



NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

May 2023


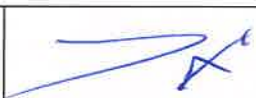

					
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TABLE OF CONTENTS

EXECUTIVE SUMMARY	5
1. ENVIRONMENTAL MANAGEMENT MONITORING	7
1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)	7
1.2 COMPLIANCE MANAGEMENT	8
1.2.1 <i>Site Inspection by the Environment Management Unit (EMU)</i>	9
1.2.2 <i>Site Decommissioning and Rehabilitation</i>	9
1.3 WATER QUALITY MONITORING	9
1.3.1 <i>Effluent Discharge from Camps and Construction Sites</i>	9
1.3.2 <i>Ambient Surface Water and Reservoir Water Quality Monitoring</i>	10
1.3.3 <i>Groundwater Quality Monitoring</i>	16
1.3.4 <i>Gravity Fed Water Supply (GFWS) Quality Monitoring</i>	17
1.3.5 <i>Landfill Leachate Monitoring</i>	18
1.4 DISCHARGE MONITORING	19
1.4.1 <i>Main Reservoir – Water Level, Inflow and Discharge</i>	19
1.4.2 <i>Re-regulation Reservoir – Discharge</i>	20
1.4.3 <i>Nam Ngiep Downstream Water Depth Monitoring</i>	20
1.5 PROJECT WASTE MANAGEMENT	20
1.5.1 <i>Solid Waste Management</i>	20
1.5.2 <i>Hazardous Materials and Waste Management</i>	21
1.6 COMMUNITY WASTE MANAGEMENT	22
1.6.1 <i>Community Solid Waste Management and Recycling Programmes</i>	22
2 WATERSHED AND BIODIVERSITY MANAGEMENT	22
2.1 WATERSHED MANAGEMENT	22
2.1.1 <i>Implementation of Annual Implementation Plan (AIP)</i>	22
2.1.2 <i>Preparation of Annual Implementation Plan (AIP) 2022</i>	24
2.1.3 <i>Preparation of Annual Implementation Plan (AIP) 2023</i>	24
2.2 BIODIVERSITY OFFSET MANAGEMENT	24
2.2.1 <i>Implementation of BOMP Annual Implementation Plan (AIP)</i>	24
2.2.2 <i>Preparation of Annual Implementation Plan (AIP) 2023</i>	26
2.3 FISHERY MONITORING	26
3 EXTERNAL MISSIONS AND VISITS	32
ANNEX A: RESULTS OF WATER QUALITY MONITORING	34

TABLE OF TABLES

Table 1.1-1: The Details of EMPs 2023 implementation.	7
Table 1.3-1: Status of Corrective Actions for Non-Compliances at WWTs in May 2023	9
Table 1.3-2: 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	15
Table 1.3-3: Results of Surface Water Quality Monitoring for Total Suspended Solids (mg/L)	15
Table 1.3-4: Results of Surface Water Quality Monitoring for BOD₅ (mg/L) - Water Quality Standard: < 1.5 mg/L	16
Table 1.3-5: Groundwater Quality Monitoring Results in Phouhomxay, Somsuen, Nam Pa, ThongNoy and Pou Villages	16
Table 1.3-6: Results of the Gravity Fed Water Supply Quality Monitoring	17
Table 1.3-7: Results of the Landfill Leachate Monitoring.....	18
Table 1.5-1: Amounts of Recyclable Waste Sold and collection in May 2023	21
Table 1.5-2: Record of Hazardous Material Inventory in May 2023	21
Table 1.5-3: Record of Hazardous Waste Inventory	22
Table 2.3-1: Fish Species dominating the Fish Catch in April 2023	27
Table 2.3-2: Threatened Species of April 2023 Fish Catch.....	27
Table 2.3-3: Main Biodiversity Indicators for April 2023	27
Table 2.3-4: Mean reported number of fishing days by fishing zone for the month of April from 2016 to 2023	29
Table 2.3-5: Mean Monthly Household Fish Catch for the month of April from 2016 to 2023	30
Table 2.3-6: Mean Daily Fish Catch per Household for the month of April from 2016 to 2023....	31
Table 2.3-7: Proportion of the catch reported by main habitats (%) in April 2023.....	31
Table 2.3-8: Proportion of OAA to the total reported number of fish and OAA for the month of April from 2016 to 2023.....	32

TABLE OF FIGURES

Figure 1.2-1: Joint Monthly Inspection in May 2023	8
Figure 1.3-1: Surface Water and Re-regulation Reservoir Water Quality Monitoring Stations ...	11
Figure 1.3-2: DO Depth Profiles Time Series in R05 (Since September 2018 to May 2023)	12
Figure 1.3-3: Concentration of Dissolved Oxygen (mg/L) in the upper 0.2 m since September 2019 to May 2023	14
Figure 1.3-4: Dissolved Oxygen (Mg/L) Long Profile in May 2023 (from Immediately Upper Main Dam to Lower Nam Ngiep River).....	14
Figure 1.4-1: Inflow for the Main Reservoir during January 2020 to May 2023	19
Figure 1.4-2: Water Level for the Main Reservoir during January 2020 to May 2023	19
Figure 1.4-3: Discharge Monitoring at the Re-regulation Dam in March to May 2023	20
Figure 2-1: Representative photos from PLUP updated activity in Viengthong District	25
Figure 2.3-1: Fish diversity index (Shannon) by fishing zone from July 2015 to April 2023	28
Figure 2.3-2: Proportion of total number of households actively fishing by fishing zone from July 2015 to April 2023	28
Figure 2.3-3: Mean of monthly fishing day from July 2015 to April 2023	29
Figure 2.3-4: Mean Monthly Household Fish Catch from July 2015 to April 2023	30
Figure 2.3-5: Mean Daily Fish Catch per Household from July 2015 to April 2023	31
Figure 2.3-6: Proportion of OAA to the total reported number of fish and OAA for a 7-day period by fishing zone from July 2015 to April 2023	32

EXECUTIVE SUMMARY

During May 2023, activities related to ISO14001:2015 implementation continued such as the implementation of the four (04) Environmental Management Plans (EMPs). The EMPs will be executed from April 2023 to March 2024 including 1) HSE awareness training for NNP1PC staff and contractors, 2) reducing the paper consumption in NNP1 offices, 3) minimizing the quantity of waste disposal at NNP1 project landfill, and 4) planting trees.

During this reporting period, no new document was submitted to the Environment Management Office (EMO) for review and approval.

On 10 May 2023, EMO, ADM and TD conducted a joint monthly site inspection to follow up on the ongoing corrective actions from the previous findings related to waste management, NNP1 landfill operation, hazardous material and waste management and wastewater treatment system operation and maintenance. Some improvements were carried out including the maintenance of wetland ponds at SOSV1 by weeding, replacing dead reeds and fixing the fencing. However, waste compaction process at NNP1 landfill is currently on hold, waiting for ADM to finalize an arrangement for waste compaction.

At R05 (in the Main Reservoir approx. 0.5 km upstream the Main Dam), the average DO concentration was 7.7 mg/L in the upper 9.5 m varying between 5.0 mg/L and 8.4 mg/L. Anoxic conditions (less than 0.5 mg/L) were found at depths from 32 m to the bottom on 03 May 2023, from 20 m to bottom on 10 May 2023, from 15 m to bottom on 18 May 2023, from 13 m to bottom on 24 May 2023 and from 12 m to bottom on 29 May 2023. At the water intake level, DO concentrations varied between 0.1 mg/L and 1.3 mg/L. In the Re-regulation Reservoir, the mean DO concentrations in the water column of the two monitoring stations were 2.6 mg/L and 1.7 mg/L respectively.

The DO measurements downstream the Re-regulation Dam during combination of turbine and gate discharges were less than 6 mg/L in all stations.

NNP1PC continues to carefully compile and assess all monitoring data to determine if any additional water aeration measures may be necessary to improve the DO levels in Nam Ngiep River downstream the Re-regulation Dam. Water quality monitoring will be maintained, and the development of the situation in the reservoir and in the downstream area will be closely followed until a satisfactory situation has been reached. In this regard, it should be noted that since the Commercial Operation Date (COD) in September 2019 no dead fish have been observed in Nam Ngiep downstream the Re-regulation Dam.

A total of 9.04 m³ of solid waste was disposed of at the NNP1 Project Landfill in May 2023, same as in April 2023. NNP1 EMO highlighted the efforts made in coordinating with the Bolikhan District Environment Management Unit or EMU for transferring the management of the communities' solid waste and Houay Soup Landfill to the local authorities. The EMU will initiate discussions involving NNP1, village, and district authorities after receiving the 2022 monitoring fund, which NNP1 transferred to MONRE on 11 May 2023 following the fund disbursement request by MONRE on 20 April 2023.

As of the end of May 2023, Bolikhamxay Watershed and Reservoir Protection Office (WRPO) has not yet received the funds for the first two quarters under the approved Bolikhamxay Annual Implementation Plan (AIP) 2023 from the Forest Protection Fund (FPF) office of the Department of Forestry (DOF) – Ministry of Agriculture and Forestry (MAF). Bolikhamxay WRPO could only continue with the forest and reservoir patrol in May 2023 using the remaining budget under the AIP2022.

The Head of Xaysomboun PAFO and the Xaysomboun WRPO team are still working on the progress as per the agreement from the meeting in April 2023 including following-up with the Xaysomboun Provincial Energy and Mines office related to the mining exploration and hydropower project development in the NNP1 watershed Totally Protected Zone (TPZ), the internal discussion on reviewing the patrol team establishment and the further implementation of fishery co-management, and following up with the contractor for the construction of two reservoir checkpoints.

