




## Nam Ngiep 1 Hydropower Project

# Environmental Management Monthly Monitoring Report

June 2020

					
					
A	27 July 2020	Hendra WINASTU Khamstone SAYSOMPHOU		Khamlar PHONSAVAT	Final
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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
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 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
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

In June 2020, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) did not receive any document for review and approval. The GoL (Ministry of Natural Resources and Environment as well as its line departments in Bolikhamxay and Xaysomboun Provinces) conducted a joint site inspection on 10 June 2020.

A total of 21 out of 22 sites were successfully revegetated with local grass and local tree species where the soil and site conditions are suitable (former V&K camp, Song Da5 camp 1 and OC camp). Sub-contractors have been appointed to maintain these revegetated sites responsible by the Civil Works Contractor.

At the former LILAMA10 camp, the Contractor responded to the NCR level 1 issued by NNP1PC-EMO on 15 April 2020 that it will complete the vegetation work after the country's COVID-19 lockdown is lifted.

Due to the country's COVID-19 lockdown since mid-March 2020 until the end of May and continued to the end of June, no water samples were shipped to UAE Laboratory in Thailand. The water samples were measured the in-situ parameters and the 5 parameters (TSS, BOD<sub>5</sub>, Faecal Coliform, E. Coli Bacteria and Total Coliform) were analysed at NNP1 Project Environmental Laboratory.

The effluent monitoring results for the remaining camps indicate non-compliances with the GoL standards for total coliform and faecal coliform. An external consultant contract was signed to assess and evaluate the design and operation of the existing WWTS at the OSOV2 and other sites as well as to provide an improved design using a more sustainable technology. It is expected that a site visit by the external consultant will be carried out after the country's lockdown is lifted. In the meantime, NNP1PC-EMO has provided all relevant designs, drawings and water quality monitoring data to the consultant for a desk review.

During the month, Dissolved Oxygen (DO) levels at the surface of the main reservoir (R1, R2, R3, R4 and R5) were generally between 6 and 8 mg/L. In the re-regulation reservoir (R6 and R7), the DO levels were below 4 mg/L.

The discharge from the re-regulation dam alternated between discharges from the gate and turbines. Similar to May 2020, all DO concentrations (except on 04 June 2020 during the gate discharge) were below 6 mg/L at Nam Ngiep downstream stations. However, same as the previous months with the same range of DO levels, no dead fish was observed during this monitoring period. NNP1PC is in the process of hiring an international consulting company to assist with the design of additional aeration system to improve the DO level at downstream.

A total of 19.4 m<sup>3</sup> of solid waste was disposed of at the NNP1 Project Landfill, an increase of 2.8 m<sup>3</sup> compared to May 2020. A total of 3,137 kg of recyclable waste was recorded at the Community Recycle Waste Bank. A total of 17.1 m<sup>3</sup> of solid waste from Phouhomxay, Thahuea and Hat Gniun Villages was disposed of at the Houay Soup Landfill.

Xaysomboun Provincial WRPO conducted the TPZ boundary survey and verification in Hom and Anouvong District between 08 – 26 June 2020. Reservoir patrolling was also carried out in the reservoir zone 4 of Thathom District and reservoir zone 2 and 3 of Hom District between 19-26 June 2020. There was no implementation activity by Bolikhamxay Provincial WRPO during this reporting period.

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



The fish catch monitoring for April and May 2020 in Nam Ngiep watershed was dominated *Channa striata*, and species groups of *Sikukia gudgeri* and *Amblyrhynchichthys truncates*, *Barbonymus* and *Hypsibarbus*, *Poropuntius* and *Hampala* that are classified as Least Concern (LC) according to the IUCN Red List, except *Sikukia gudgeri* is classified as Data Deficient (DD).

## 1. INTRODUCTION

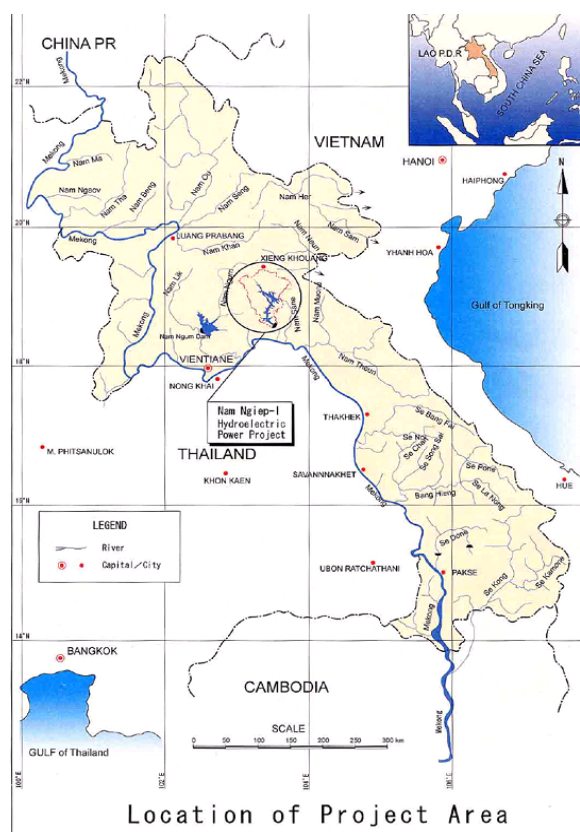
The Nam Ngiep originates in the mountains of Xieng Khouang Province, flowing through Khoum District into Thathom District of Xaysomboun Province, through Hom District and into Bolikhamxay Province. The Nam Ngiep meets the Mekong River just upstream from Pakxan in Bolikhamxay Province (Fig. 1-1).

**FIGURE 1-1: LOCATION MAP**

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

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

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



## 2. WORK PROGRESS OF PRINCIPAL CONTRACTORS

Construction works for the Project have been 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. Each Contract is in its Defects Notification Period all ending variously in 2020 or 2021 following the issue of Taking-over Certificates in 2018 and 2019.

**Figure 2-1** shows the progress of the minor outstanding work and defects that comprise the Punch List of work items completed for each of these four principal Contracts for the Project. An addendum to the Punch List is maintained for each Contract for any and all defects list that are discovered during the Defects Notification Period with relevant tabular records made of the date of the discovery, the nature of the defects and by what date the defect was remedied.

## 2.1 MAINTENANCE AND REPAIR WORK (CIVIL WORK)

The contract with Maintenance and Repair Contracting Company was made in November 2019 and expired in June 2020. An evaluation of bidding for new contract and contractor from July to December 2020 was concluded in June 2020.

The work activities were summarized as following:

1. Clearing vegetation work around Main Dam ongoing, Re-regulation Dam dyke cleaning by grass, weed cutting was completed in December 2019. Additional part at Main Dam and Re-regulation Dike was conducted in June 2020.
2. Spillway Gate stop log and intake gates relocation was completed and movement from existing storage yard to a new storage yard at the Main Powerhouse was completed for total 11 Numbers and the work was completed in December 2019.
3. Removal of floating log and debris material in Main Dam and Re-regulation Dam reservoir was completed in January 2020 and monitoring for coming new flowing material will be continued. Additional part of floated material at Main Dam and Re-regulation dam Reservoir was conducted in June 2020.
4. Re-installation of log boom system for the Main Dam and Re-regulation reservoir was started from January 2020 and completed in the middle of March 2020.
5. Light maintenance works and general cleaning around the Main Dam, Main Powerhouse and Re-regulation Power Station were completed in March 2020. Additional cleaning for Main Power house and Re-regulation Power house was conducted in June 2020.
6. Carried out an operation test for Spillway gates and Intake gantry crane at Main Dam in April 2020.
7. Carry out a monthly operation test for main facilities such as spillway gate, Gantry of intake gate at Main Dam, gantry of draft gate at Main Power house.

## 2.2 RESERVOIR

**Figure 2-1: Reservoir of Main Dam**



**Figure 2-2: Reservoir of Re-regulation Dam**





## 2.3 DAM AND POWER PLANT

### 2.3.1 Rehabilitation works

#### 2.3.1.1 Plant Yards

Demobilization of plant facilities for both RCC and CVC plants was completed in December 2019. The vegetation improvement for rehabilitation of those areas is ongoing.



**Figure 2-3: Re-vegetation of RCC Plant Yard**



**Figure 2-4: Re-vegetation of CVC Plant Yard**

#### 2.3.1.2 Quarry

The final blasting was carried out 27 March 2018. GOL have acknowledged that the quarry operation is completed. After several inspections by GOL and ADB for the Lenders, the quarry site has been improved by such as partial levelling, vegetation at the berms of slopes and large rock installation at top of slopes from an environmental and a safety point of view. Fence for safety was installed at top slope at right side. The grading at the quarry bottom and spreading of top soil was completed in January 2020.



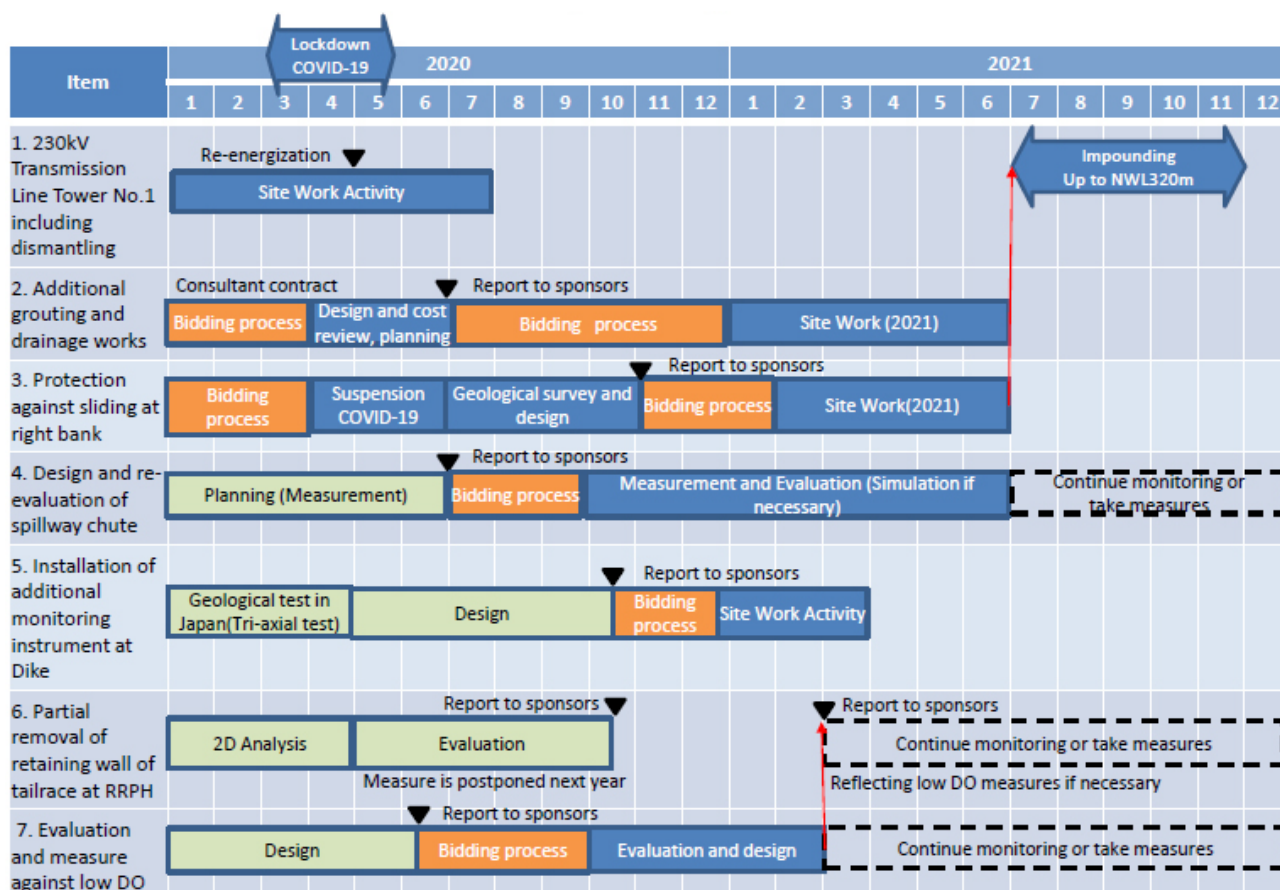
**Figure 2-5: Quarry Area View Showing Re-Vegetation and Safety Fence Installation**

### 2.3.2 Disposal Areas and Solid Waste Landfill Sites

The operation of both HSRA and Project landfills is ongoing with collection waste material from Resettlement “Phouhomxay”, neighbour villages and the Owner Site Office and Village.

