NO ₃ -N (mg/L)	<5.0		0.03		
7-Dec-20	Faecal coliform (MPN/100 mL)	<1,000	17			
8-Dec-20	Faecal coliform (MPN/100 mL)	<1,000		7.8		
9-Dec-20	Faecal coliform (MPN/100 mL)	<1,000				
10-Dec-20	Faecal coliform (MPN/100 mL)	<1,000			49	170
7-Dec-20	Total Coliform (MPN/100 mL)	<5,000	110			
8-Dec-20	Total Coliform (MPN/100 mL)	<5,000		79		
9-Dec-20	Total Coliform (MPN/100 mL)	<5,000				
10-Dec-20	Total Coliform (MPN/100 mL)	<5,000			540	540
7-Dec-20	TKN		<1.5			
8-Dec-20	TKN			<1.5		
8-Dec-20	TKN-Hypolimnion					
9-Dec-20	TKN					
9-Dec-20	TKN-Hypolimnion					
7-Dec-20	TOC (mg/L)		6.1			
8-Dec-20	TOC (mg/L)			9.81		
10-Dec-20	TOC (mg/L)				0.93	1.48
8-Dec-20	Phytoplankton Biomass (g dry wt/m³)					
9-Dec-20	Phytoplankton Biomass (g dry wt/m³)					
7-Dec-20	Total Phosphorus (mg/L)		<0.01			
8-Dec-20	Total Phosphorus (mg/L)			<0.01		
9-Dec-20	Total Phosphorus (mg/L)					
7-Dec-20	Total Dissolved Phosphorus (mg/L)		<0.01			
8-Dec-20	Total Dissolved Phosphorus (mg/L)			<0.01		
9-Dec-20	Total Dissolved Phosphorus (mg/L)					
8-Dec-20	Hydrogen Sulfide (mg/L)					
9-Dec-20	Hydrogen Sulfide (mg/L)					

Annex B: Results of Effluent Analyses

TABLE B-2: RESULTS OF CAMP EFFLUENTS IN DECEMBER 2020

	Site Name	OSOV1 (Owner's Site Office and Village)		OSOV2 (ESD Camp)		Main Powerhouse	
		EF01		EF13		EF19	
		02-Dec-20	14-Dec-20	02-Dec-20	14-Dec-20	02-Dec-20	14-Dec-20
Parameters (Unit)	Guideline						
pH	6.0 - 9.0	6.7	6.56	7.6	7.51	7.42	7.31
Sat. DO (%)		80.2	75.9	13.1	44.2	24	40.7
DO (mg/L)		6.51	6.29	1.06	3.52	1.83	3.1
Conductivity (µs/cm)		342	340	359	537	769	776
TDS (mg/L)		171	170	179.5	268.5	384.5	388
Temperature (°C)		24.7	25.2	25	25.5	28.3	28
Turbidity (NTU)		1.39	2.38	20	17.34	7.37	17.91
TSS (mg/L)	<50	<5	<5	9.3	9.1	24.0	87.1
BOD ₅ (mg/L)	<30	<6	<6	<6	24.48	<6	<6
COD (mg/L)	<125	<25	<25	47.2	93.3	51.6	116
NH ₃ -N (mg/L)	<10.0	<2	3	2.3	18	27.9	30.7
Total Nitrogen (mg/L)	<10.0	2.39	7.33	5.41	23	29.3	34.7
Total Phosphorus (mg/L)	<2	1.29	1	1.33	1.47	7.94	6.72
Oil & Grease (mg/L)	<10.0	<1		<1		<1	
Total coliform (MPN/100 mL)	<400	220	49	0	0	0	0
Faecal Coliform (MPN/100 mL)	<400	22	17	0	0	0	0
Effluent Discharge Volume (L/mn)		7.5	4	4	1.5	1400	1400
Chlorination Dosing Rate (mL/mn)		n/a	n/a	30	0.33	350	350
Residual Chlorine (mg/L)	<1.0	n/a	n/a	0.87	0.82	1.61	1.01