As of end of May 2023, the FPF DOF-MAF has not yet submitted an official fund disbursement request for the first two-quarters of the approved Bolikhamxay Biodiversity Offset Management Unit (BOMU) AIP2023. The activities under the AIP2023 will be delayed until BOMU has received the funds.

The Head of FPF DOF-MAF informed NNP1 EMO that after their internal discussion then the Financial Management Manual (FMM) was approved by the Director General of DOF-MAF on 15 May 2023. They will produce the official copies of the FMM and distribute them to relevant offices.

The fish catch monitoring for April 2023 in Nam Ngiep Watershed was dominated by *Oreochromis niloticus* and *Channa striata* and species groups of Hampala, Mastacembelus and Poropuntius. They are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species and *Oreochromis niloticus* is an exotic species. The recorded catch of threatened species includes three Vulnerable species (VU): *Cirrhinus cirrhosis*, *Scaphognathops bandanensis* and *Tor sinensis*.

1. ENVIRONMENTAL MANAGEMENT MONITORING

1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

During May 2023, activities related to ISO14001:2015 implementation continued such as the implementation of the four (04) Environmental Management Plans (EMPs). The EMPs will be executed from April 2023 to March 2024 including 1) HSE awareness training for NNP1PC staff and contractors, 2) reducing the paper consumption in NNP1 offices, 3) minimizing the quantity of waste disposal at NNP1 project landfill, and 4) planting tree. The details of EMPs 2023 implementation are shown in **Table 1.1-1**.

Table 1.1-1: The Details of EMPs 2023 implementation.

EMP No.	Activity Description	KPI	The EMP Evaluation Schedule	Implementation Result
01/2023*	Providing HSE awareness training to NNP1PC staff and contractors	80% of NNP1PC staff and the Contractors are trained on Health, Safety and Environmental awareness during April 2023 to March 2024	Oct 2023 – Feb 2024	
02/2023*	Reducing the paper consumption in NNP1 offices	Total use of A4 paper for printing in the NNP1PC's offices (VTE, OSOV1, OSOV2) is reduced by 10% during April 2023 to March 2024 compared with the previous 12 months	Oct 2023 – Dec 2024	
03/2023*	Reducing the quantity of waste disposal at NNP1 Project Landfill	Total use of A4 paper for printing in the NNP1PC's offices (VTE, OSOV1, OSOV2) is reduced by 10% during April 2023 to March 2024 compared with the previous 12 months	Sept 2023 – Mar 2024	
04/2023 [#]	Planting tree	Percentage of plant survival, the potential plantation fields in contributing to the environmentally sustainability objectives (refer to Tree Planting Plan)	Feb 2024	

*EMP^s implemented in 2022 will continue in 2023 for further success

[#] New EMP suggested by the external ISO Auditor (SGS)

1.2 COMPLIANCE MANAGEMENT

On 10 May 2023, EMO, ADM and TD conducted a joint monthly site inspection to follow up on the progress of corrective actions from the previous findings related to waste management, NNP1 landfill operation, hazardous material and waste management and wastewater treatment system operation and maintenance. Some improvements were carried out including maintenance of wetland ponds at SOSV1 by weeding, replacing dead reeds and fixing the fencing. However, waste compaction at NNP1 landfill is currently on hold, waiting for ADM to finalize an arrangement for waste compaction.

Figure 1.2-1: Joint Monthly Inspection in May 2023

	
<p>All 17 tanks and air blowers at OSOV1 were randomly checked by the ADM staff and they are functioning properly</p>	<p>Maintenance for OSOV1 wetland ponds including weeding, replacing dead reeds and fixing the fence have been completed.</p>
	
<p>The waste compaction at NNP1 landfill is currently on hold, waiting for ADM to finalize an arrangement for waste compaction.</p>	<ul style="list-style-type: none"> ○ EMO and TD have planned to incinerate the use hydraulic oil at an authorized factory by early July 2023. ○ The outlet pipe of the storage facility needs to be permanently closed or equipped with a control valve to prevent accidental oil releases.

1.2.1 Site Inspection by the Environment Management Unit (EMU)

There was no site visit by the EMU of Bolikhan District, Bolikhamxay Province in May 2023. It is expected that their site visit will be in Q4 2023 after receiving the monitoring fund for 2022, which NNP1 transferred to MONRE on 11 May 2023, following the fund disbursement request by MONRE on 20 April 2023.

1.2.2 Site Decommissioning and Rehabilitation

During May 2023, all 31 rehabilitated areas were inspected, and no site disturbances were identified. The assessment of the vegetation cover will continue during the rainy season of 2023.

1.3 WATER 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 *Error! Reference source not found.* of this Report. The status of implementation of the corrective actions addressing non-compliances at the camps and key project facilities are summarized in **Table 1.3-1**

Table 1.3-1: Status of Corrective Actions for Non-Compliances at WWTSs in May 2023

Site	Sampling ID	Status	Corrective Actions
OSOV1	EF01	Non-compliance for total coliform.	<p>In 10 May 2023, EMO, ADM and TD conducted a monthly joint inspection for the operation and maintenance of the WWTS:</p> <ul style="list-style-type: none"> All 17 tanks and air blowers at OSOV1 were randomly checked by the ADM staff and they are functioning properly. Wetland maintenance at OSOV1 including weeding and replacing dead reeds and fixing the fence have been completed. Closely monitor the residual chlorine content and chlorination dosage adjustment for the effluents of OSOV2 and the Main Powerhouse WWTS.
OSOV2	EF13	Non-compliance for total phosphorus, total nitrogen and ammonia-nitrogen.	
Main Powerhouse	EF19	Non-compliance for total nitrogen, total phosphorus and ammonia-nitrogen (first fortnightly sampling), and faecal coliform and total coliform (both fortnightly samplings).	

1.3.2 Ambient Surface Water and Reservoir 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]).

Weekly depth profile monitoring (pH, DO, conductivity and temperature) has been undertaken since 18 September 2018 for stations located in the Re-regulation reservoir and the main reservoir. The locations of the monitoring stations are shown in **Figure 1.3-1**.

The monitoring results for key parameters (DO, TSS and BOD₅) during May 2023 are presented in **Table 1.3-2**, **Table 1.3-3** and **Table 1.3-4**. The full set of data for May 2023 is attached in Annex A. In addition, the DO depth profile timeseries for R05 are shown in **Figure 1.3-2**, and the results for DO timeseries are presented as line graphs in **Figure 1.3-3** and DO Long Profile graphs **Figure 1.3-4**.

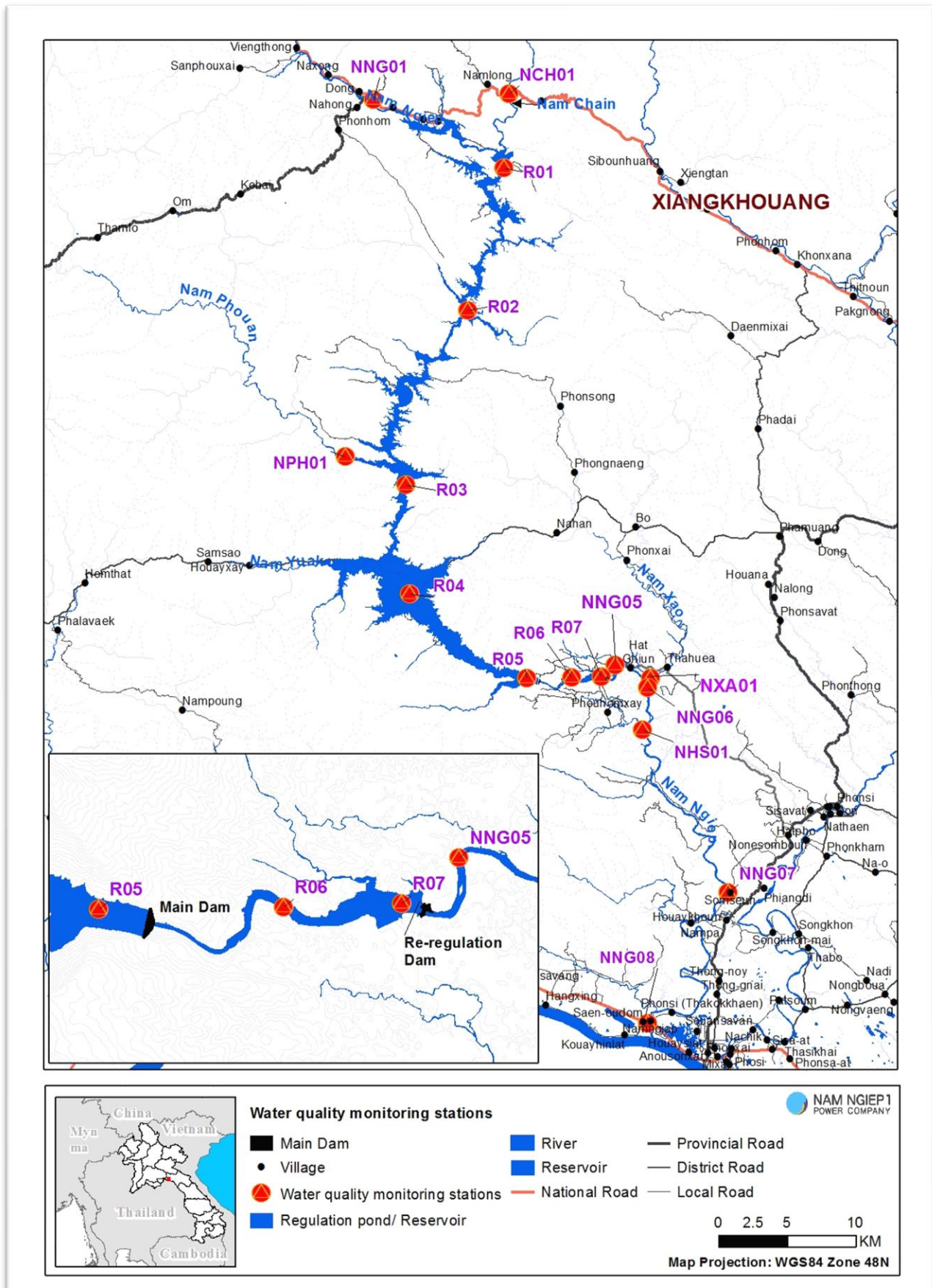


Figure 1.3-1: Surface Water and Re-regulation Reservoir Water Quality Monitoring Stations

Main Reservoir

During May 2023, the water level in the main reservoir decreased from El. 305.12 m asl to El. 299.03 m asl.