**Figure 2-6: Phase 2 of Project Landfill Development on 08 June 2017****Current condition of landfill****2.3.3 Remaining Work**

As shown in **Figure 2.7**, there remain seven items of significant works. Nos. 1, 2, 3, 4 are related to the main powerhouse and Nos. 5 and 6 are related to the re-regulation powerhouse. Nos 7 is related to power operation and environmental issues.

**Figure 2-7: Schedule of Significant Remaining Works in 2020**



## 2.4 TRANSMISSION SYSTEM

### 2.4.1 Tower No.1 of 230 kV TL Replacement and Dismantling

The Tower No.1 was damaged due to the slope failure of approximately 150 m<sup>3</sup> volume of material above and behind Tower No.1 that occurred overnight on 17 to 18 of August 2019. Some of the structural steel members of the Tower No.1 were deformed. Tower No.1 did not move significantly but remained an unsafe structure. Movement of the upper part of the steel structure of the tower was observed.

Therefore, a Temporary Tower No.1 was constructed and the transmission line was moved to it from the damaged tower over the period 06 to 24 September 2019. The construction of the permanent Replacement Tower No.1, disassembly of existing Tower No.1 was contracted in late December 2019. The foundation excavation of legs for new Tower No.1 started in the middle of January 2020 and was completed on February 2020; the damaged Tower No.1 was almost dismantled in January 2020. The installation of gantry structure and new Tower No.1 was completed in the beginning of April 2020. Energization test was completed on 30 April 2020. Remaining works including slope protection around the Tower will be completed by the end of July 2020.

## 3. ENVIRONMENTAL MANAGEMENT MONITORING

### 3.1 COMPLIANCE MANAGEMENT

In June 2020, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) did not receive any document for review and approval.

The status of compliance reports (Observation of Non-Compliance or ONC, Non-Compliance Report or NCR) issued by NNP1PC to the Contractors is summarized in **Table 3-2**. The pending NCR1 related to site rehabilitation requirement at the former LILAMA10 camp will not be resolved until the country's COVID-19 lockdown is lifted, when the Japanese Contractor can come back to check the site condition and conduct the revegetation work as required by NNP1PC. These pending ONCs and NCR issues will be followed up and reported in the next MPR.

**TABLE 3-1: SUMMARY OF ONCs AND NCRs**

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from May 2020	6	1	0	0
Newly Opened in June 2020	0	0	0	0
<b>Total in June 2020</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>
Resolved in June 2020	2	0	0	0
Carried over to July 2020	4	1	0	0
Unsolved Exceeding Deadlines	4	1	0	0

### 3.1.1 Site Inspection by Environment Management Unit

On 10 June 2020, representatives from the Department of Pollution Control, Ministry of Natural Resources and Environment (MONRE); Bolikhamxay Provincial Office of Natural Resources and Environment (PONRE); Bolikhan District Office of Natural Resources and Environment (DONRE) who acts as an EMU (Bolikhamxay Province); Xaysomboun PONRE and Thathom DONRE (Xaysomboun Province) conducted a joint site inspection at the Project site. No major environmental issues were identified. The Government requested NNP1PC to disburse the first EMU fund to GOL in September 2020, submit a plan for resolving the low DO downstream of the re-regulation reservoir, submit an Emergency Action Plan and train local villagers to be aware of the evacuation plan. NNP1PC also requested support from MONRE to convey NNP1PC's concerns to the designated GOL authorities about the solid waste, and pesticides and chemical fertiliser usage by the banana plantation located in Hat Gniun and Thahuea Villages and the risk of impacts on the water quality in Nam Ngiep and local people's health to also avoid reputational damage to NNP1PC.

### 3.1.2 Site Decommissioning and Rehabilitation

The decommissioning of all 22 sites including construction sites, camps, workshops and other associated facilities was successfully completed by the end of March 2020 and rehabilitation has been ongoing in all sites following the Construction Site Decommissioning and Rehabilitation Plan (CSDRP) except at the former Lilama 10 Camp. All areas with suitable soil and site conditions in 21 sites were successfully revegetated with local grass and local tree species (former V&K camp, Song Da5 camp 1 and OC camp). The Civil Works Contractor has appointed sub-contractors to maintain these revegetated sites.

At the former LILAMA10 camp, the Contractor responded to the NCR level 1 issued by NNP1PC-EMO on 15 April 2020 that it will complete the vegetation work after the country's COVID-19 lockdown is lifted.

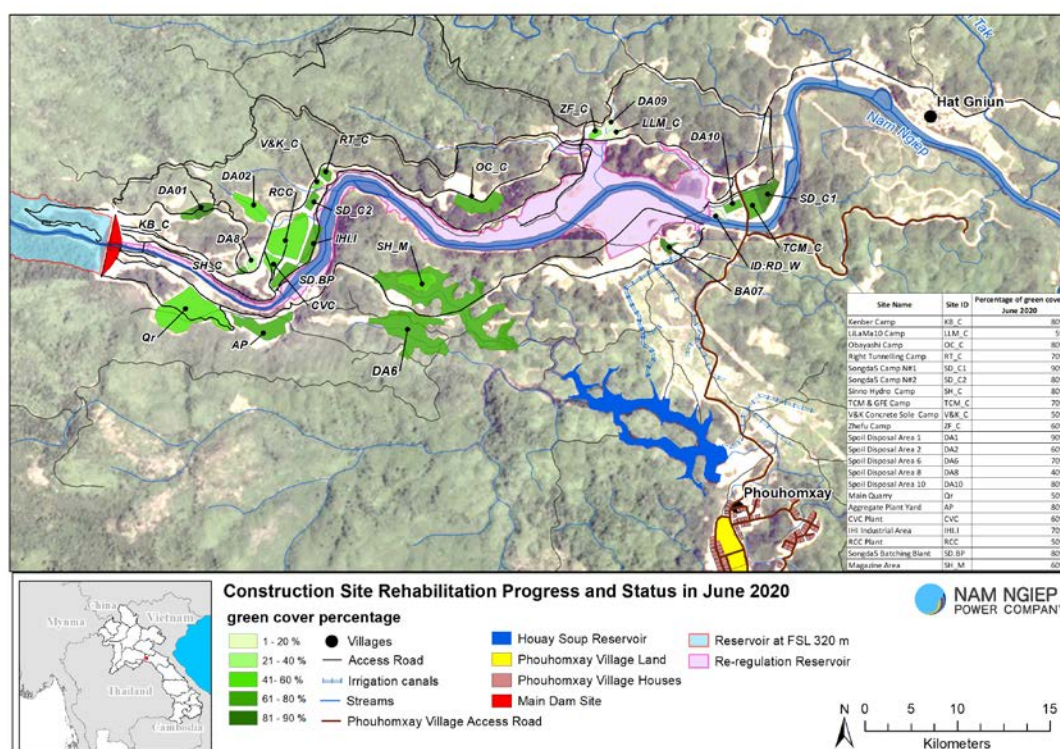
The status of site rehabilitation and revegetation is summarized in *TABLE 3-2* and *FIGURE 3-1*.

**TABLE 3-2: SUMMARY STATUS OF CONSTRUCTION SITE REHABILITATION**

No	Site Name	Status of Decommissioning	Status of Re-vegetation	Percentage of green cover
01	KENBER camp	Completed	Completed	80
02	LILAMA10 camp	Completed	Pending	5
03	OBAYASHI camp	Completed	On-going	80
04	Right Tunneling camp	Completed	On-going	70
05	Song Da5 camp No.1	Completed	On-going	90
06	Song Da5 camp No.2	Completed	On-going	80
07	TCM and GFE camp	Completed	Completed	70
08	V&K camp	Completed	On-going	50

No	Site Name	Status of Decommissioning	Status of Re-vegetation	Percentage of green cover
09	ZHEFU camp	Completed	Completed	60
10	Sino Hydro camp	Completed	Completed	80
11	Spoil Disposal Area No.1	Completed	Completed	90
12	Spoil Disposal Area No.2 and Main Dam workshop	Completed	On-going	60
13	Spoil Disposal Area No.6	Completed	On-going	70
14	Spoil Disposal Area No.8	Completed	On-going	40
15	Spoil Disposal Area No.10	Completed	Completed	80
16	Main Quarry	Completed	On-going	50
17	Aggregate plant yard	Completed	Completed	80
18	CVC plant yard	Completed	On-going	60
19	RCC plant yard	Completed	On-going	50
20	IHI field shop & Labor camp	Completed	Completed	70
21	Song Da5 batching plant & stock yard	Completed	On-going	90
22	Son Da5 magazine	Completed	On-going	60

FIGURE 3-1: REVEGETATED SITES





### 3.2 ENVIRONMENTAL QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD<sub>5</sub>), Faecal Coliform, E. Coli Bacteria and Total Coliform 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/>

Due to the country's COVID-19 lockdown since mid-March 2020 until the end of June 2020, no water samples were shipped to UAE Laboratory in Thailand. The water samples were measured the in-situ parameters and the 5 parameters (TSS, BOD<sub>5</sub>, Faecal Coliform, E. coli Bacteria and Total Coliform) were analysed at NNP1 Project Environmental Laboratory. Therefore, there are no results for COD, Ammonia-Nitrogen, Total Nitrogen, Total Phosphorus and Oil and Grease in this reporting month.

#### 3.2.1 Effluent Discharge from Camps and Construction Sites

Detailed monitoring results are provided in the **Annex B** of this Report. The effluent camp monitoring results in June 2020 indicated non-compliances for total coliform and faecal coliform in some camps.

The status of the implementation of the corrective actions addressing non-compliances at the camps and key project facilities that continue to have non-compliances are summarized in below.

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

Site	Sampling ID	Status	Corrective Actions
<b>OSOV1</b>	EF01	Non-compliance for faecal coliform and total coliform in the first fortnightly sampling. However, full compliance in the second fortnightly sampling	- The ADM was instructed to conduct regular maintenance work (wetland weeding and cleaning).
<b>OSOV2 (ESD Camp)</b>	EF13	Non-compliance for faecal coliform and total coliform.	<ul style="list-style-type: none"> <li>- General maintenance of the WWTS was improved. However, chlorine dripping ratio is less than the recommended dosage (3 ml/mn);</li> <li>- Improvements to the operation were discussed with the site ADM and this will be followed up and reported in the next fortnightly monitoring.</li> </ul>
	EF14	Non-compliance for faecal coliform and total coliform.	
<b>Main Powerhouse</b>	EF19	Full compliance.	

### 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 Phouane [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 location of the monitoring stations is shown in Figure 3-2.

Due to the country's lockdown, only pH, DO, Conductivity, Temperature, Turbidity, TSS, BOD<sub>5</sub>, Faecal Coliform and Total Coliform were measured and analysed in June 2020.

The monitoring results for key parameters (DO, TSS and BOD<sub>5</sub>) during June 2020 are presented in **Table 3-5, 3-6 and 3-7**. The full set of data for June 2020 is attached in **Annex A**. In addition, the results for DO are presented as line graphs in **Figure 3-3**.

#### Main Reservoir

From 01 to 14 June 2020, the water level in the main reservoir decreased from El. 298.2 m asl to El. 297.5 m asl, where after the main reservoir started filling-up and the water level reached El. 298.2 m asl on 30 June 2020.

At R5, during June 2020, the DO level in the upper 6.5 m was generally between 6 mg/L and 7 mg/L, and an oxycline had formed at a depth between 7.0 m and 10.0 m corresponding to El. 288 m asl – 290 m asl. The entire water column below 18.0 m had a DO level of less than 1 mg/L.

At R4, the DO concentrations in the upper 5.5 m was generally between 6 mg/L and 7 mg/L, and in the entire water column below 8.0 m, the DO concentration was less than 2 mg/L.

The DO concentrations at R3 were recorded between 7 mg/L and 8 mg/L in the upper 4.0 m and below 8 m, the concentration of DO was generally between 3 mg/L and 1 mg/L.

At R2, the DO concentrations in the entire water column were generally between 3.4 and 8.8 mg/L.

At R1, the DO level was generally about 6 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 – 250 mg/L and low flow season means of 20 - 50 mg/L.

The BOD<sub>5</sub> measurement at R3, R4 and R5 in the epilimnion were within the standard, but in the hypolimnion, BOD<sub>5</sub> was recorded at 10.38 mg/L, 6.36 mg/L and 4.6 mg/L respectively, exceeding the standard.

#### Re-regulation Reservoir

In June 2020, the turbine discharges from the main powerhouse varied between 150 m<sup>3</sup>/s and 220 m<sup>3</sup>/s and usually interrupted by night-time periods with no discharge.

The DO measurements at R6 and R7 representing turbine discharges from the main dam generally had DO concentrations below 4 mg/L in the entire water column.

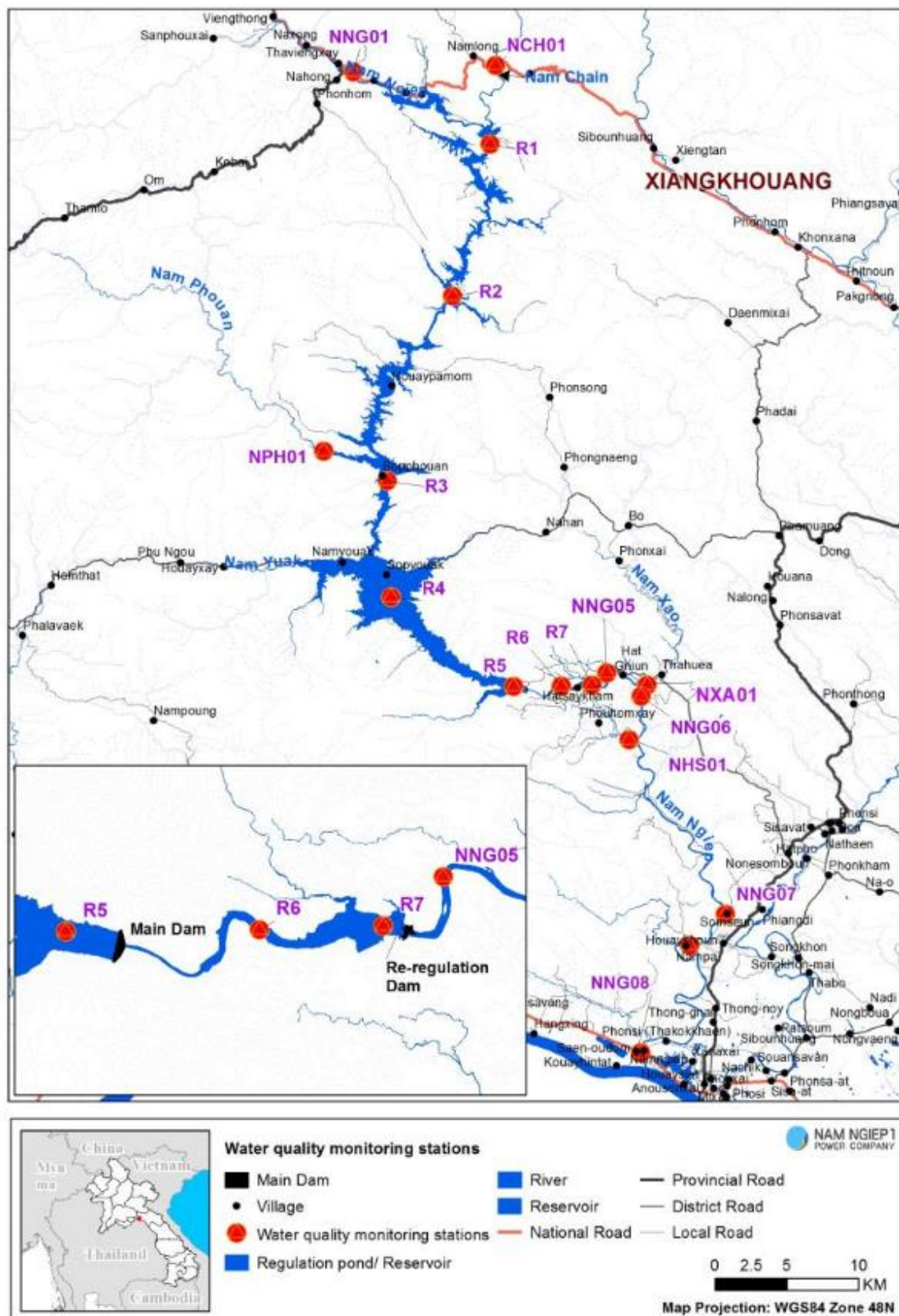
The BOD<sub>5</sub> concentration in R6 and R7 were 3.49 and 2.48 mg/L respectively.

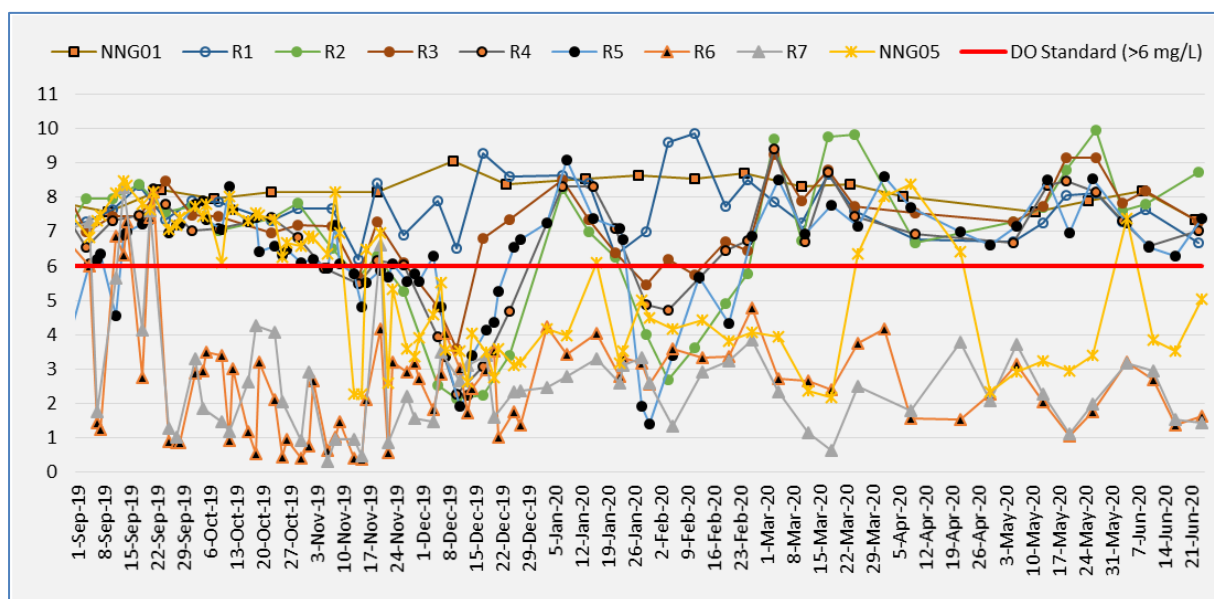
### **Downstream**

During June 2020, the discharge from the re-regulation dam alternated between discharges from the gate and turbines. All DO concentrations (except on 04 June 2020 during gate discharge) were less than 6 mg/L at the Nam Ngiep downstream stations and thus are non-compliant with the GoL Standard. No dead fish were observed in Nam Ngiep downstream during the periods with low DO. NNP1PC is in the process of hiring an international consulting company to assist with the design of additional aeration system to improve the DO level at downstream.

The BOD<sub>5</sub> in the downstream stations were below 1.86 mg/L.

**FIGURE 3-2: SURFACE WATER AND RE-REGULATION RESERVOIR WATER QUALITY MONITORING STATIONS**



**FIGURE 3-3: Concentration of Dissolved Oxygen in the Upper 0.2 m since September 2019 to June 2020****TABLE 3-4: 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
3-Jun-20		7.28	7.61	7.83	7.31									8.75		
4-Jun-20						7.26	3.21	3.17	7.38	7.05	6.89	6.8			6.95	7.08
8-Jun-20	8.2												7.48			
9-Jun-20		7.64	7.81	8.17										8.18		
10-Jun-20					6.57	6.55										
11-Jun-20							2.68	2.95	3.83	3.04	5.8	5.56			5.38	5.88
17-Jun-20						6.29	1.37	1.53	3.53	4.3	5.92	6.06			6.48	6.03
22-Jun-20	7.34												8.47			
23-Jun-20		6.66	8.73	7.3	7.02									7.89		
24-Jun-20						7.39	1.63	1.44	5.03	4.95	4.09	5.81			6.59	6.7

**TABLE 3-5: 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
8-Jun-20	10.53												9.26			
9-Jun-20		346.19		6.6										65.87		
9-Jun-20 - Hypolimnion				23.58												
10-Jun-20					<5	<5										
10-Jun-20 - Hypolimnion					12.01	6.36										
11-Jun-20							<5	<5	5.8	<5	14.69	14.41			14.13	5.24

**TABLE 3-6: RESULTS OF SURFACE WATER QUALITY MONITORING FOR BOD<sub>5</sub> (MG/L) - WATER QUALITY STANDARD: < 1.5 MG/L**

BOD <sub>5</sub> (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
8-Jun-20	<1												<1			
9-Jun-20		<1		<1										<1		
9-Jun-20 - Hypolimnion				10.38												
10-Jun-20					<1	<1										
10-Jun-20 - Hypolimnion					6.36	4.6										
11-Jun-20							3.49	2.48	1.42	1.86	<1	<1			<1	<1

### 3.2.3 Groundwater Quality Monitoring

During June 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 results indicated compliance with the groundwater quality standards for water supply purposes, except for faecal coliform and E.Coli bacteria as presented in Table below.



**TABLE 3-7: GROUNDWATER QUALITY MONITORING RESULTS IN SOMSUEN, NAM PA, THONGNOY AND POU VILLAGES**

Parameter (Unit)	Site Name	Somseun Village	Nam Pa Village	Thong Noy Village	Pou Village	Phouhomxay Village	
	Station	GSXN01	GNPA01	GTHN01	GPOU01	GPHX01	GPHX02
	Guideline						
pH	6.5 - 9.2	7.54	7.56	7.04	7.96	6.06	6.2
Sat. DO (%)		78.2	80.7	56.3	88.8	33.3	27.8
DO (mg/L)		6.12	6.31	4.3	6.46	2.59	2.17
Conductivity (µS/cm)		337	375	396	14.86	209	276
Temperature (°C)		27.21	27.99	29.34	29.1	26.5	26.6
Turbidity (NTU)	<20	1.75	1.71	2.03	3.04	2.35	2.32
Faecal Coliform (MPN/100 mL)	0	2	4	240	0	6.8	1.8
E.coli Bacteria (MPN/100 mL)	0	0	4	240	0	6.8	1.8

### 3.2.4 Landfill Leachate Monitoring

During June 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 NNP1 Project Landfill and Houay Soup Landfill did not comply with the total coliform standard. However, the leachate is still contained in the leachate ponds without discharging to the environment. EMO will continue to monitor the leachate and report the results in the next monthly progress report. The landfill leachate monitoring results for June 2020 can be found in Table below.