At R05 (in the Main Reservoir approx. 0.5 km upstream the Main Dam), the average DO concentration was 7.7 mg/L in the upper 9.5 m varying between 5.0 mg/L and 8.4 mg/L. Over the month, the oxycline occurred at depths between 8.5 m and 11 m. Anoxic conditions (less than 0.5 mg/L) were found at depths from 32 m to the bottom on 03 May 2023, from 20 m to bottom on 10 May 2023 from 15 m to bottom on 18 May 2023 from 13 m to bottom on 24 May 2023 and from 12 m to bottom on 29 May 2023. At the water intake level, DO concentrations varied between 0.1 mg/L and 1.3 mg/L.

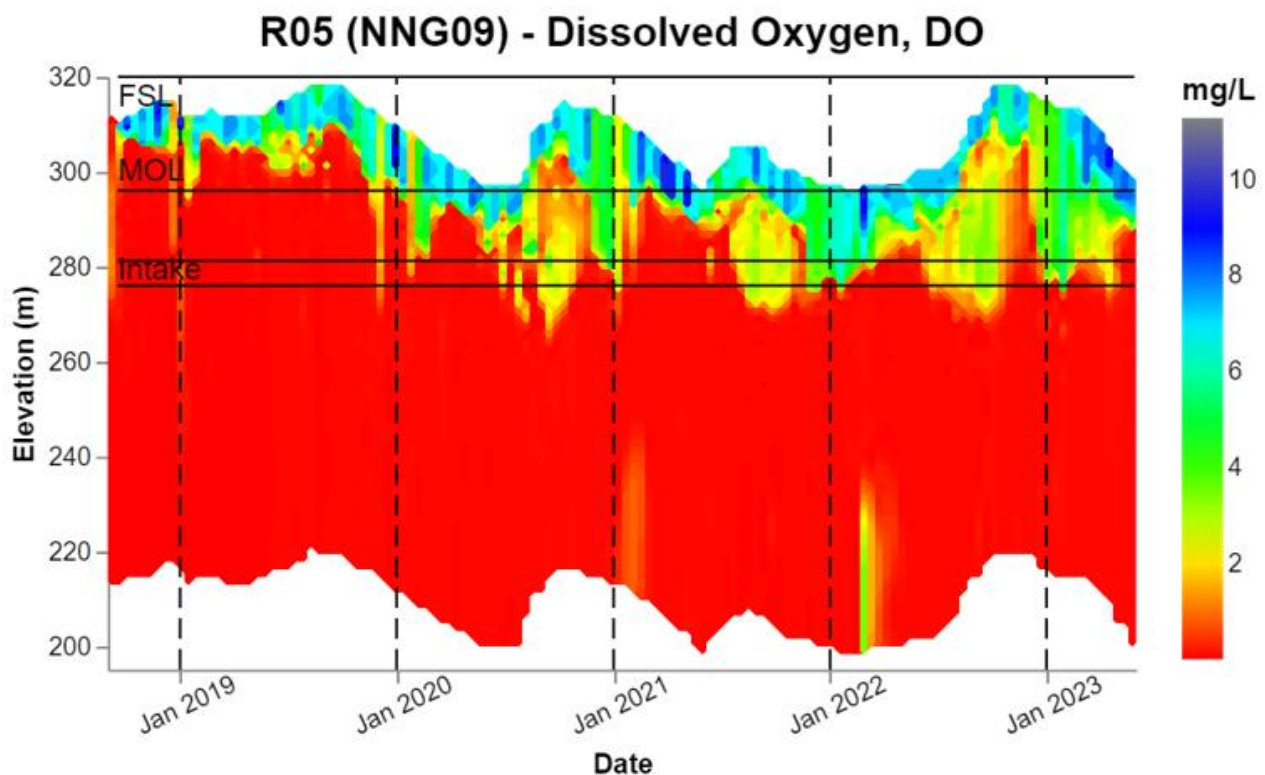


Figure 1.3-2: DO Depth Profiles Time Series in R05 (Since September 2018 to May 2023)

At R04, the average DO concentration was 7.6 mg/L in the upper 7.5 m varying between 6.1 mg/L and 8.9 mg/L. From 8.0 m to 28 m, DO concentration varied between 0.1 mg/L and 6.1 mg/L with an average of 0.85 mg/L. Oxyclines were found at depths between 6.5 m and 11 m. Anoxic conditions (less than 0.5 mg/L) were found at depths from 12 m to 24 m and 30 m to bottom (on 03 May 2023), at depths from 9.5 m to 13 m and 20 m to bottom (on 10 May 2023), at depths from 10 m to 14 m and 24 m to bottom (18 May 2023) and at depths from 9.0 m – 9.5 m to the bottom during the last two weeks of May 2023.

At R03, the average DO concentration was 8.2 mg/L in the upper 5.5 m varying between 4.4 mg/L and 10 mg/L. Oxyclines were found at depths between 5.0 m and 6.5 m. From 6.0 m to bottom, DO concentration varied between 0.1 mg/L and 7.3 mg/L with an average of 0.8 mg/L. Anoxic conditions (less than 0.5 mg/L) were found at depths from 8.5 m - 12 m to the bottom during May 2023.

At R02, the average DO concentration was 8.0 mg/L in the upper 3.0 m varying between 3.4 mg/L and 9.8 mg/L. Oxycines were found at depths between 2.5 m and 4.0 m. Anoxic conditions occurred at the depths from 13 m to the bottom on 02 and 09 May 2023. From 3.5 m to the bottom, DO concentrations varied between 0.1 mg/L and 8.3 mg/L with an average of 2.5 mg/L.

At R01, the DO levels in the water column varied between 6.4 mg/L and 7.3 mg/L with an average of 6.8 mg/L.

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 mg/L - 50 mg/L prior to impounding.

The BOD₅ measurements in both epilimnion and hypolimnion at R01, R03, R04 and R05 were less than 1.0 mg/L.

Re-regulation Reservoir

In May 2023, the turbine discharges from the Main Powerhouse varied between 70 and 240 m³/s usually interrupted by night-time periods with no discharge.

The mean DO concentrations in the water column of the two monitoring stations were 1.3 mg/L and 1.7 mg/L in R06 and R07 respectively.

The BOD₅ concentrations in both R06 and R07 were less than 1.0 mg/L.

Nam Ngiep Downstream

During May 2023, the monthly downstream water quality monitoring was carried out during a period with combination of discharge between a turbine at 150 m³/s and gate at 57 m³/s from the Re-regulation Dam, DO concentrations were less than 6 mg/L in all stations, indicating that a greater amount of turbine discharge resulted in a decrease of DO level.

NNP1PC continues to carefully compile and assess all monitoring data to determine if any additional water aeration measures may be necessary to improve the DO levels in Nam Ngiep River downstream the Re-regulation Dam. Water quality monitoring will be maintained, and the development of the situation in the reservoir and in the downstream area will be closely followed. In this regard, it should be noted that since the Commercial Operation Date (COD) in September 2019 no dead fish have been observed in Nam Ngiep downstream the re-regulation dam.

The BOD₅ in the downstream stations were less than 1 mg/L and complied with the national surface water quality standard.

Main Tributaries to Nam Ngiep

The monitored parameters in the Nam Chiane (NCH01), Nam Xao (NXA01), Nam Phouan (NPH01) and Nam Houaysoup (NHS01) complied with the standards, except BOD in Nam Chian (NCH01), DO in Nam Houaysoup (NHS01), COD in all main tributaries.

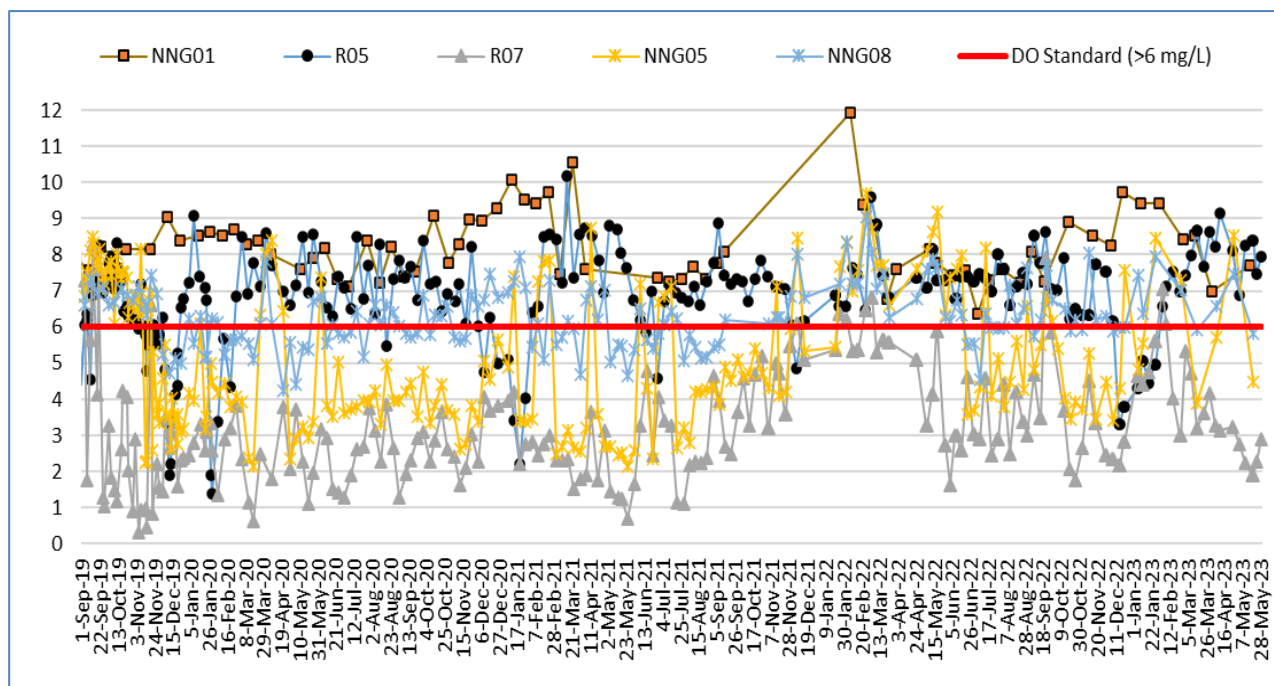


Figure 1.3-3: Concentration of Dissolved Oxygen (mg/L) in the upper 0.2 m since September 2019 to May 2023