**TABLE 3-8: 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								
1-Jun-20	pH	6.0-9.0					8.71		8.15	
1-Jun-20	Sat. DO (%)						130.6		139.7	
1-Jun-20	DO (mg/L)						9.45		10.33	
1-Jun-20	Conductivity (µS/cm)						59.1		330	
1-Jun-20	Temperature (°C)						30.5		29.3	
1-Jun-20	Turbidity (NTU)						37.25		10.56	
1-Jun-20	BOD <sub>5</sub> (mg/L)	<30					8.94		15.0	

		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							
1-Jun-20	Faecal Coliform (MPN/100 mL)	<400				11		0	
1-Jun-20	Total Coliform (MPN/100 mL)	<400				920		920	

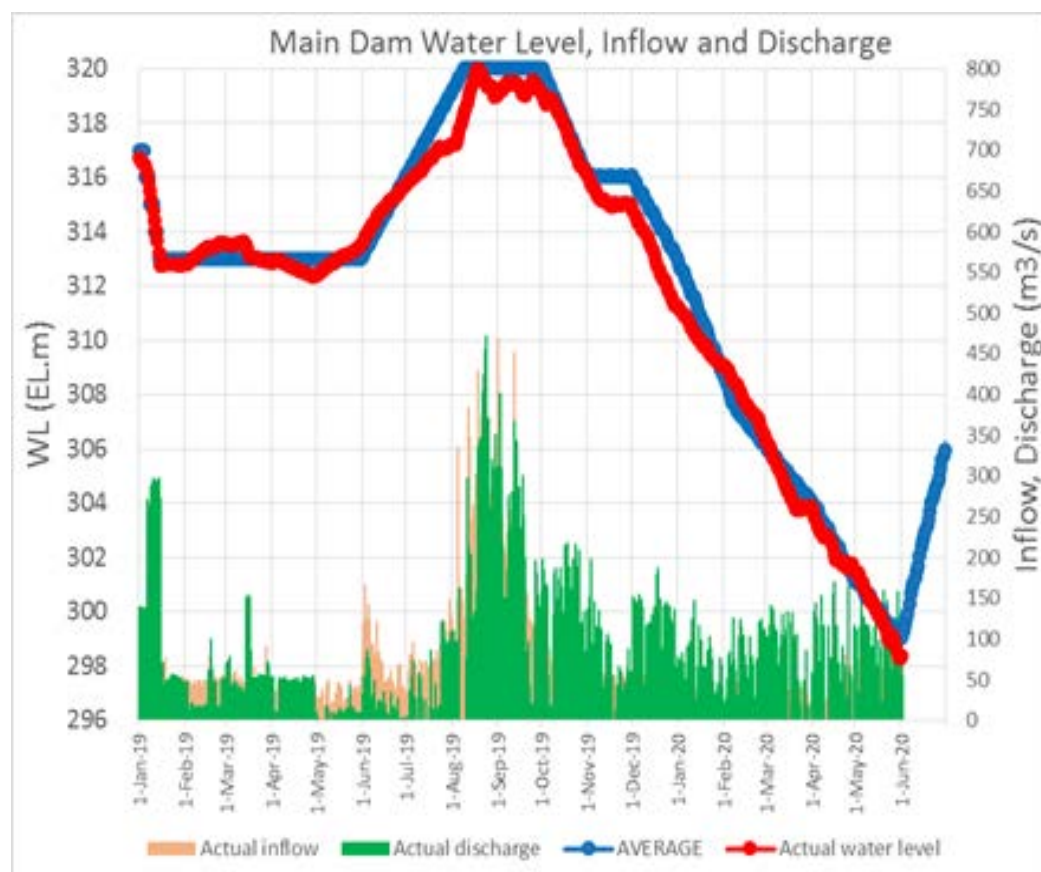
### 3.2.5 Discharge Monitoring

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 3-4.

During June 2020, the mean inflow to the main reservoir was 65 m<sup>3</sup>/s during the first 2 weeks where after the inflow increase to a mean of about 140 m<sup>3</sup>/s during the remaining part of June 2020 corresponding to the onset of the wet season.

From 01 to 14 June 2020, the water level in the main reservoir decreased from El. 298.2 m asl to El. 297.5 m asl, where after the main reservoir started filling-up and the water level reached El. 298.2 m asl on 30 June 2020.

**FIGURE 3-4: WATER LEVEL, INFLOW AND DISCHARGE FOR THE MAIN RESERVOIR**



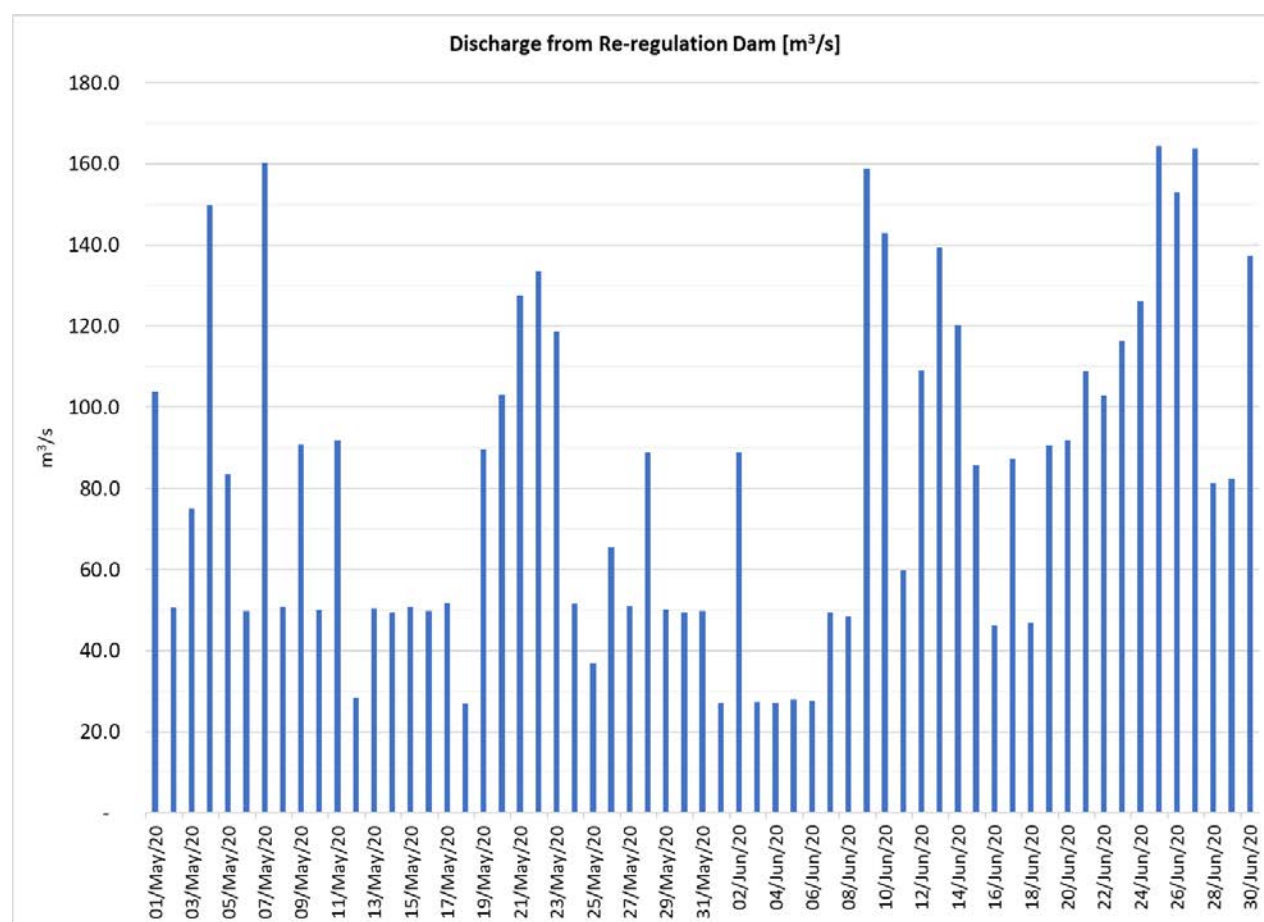


The discharge monitoring data for the re-regulation dam during May and June 2020 is presented in Figure 3-5.

During June 2020, the mean discharge from the re-regulation dam was about 90 m<sup>3</sup>/s with turbine discharges varying between 50 and 160 m<sup>3</sup>/s, interrupted by periods with gate discharge of about 28 m<sup>3</sup>/s. In the second half of the month there were also periods with combined gate and turbine discharge. The discharge was kept above the minimum flow requirement of 27 m<sup>3</sup>/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 3-5: DISCHARGE MONITORING AT THE RE-REGULATION DAM IN MAY AND JUNE 2020**



### 3.2.6 Nam Ngiep Downstream Water Depth Monitoring

In June 2020, EMO carried out four 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 but none of them were found to be difficult to navigate.

### 3.3 PROJECT WASTE MANAGEMENT

#### 3.3.1 Solid Waste Management

In June 2020, a total of 19.4 m<sup>3</sup> of solid waste was disposed of at the NNP1 Project Landfill, an increase of 2.8 m<sup>3</sup> compared to May 2020.

During June 2020, the local waste collection Contractor continued with the routine waste disposal and maintenance activities which included a bi-weekly waste covering, perimeter fence maintenance and cleaning-up sediment from the ditch surrounding the leachate ponds to prevent the run-off entering into the leachate ponds.

None of recyclable waste was sold this month and its cumulative is presented in Table 3-9.

**TABLE 3-9: AMOUNTS OF RECYCLABLE WASTE SOLD**

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by June 2020
1	Glass bottles	kg	0	53
2	Plastic bottles	kg	0	50
3	Paper/Cardboard	kg	0	48
4	Aluminium cans	kg	0	48
<b>Total</b>		<b>kg</b>	<b>0</b>	<b>182</b>

The villagers from Phouhomxay Village collected a total of 822 kg of food waste from the OSOV1 canteen for animal feed in June 2020, a decrease of 78 kg compared to April 2020.

#### 3.3.2 Hazardous Materials and Waste Management

The types and amounts of hazardous material and hazardous waste stored on site in June 2020 are shown in Table 3-10 and Table 3-11.

**TABLE 3-10: RECORD OF HAZARDOUS MATERIAL INVENTORY**

No.	Type of Hazardous Material	Unit	Total in June 2020 (A)	Used (B)	Remainder (A – B)
1	Diesel	Litre	5,161	4,745	416
2	Gasoline	Litre	1,000	175	825
3	Gear Lubricant	Litre	646	0	646
4	Liquid Chlorine	Litre	80	20	60
5	Grease	Drum (25 L)	29	0	29
6	Chlorine Powder	Kg	65	0	65
7	Sika	Can	7	0	7
8	Colour paint	Drum (20 L)	3	0	3
9	Thinner	Drum (3 L)	1	0	1

**TABLE 3-11: RECORD OF HAZARDOUS WASTE INVENTORY**

No.	Hazardous Waste Type	Unit	Total in June 2020 (A)	Dispose (B)	Remainder (A - B)
1	Used oil	Litre	112	0	112
2	Ink cartridge	Unit	142	0	142
3	Halogen/fluorescent bulbs	Unit	209	0	209
4	Empty spray can	Can	101	0	101
5	Contaminated soil/sand	Cubic Metre (m <sup>3</sup> )	0.39	0	0.39
6	Clinic waste	kg	8.1	0	8.1

### 3.4 COMMUNITY WASTE MANAGEMENT

#### 3.4.1 Community Recycling Programme

In June 2020, the Community Recycle Waste Bank received 15 Kg of recyclables from host villages. A total of 3,137 Kg of recyclable waste stored in the waste bank.

**TABLE 3-12: TYPES AND AMOUNTS OF RECYCLABLE WASTE TRADED AT THE COMMUNITY RECYCLE WASTE BANK**

Types of Waste	Unit	Remaining in May 2020	Additional in June 2020	Sold/dispose	Remaining in June 2020
Glass bottles	kg	2,234	15	0	2,249
Paper/cardboard	kg	852.5	0	0	852.5
Plastic bottles	kg	35.5	0	0	35.5
Aluminium cans	kg	0	0	0	0
Scrap metal	kg	0	0	0	0
<b>Total</b>	<b>kg</b>	<b>3,122</b>	<b>15</b>	<b>0</b>	<b>3,137</b>

#### 3.4.2 Community Solid Waste Management

Approximately 17.1 m<sup>3</sup> of solid waste was collected from the host and Phouhomxay Villages for disposal at Houay Soup landfill, it was the same amount compared to May 2020.

### 3.5 WATERSHED AND BIODIVERSITY MANAGEMENT

#### 3.5.1 Watershed Management

##### 3.5.1.1 Implementation of Annual Implementation Plan (AIP) 2019

Xaysomboun Provincial WRPO conducted TPZ boundary survey and verification between 8-26 June 2020 in Hom and Anouvong Districts. The results will be reported in the next monthly reporting.

Xaysomboun Provincial WRPO also conducted reservoir patrol activity between 19-26 June 2020 in the reservoir Zone 4 of Thathom District and in the reservoir zone 2 and 3 of Hom District. The results will be reported in the next monthly reporting.

Bolikhamay Provincial WRPO submitted the monthly progress report of May 2020. It is noted that the reservoir patrol activity was carried out and the patrol team encountered with two cases of land encroachment totalling around 29 ha for upland rice plantation and three cases of illegal logging. These cases were recorded close to NNP1 main reservoir at Phonsong Village, Bolikhan District. The patrol team issued warning letters to the offenders and submitted a report to District Office of Forest Inspection (DOFI) for further action.

NNP1PC and the Fishery Consultant have improved the final draft of Fishery Co-Management Plan (FCMP) and Xaysomboun Provincial Regulation for fishery management based on the comments during the final technical workshop held in May 2020. The final draft of FCMP is being translated to English and will be submitted to ADB for review and comment prior to approval by Xaysomboun PAFO.

NNP1PC and the Livelihood Consultant have improved the final report of assessment on sustainable livelihood opportunities for NNP1 watershed communities based on the technical workshop in May 2020.

### **3.5.2 Biodiversity Offset Management**

#### **3.5.2.1 Engagement of Biodiversity Service Provider (BSP)**

NNP1PC finalized the fourth draft of Memorandum of Understanding (MOU) to be signed between ADB, WCS and NNP1PC on 18 May 2020. The ADB and WCS (as Biodiversity Service Provider) agreed with the revised draft on 19 May 2020 and 17 June 2020 respectively. ADB shared the final draft of MOU with NNP1PC for confirmation on 17 June 2020.

NNP1PC organized a kick-off meeting for the BSP to meet and get introduced to the Provincial GOL with Xaysomboun Provincial WRPO team on 04 June 2020. At this meeting, the overall BSP team introduction, role and responsibility, as well as mechanisms for reporting and monitoring by relevant agencies (GOL, NNP1PC and BSP) were discussed in detail.

NNP1PC-EMO and the BSP continued to make progress by having many unofficial discussions via phone calls and emails on several topics such as the preparation of a Law Enforcement Strategy (LES) document for NC-NX offset site, the future biological monitoring focussing on the design of camera traps and listening post survey for the NC-NX Offset Site and NNP1 sub-catchment, community outreach program, conservation linked livelihood and the training on patrolling and SMART.

#### **3.5.2.2 Implementation of BOMP Annual Implementation Plan (AIP) 2019 and 2020**

Bolikhamay Provincial NC-NX BOMU received the fund for the implementation of activities under the first and second quarters of AIP2020 from DOF-MAF on 08 June 2020.

Progresses on the implementation of key activities by Component in June 2020 are described below:

##### **a. Component 1 - Spatial Planning and Regulation**

Bolikhamay Provincial NC-NX BOMU resumed the NC-NX boundary post demarcation and TPZ signage installation in the five remaining villages that was scheduled from 17 June to 04 July 2020.

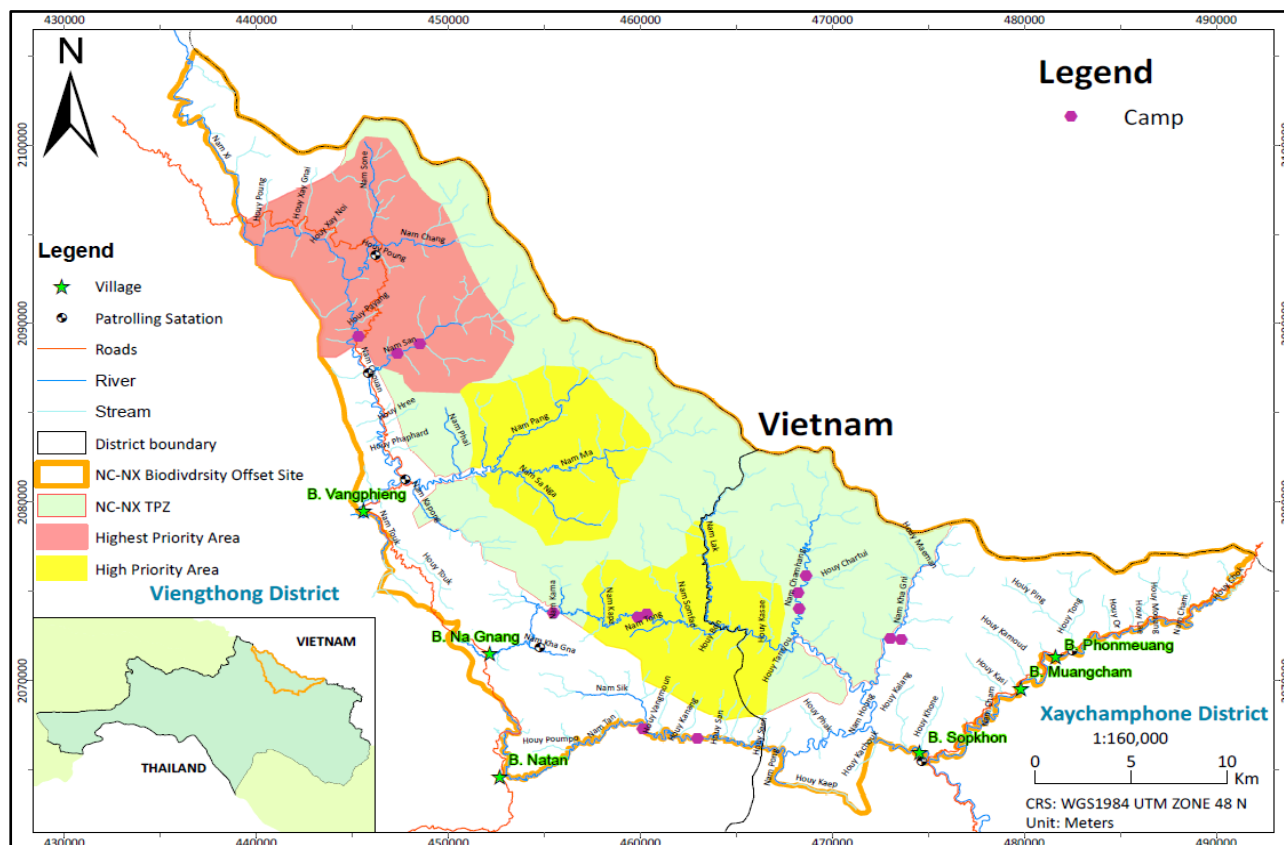
## **b. Component 2 – Law Enforcement**

The four patrol teams continued the patrolling between 10 to 30 June 2020 with the focus on the TPZ highest priority area around Nam Chouane, Nam Xi, Houay Xai Yai, Houay Xai Noi and Houay Pong and TPZ higher priority areas around Nam Phai, Nam Mong, Houay Phaphard, Houay Hree, Nam Houng, Nam Chamhung, Nam Sik and Nam Kha Gna. The results of June 2020 patrolling will be presented and discussed in July 2020 Monthly Report.

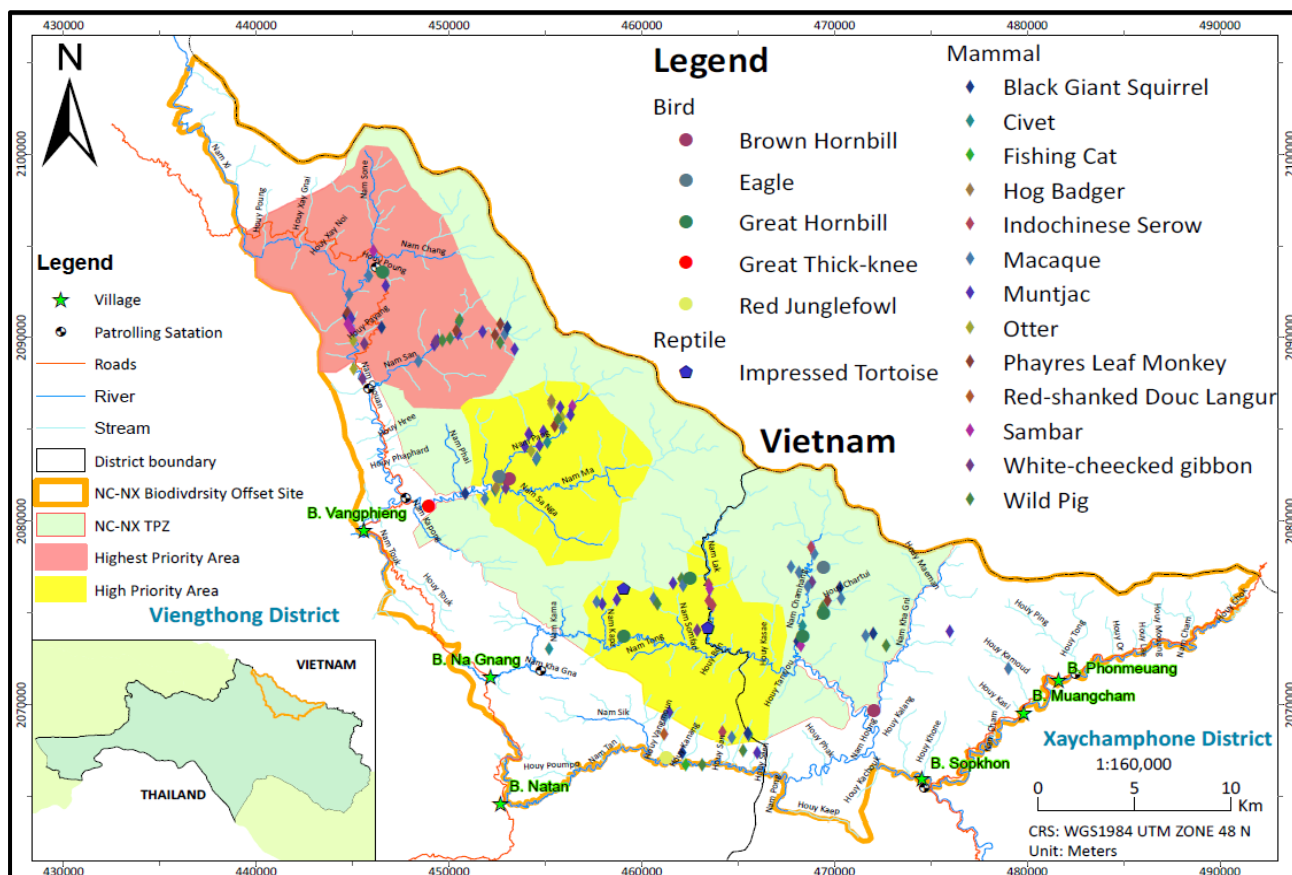
The results of patrolling activity in May 2020 are as follows:

- *The first team* carried out patrolling at TPZ highest priority area including Nam San, Nam Sone and Nam Chouane. They spent 16 days covering a distance of 69.2 km on forest patrolling and 9.8 km on road patrolling. The team made a total of six direct observations and seven indirect observations of the following wildlife: Phayre's leaf monkey, wild pig, Black Giant Squirrel, Civet, Otter, Sambar, and White-cheeked gibbons. The team also encountered with a number of threats such as recent use of two small fishing camps at Nam San and one small fishing camp at Nam Chouan. The camps were destroyed by patrolling team.
- *The second team* carried out patrolling at Nam Ma TPZ high priority area including Nam Ma, Nam Pang and Nam Mong. They spent 16 days covering a distance of 69 km on forest patrolling and 29 km on road patrolling. The team made a total of ten direct observations and seven indirect observations of the following wildlife: Civet, Eagle, Great Thick-knee, Hog Badgers, Macaque, Muntjac, Phayres leaf monkey, White-cheeked gibbons, Indochinese Serow, Otter, Sambar, and Wild Pig. The team did not encounter any threats during the patrolling.
- *The third team* carried out patrolling at Xaychamphone district area including Nam Houng, Nam Kha Gni, Nam Chamhang, Houay Kamoud, Houay Khone and Nam Chantui. They spent 16 days covering a distance of 84 km on forest patrolling. The team made a total of nine direct observations and four indirect observations of the following wildlife: Brown Hornbill, Civet, Eagle, Great Hornbills, Macaque, Muntjac, Phayre's Leaf Monkey, White-cheeked gibbons, Indochinese Serow, Sambar, and Wild Pig. The team also encountered a number of threats such as three fishing camps at Nam Chamhang and two hunting camps at Nam Kha Gni. The camps were destroyed by patrolling team.
- *The fourth team* carried out patrolling at Nam Houng TPZ high priority area including Nam Houng, Nam Tan, Nam Kha Gna, Nam Kapa, Nam Lak, Houay Vangmoun, Houay Kanang and Houay San. They spent 16 days covering a distance of 93.2 km on forest patrolling and 25.8 km on road patrolling. The team made a total of eight direct observation and seven indirect observations of the following wildlife: Muntjac, Red Junglefowl, Red-shanked Douc Langur, White-Cheeked gibbons, Civet, Fishing cat, Indochinese Serow, Macaque, Sambar, and wild pig. The team also encountered a number of threats such as three fishing camps at Nam Houng and two fishing camps at Nam Tan. The camps were destroyed by the patrolling team.