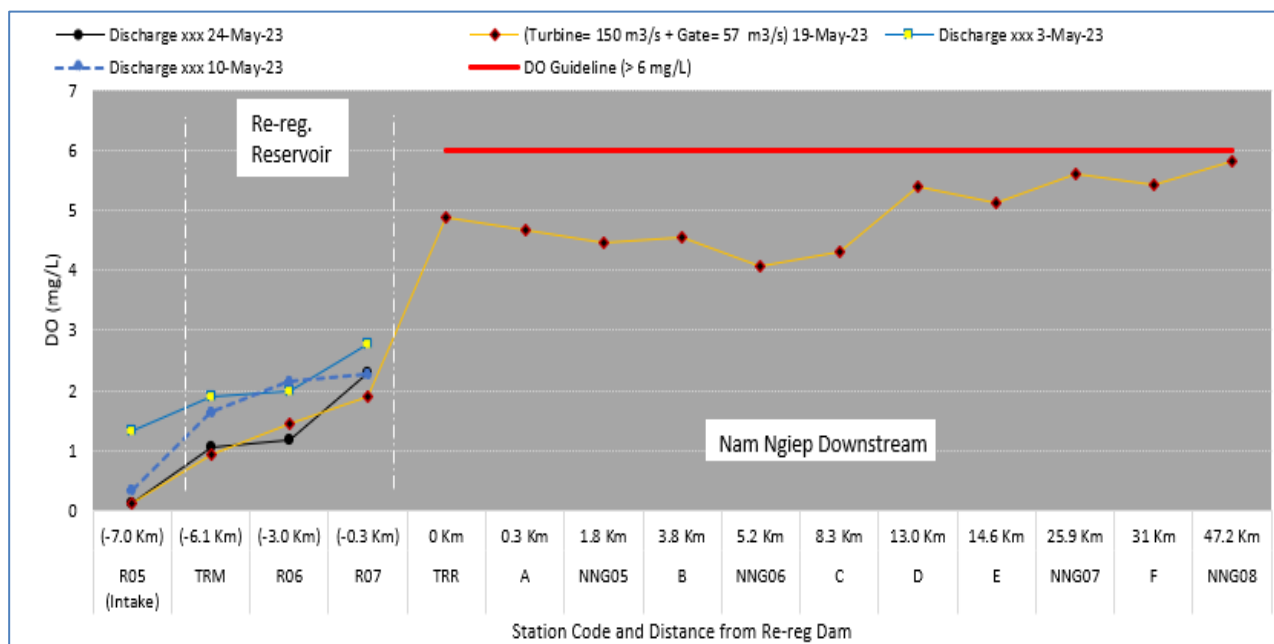


Figure 1.3-4: Dissolved Oxygen (Mg/L) Long Profile in May 2023 (from Immediately Upper Main Dam to Lower Nam Ngiep River)

Table 1.3-2: 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)	NING01	R01	R02	R03	R04	R05	R06	R07	NING05	NING06	NING07	NING08	NCH01	NPH01	NXA01	NHS01
2-May-23		6.43	8.24	8.08												
3-May-23					7.38	6.87	1.98	2.76								
9-May-23		7.27	8.32	8.35												
10-May-23					8.88	8.26	2.14	2.26								
16-May-23	7.72												6.42			
17-May-23		7.14	8.37	8.08										7.99		
18-May-23					8.02	8.39	1.43	1.9								
19-May-23									4.47	4.06	5.59	5.82			6.73	5.04
24-May-23					7.15	7.45	1.18	2.28								
25-May-23		6.64	7.01	7.28												
29-May-23					8.02	7.94	1.53	2.91								
30-May-23		7.08	9.1	9.36												

Table 1.3-3: Results of Surface Water Quality Monitoring for Total Suspended Solids (mg/L)

Total Suspended Solids (mg/L)	NING01	R01	R02	R03	R04	R05	R06	R07	NING05	NING06	NING07	NING08	NCH01	NPH01	NXA01	NHS01
16-May-23	216												54.76			
17-May-23		351.6		<5										78.46		
18-May-23					<5	<5	<5	<5	<5	<5	<5	6.8			<5	<5
19-May-23					<5	<5	<5	<5								

Table 1.3-4: 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
16-May-23	2.71												2.63			
17-May-23		1.17		<1										1.03		
18-May-23					<1	<1	<1	<1								
19-May-23									<1	<1	<1	<1			<1	<1

1.3.3 Groundwater Quality Monitoring

During May 2023, community groundwater quality analyses were carried out for all seven wells located in Somseun Village, Nam Pa Village, Thong Noy Village, Pou Village and Phouhomxay Village. The two damaged wells (GPHX01 and GPHX02) in Phouhomxay Village were repaired and have been operational since April 2023). The community groundwater samples were taken from household water taps.

The results indicate that:

- All parameters monitored from the two wells in Phouhomxay Village complied with the Standards.
- The well in Somsuen Village fully complied with the Standards.
- The well in Thong Noy and Nam Pa Villages did not comply with the Standard for faecal coliform and *E. Coli* bacteria (however, at very low concentrations)
- All monitored parameters from the two wells in Pou Village complied with the Standards.

The community groundwater quality monitoring results are presented in **Table 1.3-5**.

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.

Table 1.3-5: Groundwater Quality Monitoring Results in Phouhomxay, Somsuen, Nam Pa, ThongNoy and Pou Villages

	Site Name	Phouhomxay		Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
Parameter (Unit)	Station	GPHX01	GPHX02	GSXN01	GNPA01	GTHN01	GPOU01	GPOU02
	Guideline	10-May-23	10-May-23	12-May-23	12-May-23	12-May-23	16-May-23	16-May-23
pH	6.5 - 9.2	6.55	6.59	6.85	6.7	6.45	6.55	6.63
Sat. DO (%)		74.5	68.1	76.9	90.4	59.6	81.5	112.5

	Site Name	Phouhomxay		Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
Parameter (Unit)	Station	GPHX01	GPHX02	GSXN01	GNPA01	GTHN01	GPOU01	GPOU02
	Guideline	10-May-23	10-May-23	12-May-23	12-May-23	12-May-23	16-May-23	16-May-23
DO (mg/l)		5.96	5.56	6.06	7	4.46	6.4	8.96
Conductivity (µS/cm)		452	492	463	457	468	31	438
Temperature (°C)		26.27	25.84	27.48	28.5	30.47	27.9	26.96
Turbidity (NTU)	<20	0.65	0.56	0.65	0.34	0.84	8.35	1.03
Faecal coliform (MPN/100ml)	0	0	0	0	4	27	0	0
<i>E.coli</i> Bacteria (MPN/100ml)	0	0	0	0	2	27	0	0

1.3.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

The concentration of Faecal Coliform and *E.coli* did not comply with the standards in the water supply of Thaheua Village (WTHH02) and Hat Gnuin Village (WHGN02). There is no water sampling carried out for Phouhomxay Village (WPHX02 – Primary School Water Tap and WPHX03 – Household Water Tap) due to the system maintenance performed during the mission.

As observed in the field during water sampling, livestock are roaming around in the water intake areas which may contribute to the presence of Faecal Coliform Bacteria and *E.coli* in GFWS samples. The villagers were advised to boil water before drinking in accordance with the Law as mentioned in **1.3.3** as well as recommended to carry out the operation and maintenance improvement.

Table 1.3-6: Results of the Gravity Fed Water Supply Quality Monitoring

	Site Name	Thaheua Village	Hat Gnuin Village	Phouhomxay Village	
	Station	WTHH02	WHGN02	WPHX02	WPHX03
Parameter (Unit)	Guideline	10-May-23	10-May-23	10-May-23	10-May-23
pH	6.5 - 8.5	6.32	6.53	The water supply system was under maintenance during the sampling date. Therefore, no sampling was carried out.	
Sat. DO (%)		88.5	98.6		
DO (mg/L)		6.82	7.54		
Conductivity (µS/cm)	<1,000	84	129		
Temperature (°C)	<35	28.9	29.2		
Turbidity (NTU)	<10	4.7	1.38		
Faecal Coliform (MPN/100 mL)	0	23	79		
<i>E.coli</i> Bacteria (MPN/100 mL)	0	8	27		

1.3.5 Landfill Leachate Monitoring

During May 2023, the landfill leachate monitoring was not conducted at NNP1 Project Landfill (Last pond - LL4) because the leachate in the treatment ponds became disconnected from each other in the dry season. However, landfill leachate monitoring was carried out at Houay Soup Solid Waste Landfill (Last pond - LL6).

The results indicate that Houay Soup Landfill Leachate did not comply with the standard for total coliform. The leachate is still contained in the leachate ponds without being discharged 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 May 2023 can be found **Table 1.3-7**.

Table 1.3-7: 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							
15-May-23	pH	6.0-9.0						7.2	
15-May-23	Sat. DO (%)							101.1	
15-May-23	DO (mg/L)							7.35	
15-May-23	Conductivity (μS/cm)							173	
15-May-23	Temperature (°C)							32.24	
15-May-23	Turbidity (NTU)							36	
15-May-23	BOD5 (mg/L)	<30						9.99	
15-May-23	COD (mg/L)	<125						68.8	
15-May-23	Faecal Coliform (MPN/100mL)	<400						240	
15-May-23	Total Coliform (MPN/100mL)	<400						1,600	
15-May-23	Total Nitrogen (mg/L)	<10						2.85	
15-May-23	Lead (mg/L)	<0.2						<0.01	
15-May-23	Copper (mg/L)							<0.005	
15-May-23	Iron (mg/L)							4.01	
15-May-23	Ammonia nitrogen (mg/L)	<10						<2	
15-May-23	Oil & Grease (mg/L)	<10						<1	

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 1.4-1** and **Figure 1.4-2** presents the values recorded since January 2020.

During May 2023, the mean inflow to the main reservoir was 59 m³/s. The minimum and maximum inflows were 29 m³/s (on 02 May 2023) and 87 m³/s (on 16 May 2023) respectively.

In May 2023, the water level in the main reservoir decreased from El. 305.12 m asl to El. 299.03 m asl.

During May 2023, the hourly turbine discharges from the Main Powerhouse varied between 70 m³/s and 240 m³/s usually interrupted by night-time periods with no discharge.

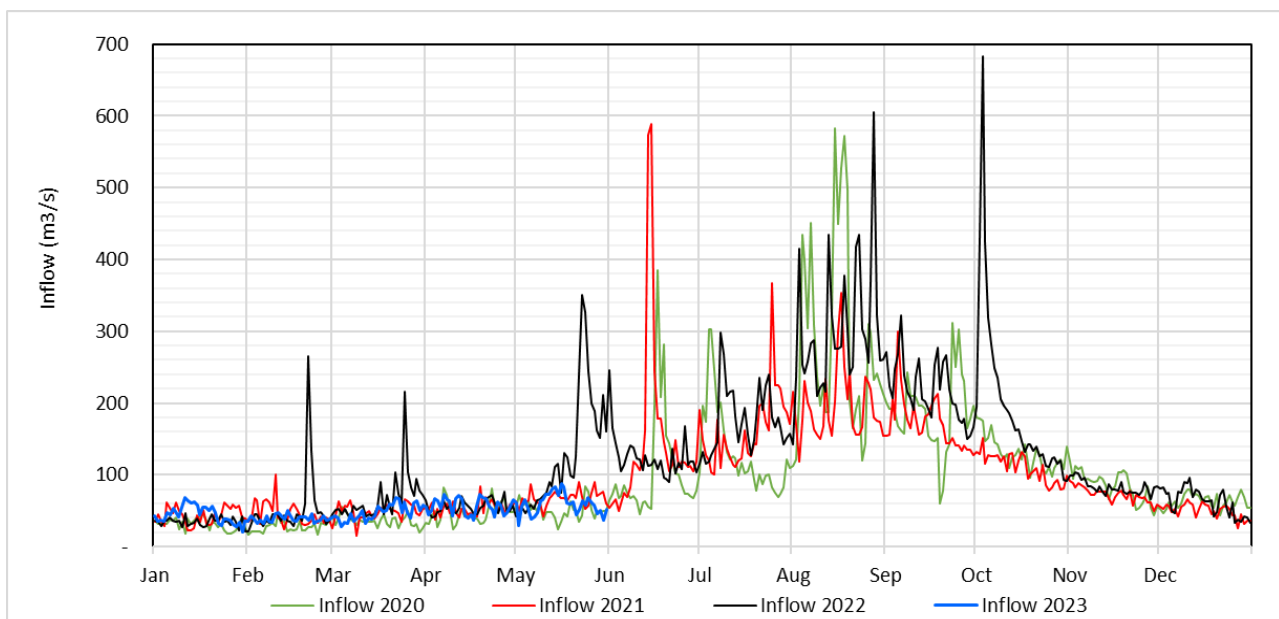


Figure 1.4-1: Inflow for the Main Reservoir during January 2020 to May 2023

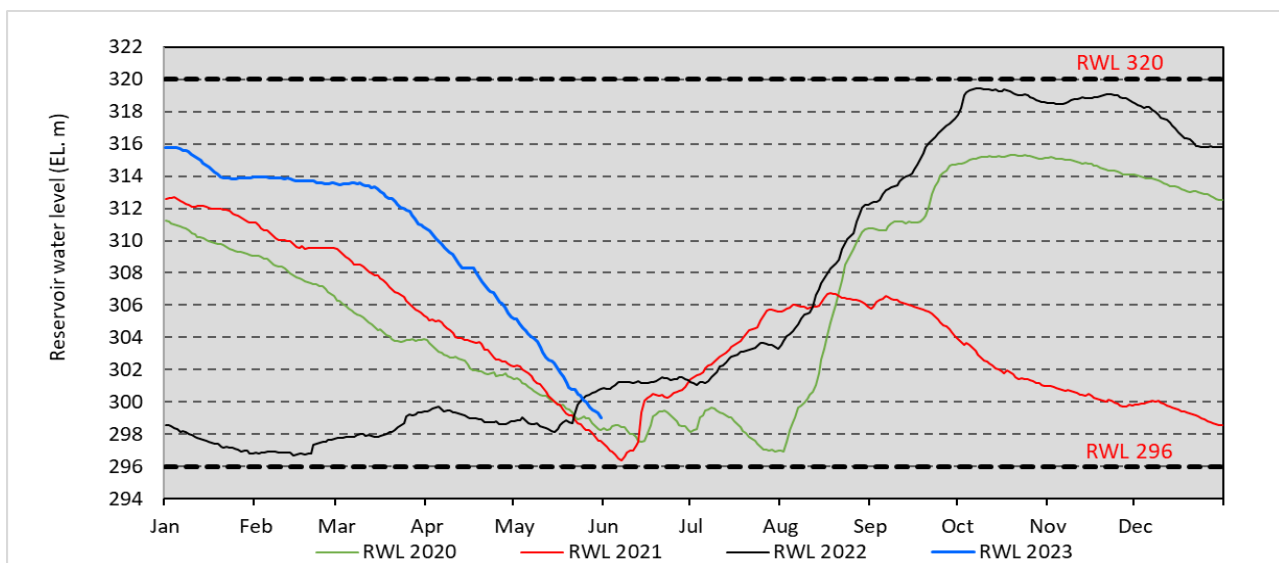


Figure 1.4-2: Water Level for the Main Reservoir during January 2020 to May 2023

1.4.2 Re-regulation Reservoir – Discharge

The daily discharge monitoring data for the Re-regulation Dam during March to May 2023 is presented in **Figure 1.4-3**.

During May 2023, the mean daily discharge from the Re-regulation Dam was about 147 m³/s, with hourly gate discharge varying between 27 m³/s and 215 m³/s, and hourly turbine discharge varying between 48 m³/s and 160 m³/s. The total discharges (combined gate and turbine discharge) varied between 76 m³/s and 230 m³/s. The hourly 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.

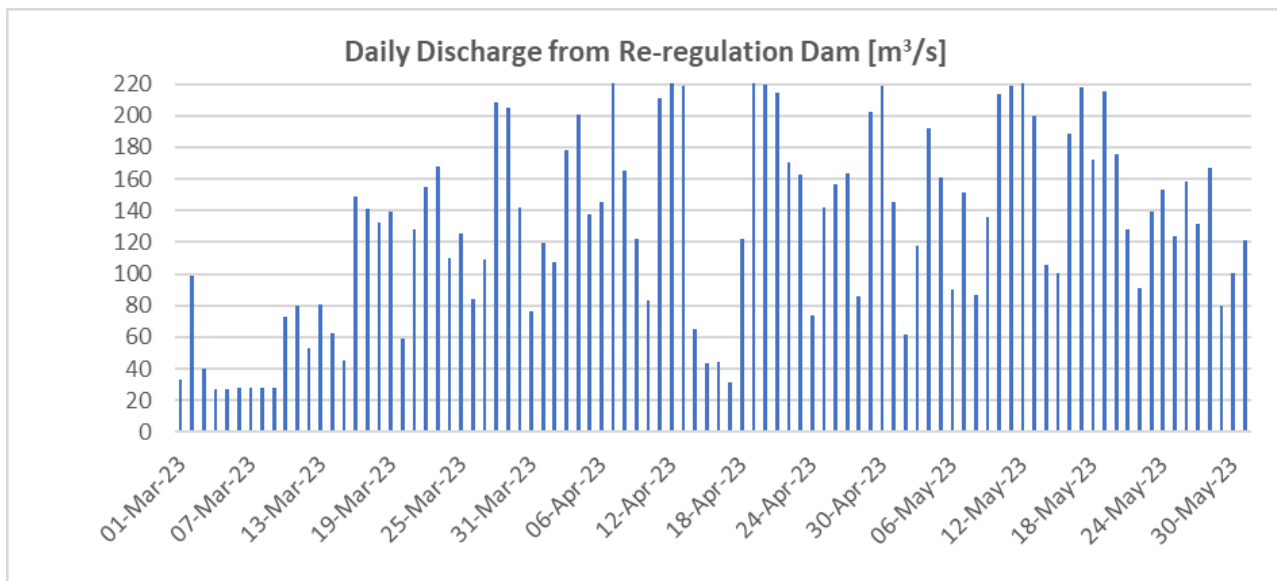


Figure 1.4-3: Discharge Monitoring at the Re-regulation Dam in March to May 2023

1.4.3 Nam Ngiep Downstream Water Depth Monitoring

In May 2023, due to the discharge from Re-reg Dam was greater than 30 m³/s, EMO did not carry out any boat missions to monitor the water depth in the Nam Ngiep downstream of the Re-regulation Dam.