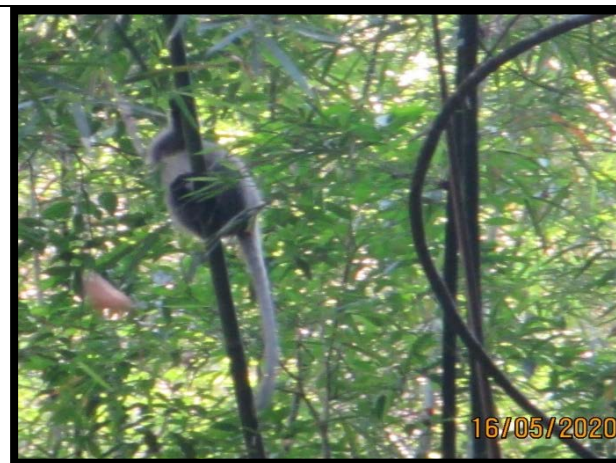
**FIGURE 3-6: MAP OF THREATS RECORDED BY PATROLLING TEAMS IN MAY 2020**



**FIGURE 3-7: MAP OF WILDLIFE SIGNS RECORDED BY PATROLLING TEAMS IN MAY 2020**





**FIGURE 3-8: FISHING CAMP OBSERVED BY TEAM 3 AT TPZ HIGH PRIORITY AREA****FIGURE 3-9: FISHING CAMP OBSERVED BY TEAM 4 AT TPZ HIGH PRIORITY AREA****FIGURE 3-10: PHAYRE'S LEAF MONKEY****FIGURE 3-11: GREAT THICK-KNEE****FIGURE 3-12: WHITE-CHEEKED GIBBON****FIGURE 3-13: GEAT HORNBILL**

### c. Component 4 – Conservation linked livelihood development

NNP1PC and the CDP consultant completed the field assessment in the six NC-NX villages on 02 June 2020, meeting and obtaining information from relevant projects in Bolikhamxay took place from 03-04 June 2020. The final technical workshop on the CDP was scheduled on 30 June - 01 July 2020.

### 3.6 FLOATING DEBRIS REMOVAL

There was no field work carried out during this reporting period.

## 4. FISHERY MONITORING

Four species groups and one species dominated the fish catch by weight in April and May 2020 as listed in **Table 4-1** and **TABLE 4-2**. All species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species<sup>1</sup>, except *Sikukia gudgeri* is classified as Data Deficient (DD).

**TABLE 4-1: FISH SPECIES DOMINATING THE FISH CATCH IN APRIL 2020**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Sikukia gudgeri</i> , <i>Amblyrhynchichthys truncatus</i>	ປາຂາວຊາຍ	169	DD, LC
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	120.6	LC
<i>Barbonymus gonionotus</i> , <i>Hypsibarbus malcomi</i> , <i>Hypsibarbus vernayi</i> , <i>Hypsibarbus wetmorei</i>	ປາປາກ	128.4	LC
<i>Channa striata</i>	ປາຄໍ່	72.6	LC
<i>Hampala dispar</i> , <i>Hampala macrolepidota</i>	ປາສູດ	71.2	LC

**TABLE 4-2: FISH SPECIES DOMINATING THE FISH CATCH IN MAY 2020**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Hampala dispar</i> , <i>Hampala macrolepidota</i>	ປາສູດ	141.1	LC
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	128.7	LC
<i>Barbonymus gonionotus</i> , <i>Hypsibarbus malcomi</i> , <i>Hypsibarbus vernayi</i> , <i>Hypsibarbus wetmorei</i>	ປາປາກ	120.2	LC
<i>Sikukia gudgeri</i> , <i>Amblyrhynchichthys truncatus</i>	ປາຂາວຊາຍ	124.1	DD, LC
<i>Channa striata</i>	ປາຄໍ່	84.2	LC

The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in April 2020 is presented in **Table 4-3**. The list includes two species that are classified as Vulnerable

<sup>1</sup> 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.



(VU) species and two Near Threatened (NT) species. Additionally, there are four species that are classified as Vulnerable (VU) species and two Near Threatened (NT) species in May 2020, which is presented in **Table 4-4**.

**TABLE 4-3: THREATENED SPECIES OF APRIL 2020 FISH CATCH**

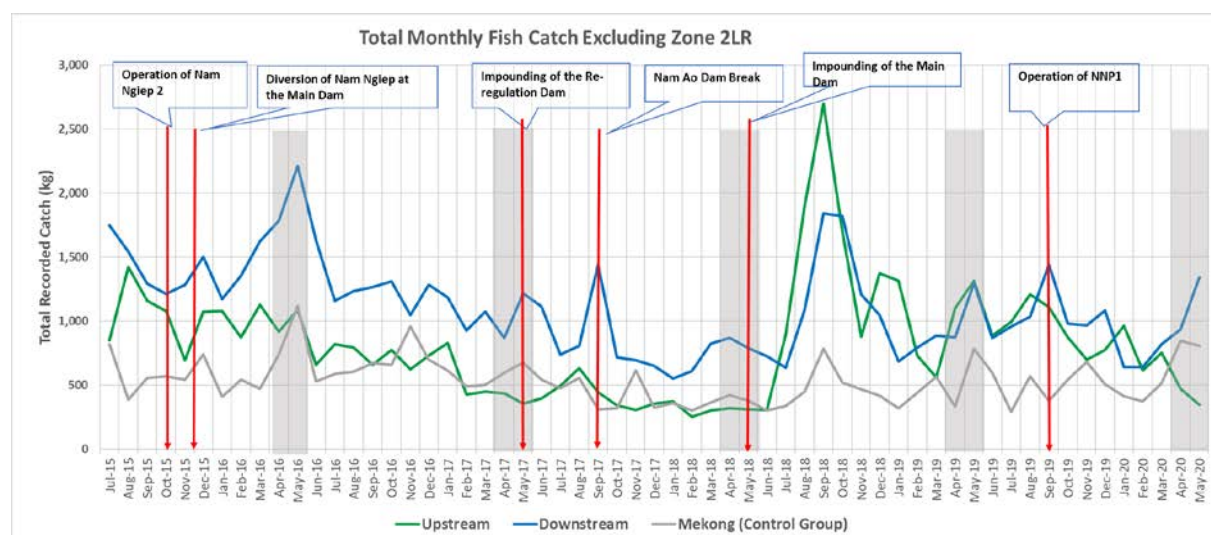
Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Neolissochilus stracheyi</i>	ປາສອງ	7.1	NT
<i>Onychostoma gerlachi</i>	ປາຄຶງ	6	NT
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປ່ຽນ	18.3	VU
<i>Tor sinensis</i>	ປາແດງ	19	VU

**TABLE 4-4: THREATENED SPECIES OF MAY 2020 FISH CATCH**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Cirrhinus cirrhosus</i>	ປານວນຈັນ/ປາແກງ	11	VU
<i>Cirrhinus molitorella</i>	ປາແກງ	3	NT
<i>Cyprinus carpio</i>	ປາໄນ	25	VU
<i>Neolissochilus stracheyi</i>	ປາສອງ	6.2	NT
<i>Onychostoma gerlachi</i>	ປາຄຶງ	7.2	NT
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປ່ຽນ	24.9	VU
<i>Tor sinensis</i>	ປາແດງ	3.8	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 May 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 – MAY 2020**

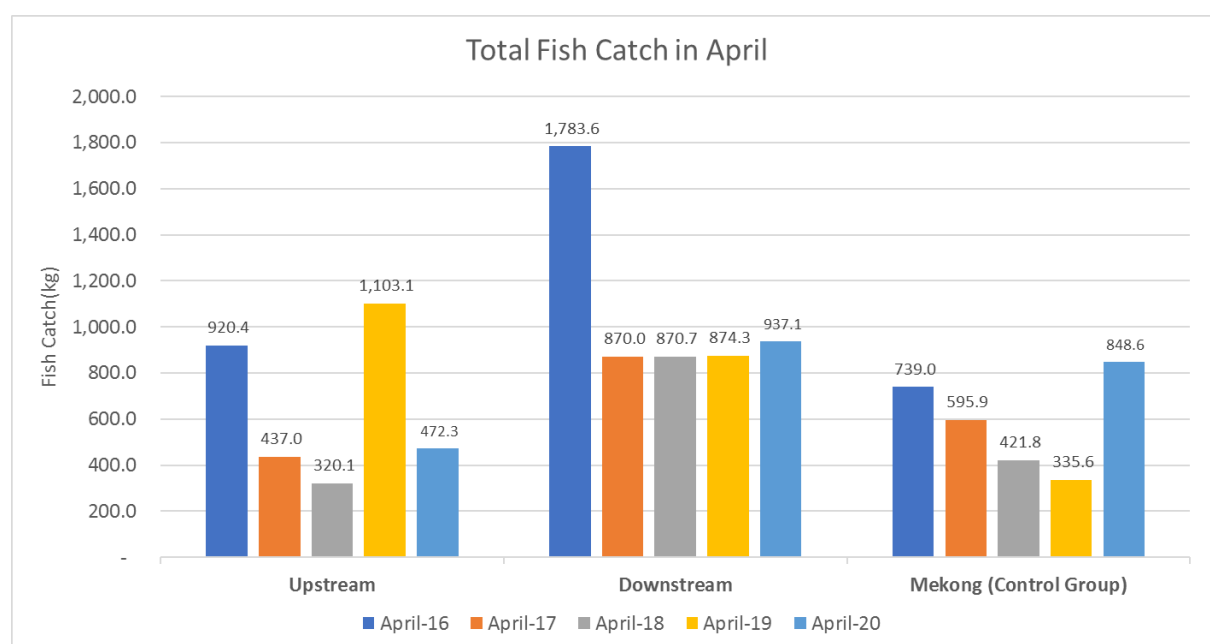


**Table 4-5** and **Figure 4-2** show the total recorded fish catch for April 2016, April 2017, April 2018, April 2019 and April 2020 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. While, **Table 4-6** and **Figure 4-3** show the total recorded fish catch for May 2016, May 2017, May 2018, May 2019 and May 2020. The total fish catch data represents the total fish supply provided by the involved fishing households.

**TABLE 4-5: TOTAL FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN APRIL 2016, APRIL 2017, APRIL 2018, APRIL 2019 AND APRIL 2020**

Fishing Zone	April 2016 (kg)	April 2017 (kg)	April 2018 (kg)	April 2019 (kg)	April 2020 (kg)
Upstream	920.4	437.0	320.1	1,103.1	472.3
Downstream	1,783.6	870.0	870.7	874.3	937.1
Mekong Control Group	739.0	595.9	421.8	335.6	848.6

**FIGURE 4-2: TOTAL FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN APRIL 2016, APRIL 2017, APRIL 2018, APRIL 2019 AND APRIL 2020**

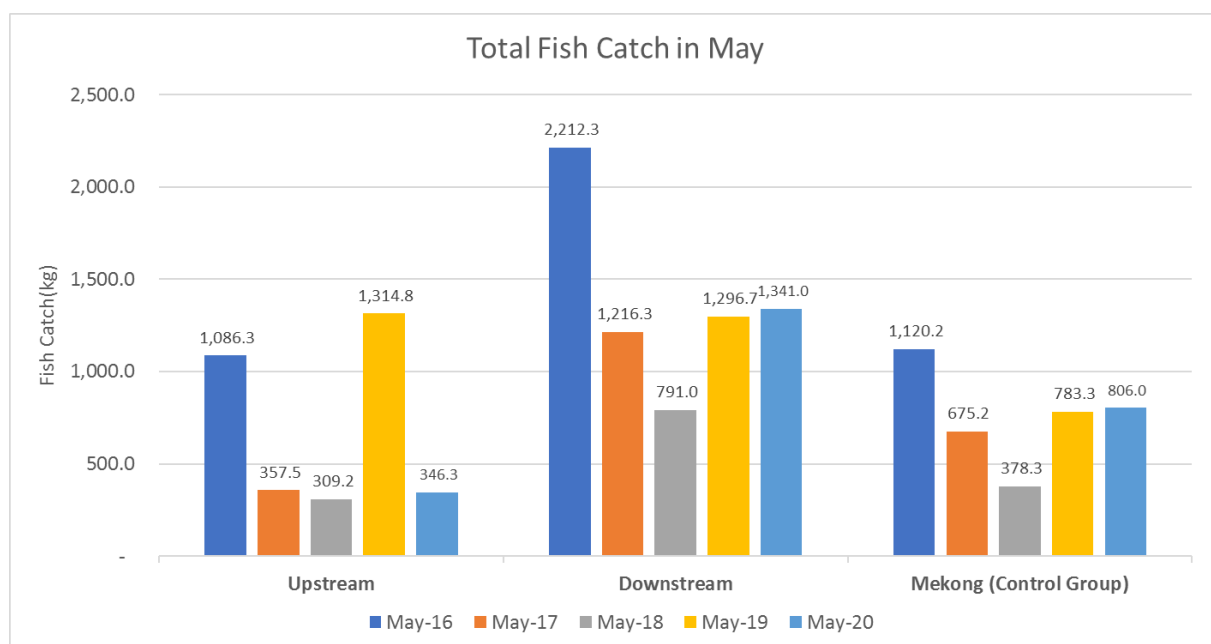


**TABLE 4-6: TOTAL FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN MAY 2016, MAY 2017, MAY 2018, MAY 2019 AND MAY 2020**