1.5 PROJECT WASTE MANAGEMENT

1.5.1 Solid Waste Management

A total of 9.04 m³ of solid waste was disposed of at the NNP1 Project Landfill, same disposal quantity compared with April 2023. The Contractor continued the regular waste collection from the NNP1PC's operation sites and operated the project landfill for three days per week. The work includes waste segregation and disposal, grass cutting and repairing of the perimeter fences. The waste compaction at NNP1 landfill is currently on hold, waiting for ADM to finalize an arrangement for waste compaction. EMO will monitor the progress with the ADM to ensure that waste is compacted before the wet season begins.

The total amount of recyclable waste sold and collected this month is summarized in **Table 1.5-1**.

Table 1.5-1: Amounts of Recyclable Waste Sold and collection in May 2023

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by May 2023
1	Plastic bottles	kg	0	38
2	Aluminium can	kg	0	0
3	Paper/Cardboard	kg	0	67
4	Glass	kg	0	38
5	Scrap Metal	Kg	0	0
Total		kg	0	143

In May 2023, the villagers from Phouhomxay Village collected a total of 519 kg of food waste from the OSOV1 canteen for feeding their animals.

1.5.2 Hazardous Materials and Waste Management

The types and amounts of hazardous materials and hazardous waste stored on site in May 2023 are shown in **Table 1.5-2** and **Table 1.5-3** respectively.

Table 1.5-2: Record of Hazardous Material Inventory in May 2023

No.	Type of Hazardous Material	Unit	Total in May 2023(A)	Used (B)	Remaining at the end of May 2023 (A – B)
1	Diesel	Litre	8,420	5,665	2,775
2	Gasoline	Litre	1,389	865	524
3	Lubricant (Turbine oil)	Litre	91	0	91
4	Colour Paint	Litre	39	0	39
5	Thinner	Litre	1	0	1
6	Grease Oil	Litre	785	0	785
7	Gear Oil	Litre	17,25	0	17,25
8	Chlorine Liquid	Litre	168	18	150
09	HA Cut AF	Litre	3,925	0	3,925.0
10	HA Cut Cat AF	Litre	372.5	0	372.5

Table 1.5-3: Record of Hazardous Waste Inventory

No.	Hazardous Waste Type	Unit	Total in May 2023 (A)	Disposed (B)	Remaining at the end of May 2023 (A - B)
1	Used Oil (Hydraulic + Engine)	Litre	335.3	0	335.3
2	Empty used oil drum/container (drum 200L)	Unit	53	0	53
3	Contaminated soil, sawdust and textile material	m ³	0.8	0	0.8
4	Used tyre	Drum	5	0	5
5	Empty used chemical drum/container (drum 20L)	Unit	6	0	6
6	Lead acid batteries	Unit	6	0	6
7	Empty paint and spray cans	Unit	40	0	40
8	Halogen/fluorescent bulbs	kg	370	0	370
9	Empty cartridge (Ink)	Unit	91	0	91
10	Clinic Waste	Kg	8,4	0	8.4
11	Expired Chlorine Powder	Kg	65	0	65

1.6 COMMUNITY WASTE MANAGEMENT

1.6.1 Community Solid Waste Management and Recycling Programmes

NNP1 EMO has continued coordinating with the Bolikhan District Environment Management Unit or EMU for transferring the management of the communities' solid waste and Houay Soup Landfill to the local authorities. The EMU will initiate discussions involving NNP1, village, and district authorities after receiving the 2022 monitoring fund, which NNP1 transferred to MONRE on 11 May 2023, following the fund disbursement request by MONRE on 20 April 2023.

2 WATERSHED AND BIODIVERSITY MANAGEMENT

2.1 WATERSHED MANAGEMENT

2.1.1 Implementation of Annual Implementation Plan (AIP)

2.1.1.1 Xaysomboun Watershed and Reservoir Protection Office (WRPO)

The progress with implementing the actions agreed on the meeting held with the Head of Xaysomboun Province Agriculture and Forestry Office (PAFO) on 26 April 2023 are summarised below:

- The Head of the Xaysomboun Watershed and Reservoir Protection Office (WRPO) informed the NNP1 EMO team at the end of May 2023 that they are still enquiring and communicating with the Xaysomboun Province Energy and Mines Office regarding the mining exploration and Nam Phouan Hydropower Project development in the NNP1 watershed Totally Protected Zone (TPZ).

- The Head of Xaysomboun WRPO informed NNP1PC, Biodiversity Service Provider (BSP) -Wildlife Conservation Society (WCS), ADB, IAP, and LTA during the reservoir site visit on 26 May 2023 that the meeting at district level to discuss about the district taking the lead in fishery co-management activities would be organized after they settle the discussion on the reservoir checkpoint construction.
- The Head of Xaysomboun PAFO agreed to review the patrol team establishment to have the district military engaged in the patrolling work. A meeting should be organized among the NNP1 EMO, Xaysomboun WRPO, and Biodiversity Service Provider (BSP)-Wildlife Conservation Society (WCS) before implementing the patrolling work, once they received the AIP2022 fund. The Head PAFO is still discussing it with the Xaysomboun WRPO team until the end of May 2023.
- The Xaysomboun WRPO agreed to check the readiness of the Xaysomboun WRPO sub-office at Vangkhiew in Hom District and inform the NNP1 EMO of the cost and repair schedule if needed. NNP1 EMO proposed that the checking should be conducted in the third week of May 2023 but the Head of Xaysomboun WRPO prefer to conduct the checking after they receive the fund under the AIP2022.
- The Head of Xaysomboun WRPO informed the NNP1 EMO team that the construction of two reservoir checkpoints was not started yet as of the end of May 2023. The budget will be used for commencing the reservoir patrolling work as agreed during the meeting. During the reservoir site visit on 26 May 2023, the Deputy Head of PAFO advised the Head of XSB WRPO to contact the contractor for discussion. If the contractor is not ready then the contract will be cancelled. The head of XSB WRPO proposed to inform the contractor on 5 June 2023 and organize the meeting the week after. The Deputy Head of PAFO and Head of XSB WRPO emphasized that NNP1 EMO could not be invited for the discussion as this is an internal matter of GOL.

2.1.1.2 Bolikhamxay Watershed and Reservoir Protection Office (WRPO)

Bolikhamxay WRPO organized the Monthly Meeting on 4 May 2023 participated by the NNP1 EMO and BSP-WCS team. The key discussion points are the following;

- The patrolling in March 2023 found that the land reservation, rubber tapping, forest encroachment, forest fire, and livestock within the NNP1 watershed are increasing. These issues should be discussed and solved as soon as possible among Bolikhamxay and Xaysomboun WRPO because most of the offenders are from Xaysomboun Province.
- Bolikhamxay WRPO clarified that the forest patrolling in March 2023 was only conducted for two days because five of the patrol members were sick and needed to return for medical treatment. Bolikhamxay WRPO confirmed that the patrol budget was used to pay for the treatment and the detailed expenditure will be included in the Bolikhamxay WRPO's monthly report.
- Bolikhamxay WRPO agreed to rent a boat engine to continue the reservoir patrolling.
- Bolikhamxay WRPO requested to organize a meeting among NNP1 and WRPOs to discuss the delays in fund disbursement. NNP1 EMO recommended Bolikhamxay WRPO to further communicate and discuss with Xaysomboun WRPO and FPF DOF-MAF about their proposal.
- BSP-WCS and NNP1 EMO also recommended Bolikhamxay WRPO to further follow up and collect pending information on matters discussed in the previous meeting including access road improvement from Nahan village to the NNP1 reservoir, the forest encroachment and rubber

tapping on the compensated rubber trees, and the action by Bolikhamxay Province Forest Inspection (POFI) on the logging case.

Bolikhamxay WRPO carried out the reservoir and forest patrol on 8-17 May 2023 using the remaining budget from the AIP2022. The outcomes of patrolling will be evaluated and discussed in the next monthly meeting, depending on the availability of the funds under the AIP2023.

NNP1PC EMO

There was no activity implemented under the NNP1 EMO watershed livelihood program this month because the team's engagement with other assignments including the follow-up on the outstanding issues with the Xaysomboun WRPO, the fishery survey in the NNP1 watershed, and the follow-up with Forest Protection Fund (FPF) of the Department of Forestry (DOF) of the Ministry of Agriculture and Forestry (MAF) on the fund disbursement to Xaysomboun and Bolikhamxay WRPO.

2.1.2 Preparation of Annual Implementation Plan (AIP) 2022

2.1.2.1 Xaysomboun WRPO

The fund transfer for the approved AIP2022 is still delayed despite close follow-up with FPF DOF-MAF. The delay is mainly due to the internal documentation and process within Xaysomboun WRPO and FPF DOF-MAF.

2.1.3 Preparation of Annual Implementation Plan (AIP) 2023

2.1.3.1 Xaysomboun WRPO

NNP1 EMO further reviewed the plan and shared it with the Head of Xaysomboun WRPO in the first week of May 2023. NNP1 EMO and BSP-WCS proposed to discuss with Xaysomboun WRPO in the third week of May 2023. The Head of Xaysomboun WRPO informed NNP1 EMO that he will lead the internal discussion with his team but he was not available during May 2023 because of his assignment for another project (Lao Landscapes and Livelihoods Project) and personal leave.

2.1.3.2 Bolikhamxay WRPO

NNP1PC transferred the funds for the two quarters of 2023 of the approved Bolikhamxay AIP2023 totalling 529,527,000 LAK to FPF DOF-MAF on 10 April 2023. The Bolikhamxay WRPO still did not receive the funds from FPF DOF-MAF as of the end of May 2023.

The Head of Bolikhamxay WRPO informed during the discussion with EMO, ADB, and IAP on 25 May 2023 that they planned to request FPF DOF-MAF to organize a meeting among WRPOs and FPF DOF-MAF about the clarity on the role and responsibility of the official assignment of FPF DOF-MAF team per agreement No. 0535/DoF dated on 6 February 2023 as well as to deal with the delays in fund disbursement.

2.2 BIODIVERSITY OFFSET MANAGEMENT

2.2.1 Implementation of BOMP Annual Implementation Plan (AIP)

The progress on the implementation of key activities by Component in April 2023 is described below:

a. Component 1 - Spatial Planning and Regulation

The first site visit under the Participatory Land Use Planning (PLUP) updating for collecting information on the current situation in the three Nam Chouane-Nam Xang (NC-NX) villages in

Viangthong District was conducted from 27 April to 16 May 2023. BOMU together with NNP1 EMO and BSP-WCS will review and analyse the collected information. The results will be presented, discussed, and agreed upon with the communities in July 2023 and the dissemination of updated PLUP is scheduled for August 2023.

Figure 2-1: Representative photos from PLUP updated activity in Viangthong District

	
PLUP updating meeting in Vangphieng Village	PLUP updating meeting in Vangphieng Village
	
PLUP updating meeting in Na Gngang Village	PLUP field survey in Na Gngang Village
	
PLUP updating meeting in Natan Village	PLUP data interview in Natan Village

b. Component 2 – Law Enforcement

There was no field patrol in May 2023 because the budget under the approved AIP2023 is not ready yet (please refer to section 6.2.2.2) and the remaining budget under the approved AIP2022 is not sufficient. BOMU continued with the sub-station guarding (Nam San, Nam Ma and Na Gngang) from 14-31 May 2023 with the support from Bolikhamxay PAFO for food and fuel. During the ADB and IAP site visit on 23-24 May 2023, ADB recommended not to continue with the practice of not paying the patrolling team allowance for sub-station safeguarding because it is not in compliance with the Labour law. NNP1 EMO noted the recommendation and will further discuss with BOMU and BSP-WCS about it. **Component 3 – Conservation Outreach**

BSP-WCS is preparing the report for the outreach activity that was conducted in April 2023.

c. Component 4 – Conservation linked livelihood development

The April 2023 monthly snare removal was scheduled from 25 April - 9 May 2023. The target areas are Nam Chang and Nam Sone. BOMU informed NNP1 EMO on 27 April 2023 that the activity is postponed to the first week of May 2023 because some of the snare removal team members are not ready yet. The Head of BOMU informed NNP1 EMO on 25 May 2023 that the remaining budget under the AIP2022 is not sufficient to implement the snare removal activity. NNP1 EMO is requesting BOMU to share the remaining budget figures for further discussion and decision.

2.2.2 Preparation of Annual Implementation Plan (AIP) 2023

The Head of Bolikhamxay PAFO approved the BOMU AIP2023 on 19 April 2023 and BOMU submitted it to the FPF DOF-MAF at the end of April 2023. NNP1PC did not receive official fund disbursement request from FPF DOF-MAF until the end of May 2023 and so the fund transfer is expected to be completed in June 2023 as soonest and subject to the internal documentation and process at FPF DOF-MAF. In this regard, all the activities under the approved AIP2023 will be delayed until the funds are transferred.

After further internal discussion between and Director General (DG) of DOF-MAF and the FPF DOF-MAF, the Financial Management Manual (FMM) was signed/endorsed by the DG of DOF-MAF on 15 May 2023. FPF DOF-MAF requested NNP1 to support printing of the FMM (around 50 copies). NNP1 and FPF will further agree on the design of the FMM book prior to printing.

2.3 FISHERY MONITORING

The fishery monitoring is based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey of the month by covering the upstream, upper reservoir, lower reservoir, downstream and Mekong areas.

The fish species dominating the fish catch by weight in April 2023 as listed in **Table 2.3-1**. All species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species¹ and *Oreochromis niloticus* is an exotic species.

¹ The IUCN Red List of Threatened Species is the world's most comprehensive inventory and classification of threatened species. The Red List classifies species into nine groups: Extinct (EX), Extinct in the wild (EW), Critically endangered (CR),

Table 2.3-1: Fish Species dominating the Fish Catch in April 2023

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Hampala dispar</i> , <i>Hampala macrolepidota</i>	ປາສຸດ	113.2	LC
<i>Mastacembelus armatus</i> , <i>Mastacembelus favus</i>	ປາຫຼາດ	99.2	LC
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	98.2	LC
<i>Oreochromis niloticus</i>	ປານິນ	76.7	LC
<i>Channa striata</i>	ປາຄໍ້	73.3	LC

The recorded catch of Threatened species (IUCN Red List classification) in April 2023 are presented in **Table 2.3-2**. The list includes three species that are classified as Vulnerable species (VU).

Table 2.3-2: Threatened Species of April 2023 Fish Catch

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Cirrhinus cirrhosus</i>	ປາແກງ/ປານວນຈັນ	0.8	VU
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປຽນ	8.9	VU
<i>Tor sinensis</i>	ປາແດງ	12	VU

Species abundance and occurrence is based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey in April 2023. The catch is divided in three areas including above the main dam, below the main dam and Mekong area. Main biodiversity indicators in April 2023 for above dam, below dam and Mekong area are presented in **Table 2.3-3**.

Table 2.3-3: Main Biodiversity Indicators for April 2023

Biodiversity Indicators	Mekong	Below dam	Above dam
Total number of species and groups recorded	22	37	32
Single species	19	25	20
Species groups	3	12	12
Top 15 species (% total catch weight)	95.45%	82.96%	94.19%

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.

Biodiversity Indicators	Mekong	Below dam	Above dam
Proportion for species groups	5.78%	60.07%	51.06%
Diversity index (Shannon)	2.1033	2.9509	2.5643

Figure 2.3-1 shows fish diversity index (Shannon) for above dam, below dam and Mekong area from July 2015 to April 2023.

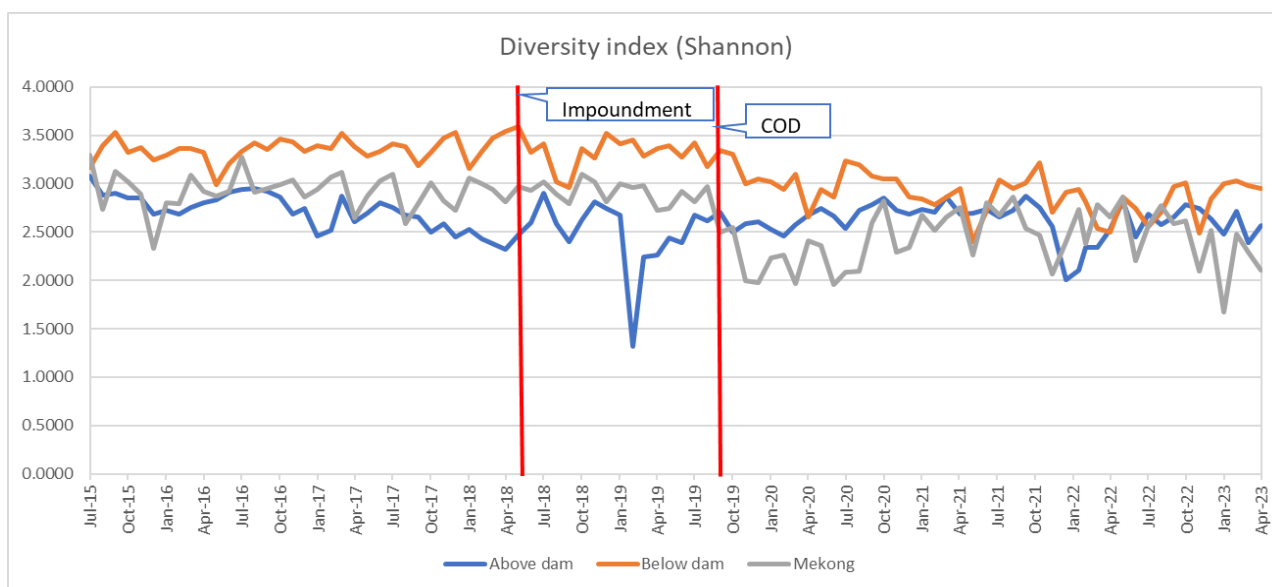


Figure 2.3-1: Fish diversity index (Shannon) by fishing zone from July 2015 to April 2023

Figure 2.3-2 shows the proportion of total number of households actively fishing by fishing zone including upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK). It ranges between 40% and 70% of active fishing households for all fishing zones in April 2023.