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)	May 2020 (kg)
Upstream	1,086.3	357.5	309.2	1,314.8	346.3
Downstream	2,212.3	1,216.3	791.0	1,296.7	1,341.0

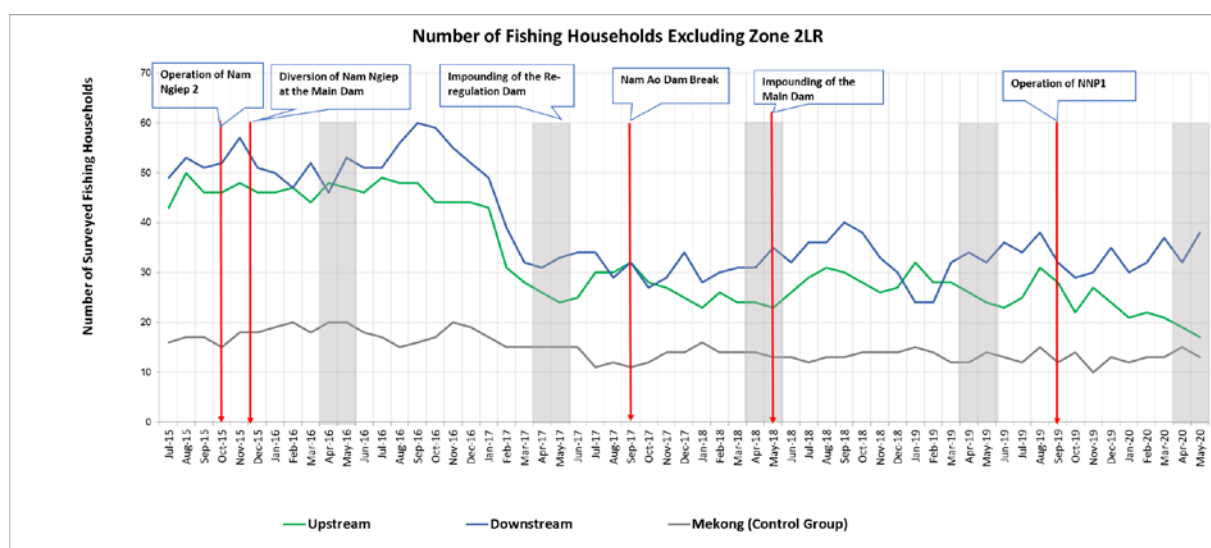
Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)	May 2020 (kg)
Mekong Control Group	1,120.2	675.2	378.3	783.3	806.0

**FIGURE 4-3: TOTAL FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN MAY 2016, MAY 2017, MAY 2018, MAY 2019 AND MAY 2020**



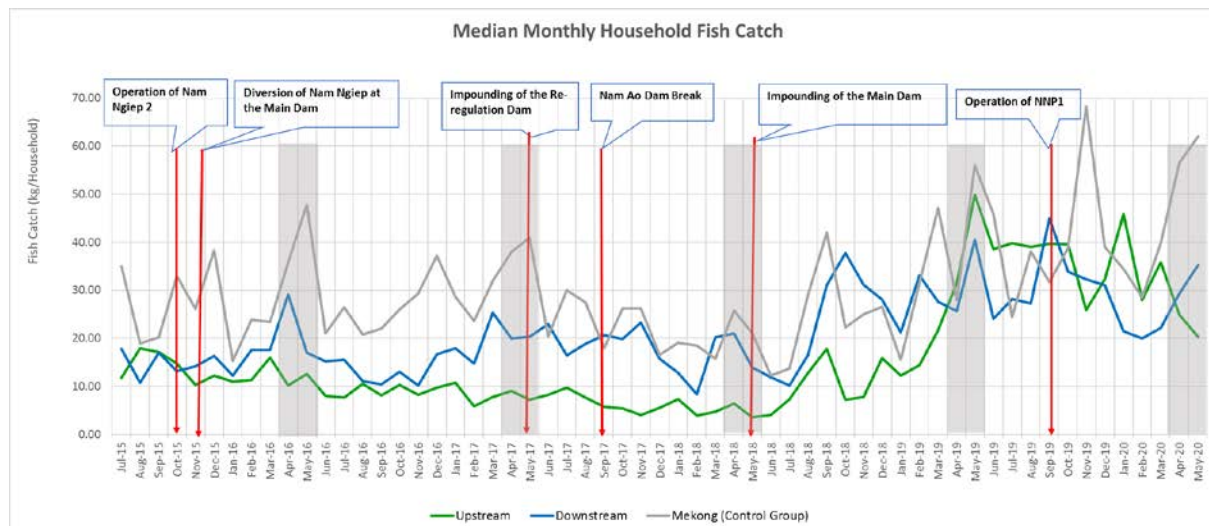
The numbers of fishing households involved in the fish catch monitoring programme are displayed in **Figure 4-4**.

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



The median monthly household fish catch from July 2015 to May 2020 for the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are presented in **Figure 4-5**.

**FIGURE 4-5: MEDIAN MONTHLY HOUSEHOLD FISH CATCH WITHOUT ZONE 2LR**



The median household fish catch for April 2016, April 2017, April 2018, April 2019 and April 2020 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group are displayed in **Table 4-7**. Moreover, **Table 4-8** shows the median household fish catch for May 2016, May 2017, May 2018, May 2019 and May 2020.

**TABLE 4-7: MEDIAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR IN APRIL**

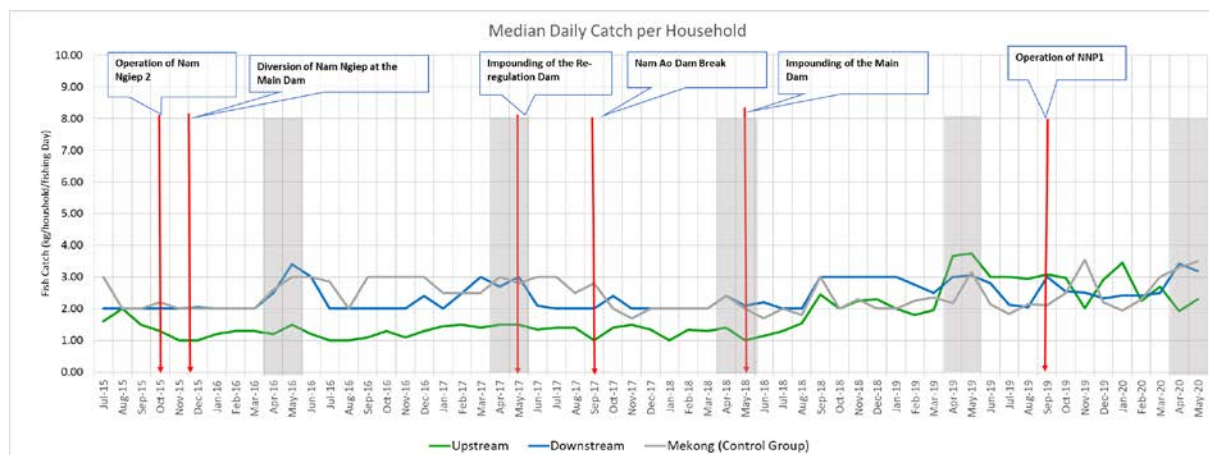
Fishing Zone	April 2016 (kg)	April 2017 (kg)	April 2018 (kg)	April 2019 (kg)	April 2020 (kg)
Upstream	10.3	9.0	6.4	31.5	24.9
Downstream	29.1	20.0	21.0	25.7	29.3
Mekong Control Group	35.8	38.0	25.8	28.0	56.6

**TABLE 4-8: MEDIAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR IN MAY**

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)	May 2020 (kg)
Upstream	12.6	7.2	3.6	49.8	20.4
Downstream	17.0	20.3	14.0	40.5	35.3
Mekong Control Group	47.8	41.0	21.1	55.9	62.0

The median daily fish catch per household are displayed in **Figure 4-6**, and the median fish catch per household per fishing day in April 2016, April 2017, April 2018, April 2019 and April 2020 are shown in **Table 4-9** and the median fish catch per household per fishing day in May 2016, May 2017, May 2018, May 2019 and May 2020 are displayed in **Table 4-10**.

**FIGURE 4-6: MEDIAN DAILY FISH CATCH PER HOUSEHOLD**



**TABLE 4-9: MEDIAN DAILY FISH CATCH PER HOUSEHOLD IN APRIL**

Fishing Zone	April 2016 (kg)	April 2017 (kg)	April 2018 (kg)	April 2019 (kg)	April 2020 (kg)
Upstream	1.20	1.50	1.40	3.67	1.93
Downstream	2.50	2.70	2.40	3.00	3.42
Mekong (Control Group)	2.60	3.00	2.40	2.18	3.30

**TABLE 4-10: MEDIAN DAILY FISH CATCH PER HOUSEHOLD IN MAY**

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)	May 2020 (kg)
Upstream	1.50	1.50	1.00	3.75	2.30
Downstream	3.40	3.00	2.10	3.05	3.19
Mekong (Control Group)	3.00	2.80	2.00	3.16	3.50

# 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**

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Re-regulation Reservoir		Downstream			
		Station Code	NN G01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NN G06	NN G07	NNG 08
Date	Parameters (Unit)	Guideline												
3-Jun-20	pH	5.0 - 9.0		6.77	7.34	7.9	6.86							
4-Jun-20	pH	5.0 - 9.0						6.84	6.93	6.98	7.63	6.89	6.71	6.65
8-Jun-20	pH	5.0 - 9.0	6.43											
9-Jun-20	pH	5.0 - 9.0		7.12	7.66	7.47								
10-Jun-20	pH	5.0 - 9.0					7.09	6.92						
11-Jun-20	pH	5.0 - 9.0							7.13	7.17	7.41	7.78	7.72	7.11
17-Jun-20	pH	5.0 - 9.0						7.51	6.96	7.03	6.97	7.36	7.45	7.42
22-Jun-20	pH	5.0 - 9.0	7.9											
23-Jun-20	pH	5.0 - 9.0		7.98	8.46	7.99	7.61							
24-Jun-20	pH	5.0 - 9.0						7.55	7.19	7.18	7.28	7.66	7.6	7.78
3-Jun-20	Sat. DO (%)			96.3	101.5	105.4	96.5							
4-Jun-20	Sat. DO (%)							94.8	39.8	40.9	93.6	91.2	89.9	57.4
8-Jun-20	Sat. DO (%)		110.4											
9-Jun-20	Sat. DO (%)			100.3	105	110.3								
10-Jun-20	Sat. DO (%)						88.3	87.2						
11-Jun-20	Sat. DO (%)								32.4	38	47.5	37.3	73.9	72.4
17-Jun-20	Sat. DO (%)							82.3	16.6	18.7	42.9	53.8	72.3	73.8
22-Jun-20	Sat. DO (%)		99.3											
23-Jun-20	Sat. DO (%)			86.4	116.3	98	93.9							
24-Jun-20	Sat. DO (%)							97.4	20	17.6	62.8	61.7	51.9	73.9
3-Jun-20	DO (mg/L)	>6.0		7.28	7.61	7.83	7.31							
4-Jun-20	DO (mg/L)	>6.0						7.26	3.21	3.17	7.38	7.05	6.89	6.8
8-Jun-20	DO (mg/L)	>6.0	8.2											
9-Jun-20	DO (mg/L)	>6.0		7.64	7.81	8.17								
10-Jun-20	DO (mg/L)	>6.0					6.57	6.55						
11-Jun-20	DO (mg/L)	>6.0							2.68	2.95	3.83	3.04	5.8	5.56
17-Jun-20	DO (mg/L)	>6.0						6.29	1.37	1.53	3.53	4.3	5.92	6.06
22-Jun-20	DO (mg/L)	>6.0	7.34											
23-Jun-20	DO (mg/L)	>6.0		6.66	8.73	7.3	7.02							
24-Jun-20	DO (mg/L)	>6.0						7.39	1.63	1.44	5.03	4.95	4.09	5.81
3-Jun-20	Conductivity (µs/cm)			104	101.5	105.4	75							
4-Jun-20	Conductivity (µs/cm)							72	86	83	70	89	63	44
8-Jun-20	Conductivity (µs/cm)		70.8											

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Re-regulation Reservoir		Downstream			
		Station Code	NN G01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NN G06	NN G07	NNG 08
Date	Parameters (Unit)	Guideline												
9-Jun-20	Conductivity (µs/cm)			77	94	78								
10-Jun-20	Conductivity (µs/cm)						75	72						
11-Jun-20	Conductivity (µs/cm)								86	82	86	86	82	70
17-Jun-20	Conductivity (µs/cm)							72	90	85	71	73	49	34
22-Jun-20	Conductivity (µs/cm)		130											
23-Jun-20	Conductivity (µs/cm)			99	87	78	73							
24-Jun-20	Conductivity (µs/cm)							72	87	85	83	87	81	72
3-Jun-20	Temperature (°C)			30.01	30.35	30.69	29.91							
4-Jun-20	Temperature (°C)							29.29	26.53	28.57	27.67	28.03	27.96	28.22
8-Jun-20	Temperature (°C)		28.3											
9-Jun-20	Temperature (°C)			29.1	31.2	31.12								
10-Jun-20	Temperature (°C)						30.8	30.35						
11-Jun-20	Temperature (°C)								25.5	26.48	26.25	26.31	27.68	29.1
17-Jun-20	Temperature (°C)							29.33	25.22	25.64	25.53	25.74	25.55	25.63
22-Jun-20	Temperature (°C)		28.5											
23-Jun-20	Temperature (°C)			28.85	30.43	21.29	30.69							
24-Jun-20	Temperature (°C)							29.72	25.79	25.78	26.58	26.62	27.04	27.74
3-Jun-20	Turbidity (NTU)			74.48	30.35	3.21	2.64							
4-Jun-20	Turbidity (NTU)							2.5	6.68	4.06	7	17.28	20.13	14.39
8-Jun-20	Turbidity (NTU)		11.33											
9-Jun-20	Turbidity (NTU)			64.71	4.53	3.72								
9-Jun-20	Turbidity (NTU) - Hypolimnion					2.58								
10-Jun-20	Turbidity (NTU)						3.21	2.07						



		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Re-regulation Reservoir		Downstream			
		Station Code	NN G01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NN G06	NN G07	NNG 08
Date	Parameters (Unit)	Guideline												
10-Jun-20	Turbidity (NTU) - Hypolimnion						2.69	5						
11-Jun-20	Turbidity (NTU)								2.36	3.57	4.17	4.93	7.7	9.33
17-Jun-20	Turbidity (NTU)							2.19	2.69	3.75	8.94	28.44	43.47	40.07
22-Jun-20	Turbidity (NTU)		41.47											
23-Jun-20	Turbidity (NTU)			61.25	3	1.9	2.08							
24-Jun-20	Turbidity (NTU)							2.95	2.6	3.76	3.67	7.35	8	7.62
8-Jun-20	TSS (mg/L)		10.53											
9-Jun-20	TSS (mg/L)			346.19		6.6								
9-Jun-20	TSS (mg/L) - Hypolimnion					23.58								
10-Jun-20	TSS (mg/L)						<5	<5						
10-Jun-20	TSS (mg/L) - Hypolimnion						12.01	6.36						
11-Jun-20	TSS (mg/L)								<5	<5	5.8	<5	14.69	14.41
8-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5	<1											
9-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5		<1		<1								
9-Jun-20	BOD <sub>5</sub> (mg/L) - Hypolimnion	<1.5				10.38								
10-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5					<1	<1						
10-Jun-20	BOD <sub>5</sub> (mg/L) - Hypolimnion	<1.5					6.36	4.6						
11-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5							3.49	2.48	1.42	1.86	<1	<1
8-Jun-20	Faecal coliform (MPN/100 mL)	<1,000	1,600											
9-Jun-20	Faecal coliform (MPN/100 mL)	<1,000		1,600		1600								
9-Jun-20	Faecal coliform (MPN/100 mL) - Hypolimnion	<1,000				1600								
10-Jun-20	Faecal coliform (MPN/100 mL)	<1,000					0	0						
10-Jun-20	Faecal coliform (MPN/100 mL) - Hypolimnion	<1,000					0	0						
11-Jun-20	Faecal coliform (MPN/100 mL)	<1,000						0	5	34	9	920	110	
8-Jun-20	Total Coliform (MPN/100 mL)	<5,000	1,600											

		River Name	Nam Ngiep											
		Zone	Location Refer to Construction Sites											
			Upstream/Main Reservoir						Re-regulation Reservoir		Downstream			
		Station Code	NN G01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NN G06	NN G07	NNG 08
Date	Parameters (Unit)	Guideline												
9-Jun-20	Total Coliform (MPN/100 mL)	<5,000		1,600		1,600								
9-Jun-20	Total Coliform (MPN/100 mL) - Hypolimnion	<5,000				1600								
10-Jun-20	Total Coliform (MPN/100 mL)	<5,000					130	70						
10-Jun-20	Total Coliform (MPN/100 mL) - Hypolimnion	<5,000					33	130						
11-Jun-20	Total Coliform (MPN/100 mL)	<5,000							540	1,600	1,600	1,600	1,600	1,600
3-Jun-20	Secchi Disk (m)				1.2	2.2	2.5							
4-Jun-20	Secchi Disk (m)							2.9	3.85	1.4				
9-Jun-20	Secchi Disk (m)				1.4	2.4								
10-Jun-20	Secchi Disk (m)						2.9	3.25						
11-Jun-20	Secchi Disk (m)								0.8	1.75				
17-Jun-20	Secchi Disk (m)							3.2	3.25	1.75				
23-Jun-20	Secchi Disk (m)				1.6	3.25	3.6							
24-Jun-20	Secchi Disk (m)							2.9	3	2.2				

**TABLE A- 2: 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				
3-Jun-20	pH	5.0 - 9.0		7.41		
4-Jun-20	pH	5.0 - 9.0			6.63	7.05
8-Jun-20	pH	5.0 - 9.0	7.98			
9-Jun-20	pH	5.0 - 9.0		7.18		
11-Jun-20	pH	5.0 - 9.0			7.33	7.58
17-Jun-20	pH	5.0 - 9.0			7.2	7.42
22-Jun-20	pH	5.0 - 9.0	8.2			
23-Jun-20	pH	5.0 - 9.0		7.91		
24-Jun-20	pH	5.0 - 9.0			7.43	7.65
3-Jun-20	Sat. DO (%)			105.7		
4-Jun-20	Sat. DO (%)				90	88
8-Jun-20	Sat. DO (%)		100			
9-Jun-20	Sat. DO (%)			103		
11-Jun-20	Sat. DO (%)				72.6	74.6
17-Jun-20	Sat. DO (%)				80.5	73.8
22-Jun-20	Sat. DO (%)		113.3			
23-Jun-20	Sat. DO (%)			95.2		
24-Jun-20	Sat. DO (%)				86.2	84.5
3-Jun-20	DO (mg/L)	>6.0		8.75		
4-Jun-20	DO (mg/L)	>6.0			6.95	7.08
8-Jun-20	DO (mg/L)	>6.0	7.48			
9-Jun-20	DO (mg/L)	>6.0		8.18		
11-Jun-20	DO (mg/L)	>6.0			5.38	5.88
17-Jun-20	DO (mg/L)	>6.0			6.48	6.03
22-Jun-20	DO (mg/L)	>6.0	8.47			
23-Jun-20	DO (mg/L)	>6.0		7.89		
24-Jun-20	DO (mg/L)	>6.0			6.59	6.7
3-Jun-20	Conductivity (µs/cm)			102		
4-Jun-20	Conductivity (µs/cm)				133	20
8-Jun-20	Conductivity (µs/cm)		23.4			
9-Jun-20	Conductivity (µs/cm)			76		
11-Jun-20	Conductivity (µs/cm)				148	26
17-Jun-20	Conductivity (µs/cm)				76	19
22-Jun-20	Conductivity (µs/cm)		67.6			

		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				
23-Jun-20	Conductivity (µs/cm)			87		
24-Jun-20	Conductivity (µs/cm)				127	33
3-Jun-20	Temperature (°C)			25.08		
4-Jun-20	Temperature (°C)				28.87	26.51
8-Jun-20	Temperature (°C)		27.5			
9-Jun-20	Temperature (°C)			27.06		
11-Jun-20	Temperature (°C)				31.28	27.58
17-Jun-20	Temperature (°C)				26.35	25.51
22-Jun-20	Temperature (°C)		27.6			
23-Jun-20	Temperature (°C)			24.77		
24-Jun-20	Temperature (°C)				29.21	27.4
3-Jun-20	Turbidity (NTU)			23.17		
4-Jun-20	Turbidity (NTU)				44.39	13.74
8-Jun-20	Turbidity (NTU)		12.47			
9-Jun-20	Turbidity (NTU)			19.97		
11-Jun-20	Turbidity (NTU)				15.39	7.11
17-Jun-20	Turbidity (NTU)				108	13.48
22-Jun-20	Turbidity (NTU)		9.12			
23-Jun-20	Turbidity (NTU)			26.85		
24-Jun-20	Turbidity (NTU)				33.74	11.47
8-Jun-20	TSS (mg/L)		9.26			
9-Jun-20	TSS (mg/L)			65.87		
11-Jun-20	TSS (mg/L)				14.13	5.24
8-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5	<1			
9-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5		<1		
11-Jun-20	BOD <sub>5</sub> (mg/L)	<1.5			<1	<1
8-Jun-20	Faecal coliform (MPN/100 mL)	<1,000	350			
9-Jun-20	Faecal coliform (MPN/100 mL)	<1,000		1600		
11-Jun-20	Faecal coliform (MPN/100 mL)	<1,000			170	350
8-Jun-20	Total Coliform (MPN/100 mL)	<5,000	1,600			
9-Jun-20	Total Coliform (MPN/100 mL)	<5,000		1,600		
11-Jun-20	Total Coliform (MPN/100 mL)	<5,000			1,600	1,600

## ANNEX B: RESULTS OF EFFLUENT ANALYSES

**TABLE B-1: RESULTS OF CAMP EFFLUENTS IN JUNE 2020**

	Site Name	Owner's Site Office and Village (OSOVI)		OSOVI (ESD Camp No.2)		OSOVI (ESD Camp 1)		Main Powerhouse	
	Station Code	EF01		EF13		EF14		EF19	
	Date	01-Jun- 20	15-Jun- 20	01-Jun- 20	15-Jun- 20	01-Jun- 20	15-Jun- 20	01-Jun- 20	15-Jun- 20
Parameters (Unit)	Guideline								
pH	6.0 - 9.0	6.3	6.29	6.12	6.08	6.03	6.12	7.51	7.28
Sat. DO (%)		44.1	42.6	68.9	38.6	52.4	57.6	55.1	41.1
DO (mg/L)		3.36	3.17	5.16	2.84	3.98	4.21	4.06	2.99
Conductivity (µs/cm)		223	337	197	190	141.4	215	834	866
TDS (mg/L)		111.5	168.5	98.5	95	70.7	104	417	433
Temperature (°C)		27.7	28.8	28.7	29.7	28	107.5	27.8	30.4
Turbidity (NTU)		5.01	2.33	5.93	5.55	5.84	4.47	14.41	14.16
TSS (mg/L)	<50	<5	<5	6.8	8.9	6	12.1	37.3	46.2
BOD <sub>5</sub> (mg/L)	<30	6.09	<6	10.26	16.38	<6	9.87	<6	<6
COD (mg/L)	<125	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NH <sub>3</sub> -N (mg/L)	<10.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Nitrogen (mg/L)	<10.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Phosphorus (mg/L)	<2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oil & Grease (mg/L)	<10.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total coliform (MPN/100 mL)	<400	9,200	350	16,000	160,000	3,500	16,000	0	0
Faecal Coliform (MPN/100 mL)	<400	9,200	350	16,000	35,000	3,500	16,000	0	0
Effluent Discharge Volume (L/mn)		6	6	4	4	2	3		
Chlorination Dosing Rate (mL/mn)		n/a	n/a	0.08	0.08		0.5	475	420
Residual Chlorine (mg/L)	<1.0	n/a	n/a	0.1	0.0	0.07	0.09	1.67	0.49