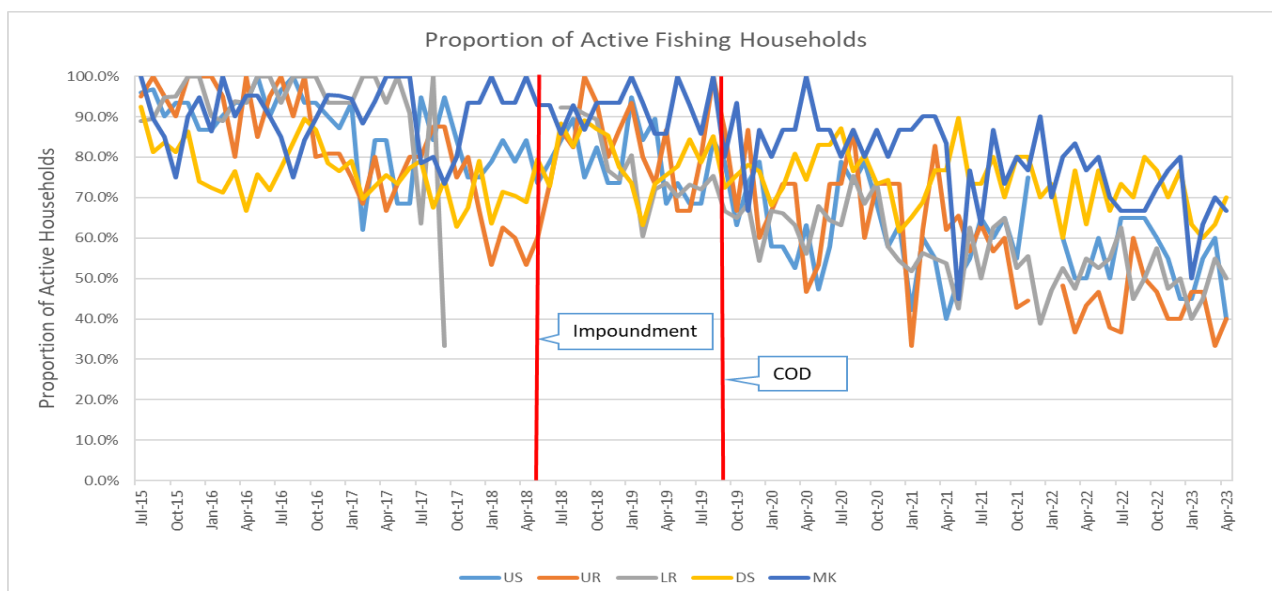


Figure 2.3-2: Proportion of total number of households actively fishing by fishing zone from July 2015 to April 2023

Note: Proportion of Active Fishing Households = (Active Fishing Households/Total Interviewed Households) x 100%.

Figure 2.3-3 shows the average (mean) of monthly household fishing days from July 2015 to April 2023 for the upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK) area.

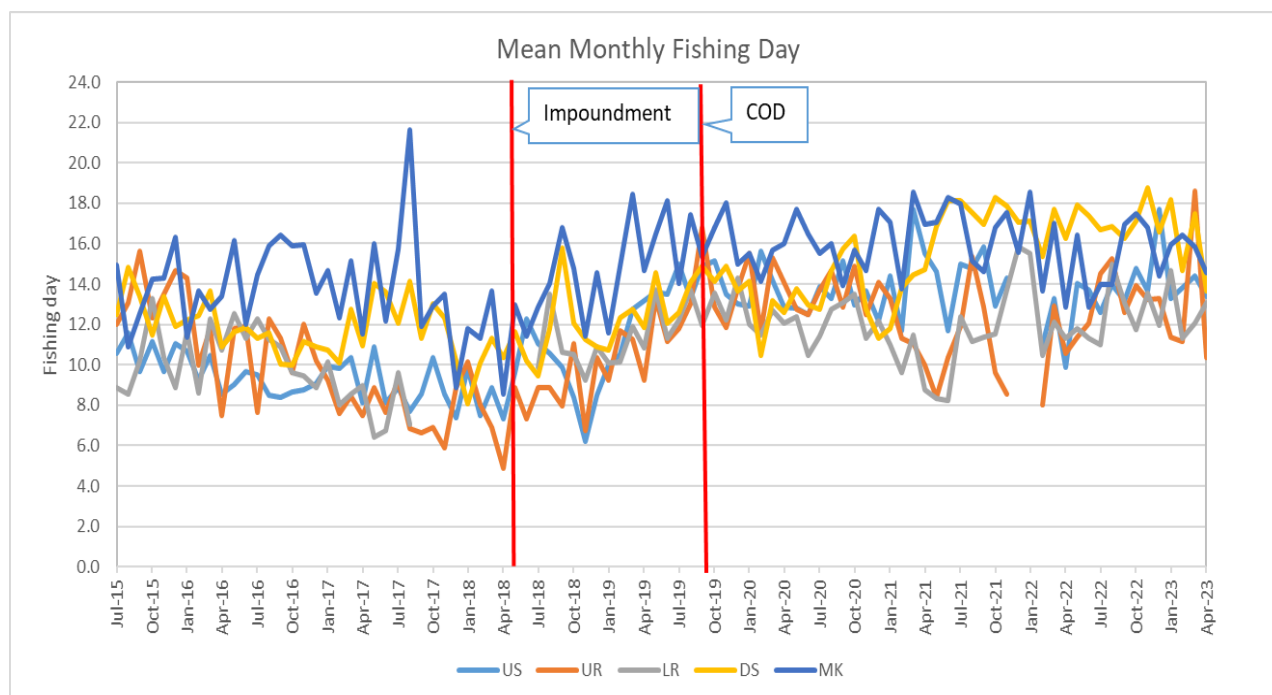


Figure 2.3-3: Mean of monthly fishing day from July 2015 to April 2023

The mean monthly number of fishing days for the month of April from 2016 to 2023 for the upstream, upper reservoir, lower reservoir, downstream and Mekong area are displayed in **Table 2.3-4**.

Table 2.3-4: Mean reported number of fishing days by fishing zone for the month of April from 2016 to 2023

Fishing Zone	April 2016 (day)	April 2017 (day)	April 2018 (day)	April 2019 (day)	April 2020 (day)	April 2021 (day)	April 2022 (day)	April 2023 (day)
Upstream	8.57	8.14	7.35	13.19	12.86	15.54	9.86	13.39
Upper reservoir	7.50	7.50	4.90	9.23	14.08	10.00	10.55	10.36
Lower reservoir	10.71	9.00	NA	10.82	12.05	8.78	11.30	13.07
Downstream	10.90	10.95	10.38	11.85	12.61	14.72	16.24	13.67
Mekong	13.39	11.54	8.57	14.64	16.00	16.97	12.86	14.57

The mean monthly household fish catch from July 2015 to April 2023 for the upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK) area are presented in **Figure 2.3-4**.

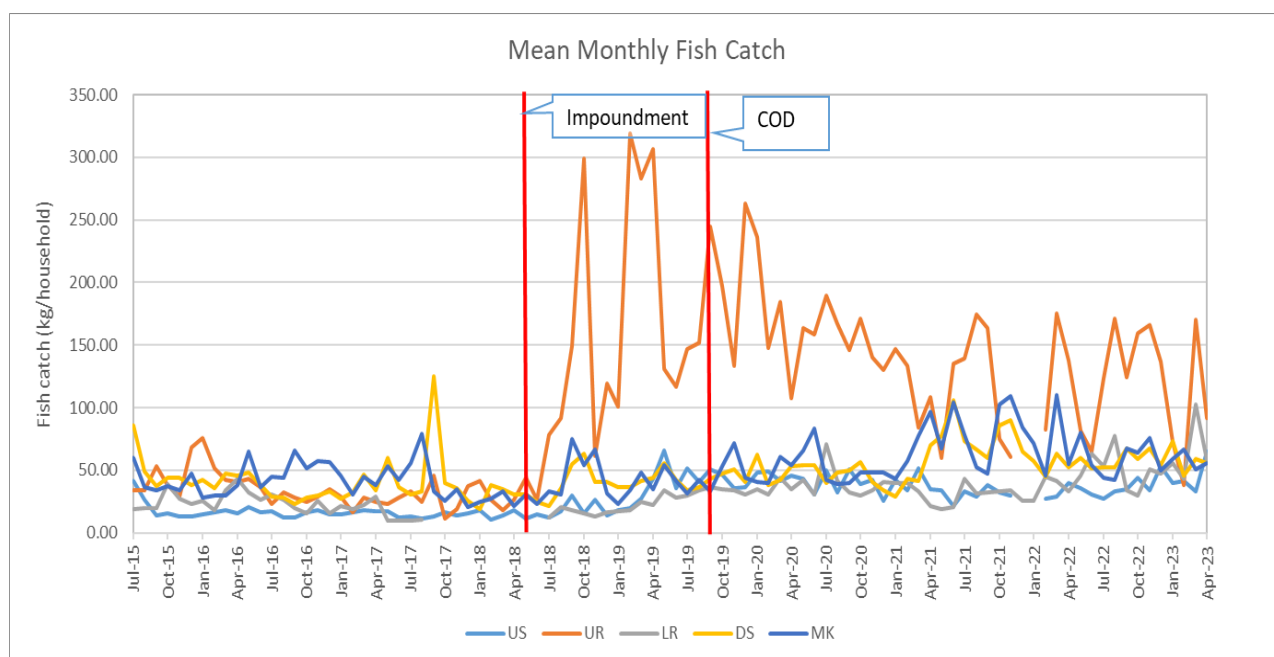


Figure 2.3-4: Mean Monthly Household Fish Catch from July 2015 to April 2023

The mean household fish catch for the month of April from 2016 to 2023 in the upstream, upper reservoir, lower reservoir, downstream and Mekong area are displayed in **Table 2.3-5**.

Table 2.3-5: Mean Monthly Household Fish Catch for the month of April from 2016 to 2023

Fishing Zone	April 2016 (kg)	April 2017 (kg)	April 2018 (kg)	April 2019 (kg)	April 2020 (kg)	April 2021 (kg)	April 2022 (kg)	April 2023 (kg)
Upstream	15.46	17.14	17.82	43.15	45.57	34.77	39.56	64.55
Upper reservoir	40.46	24.96	26.51	306.73	107.69	108.57	137.44	91.43
Lower reservoir	43.11	28.76	NA	22.68	34.89	21.49	32.88	58.63
Downstream	45.50	33.67	30.36	43.85	53.38	69.75	52.69	55.82
Mekong	38.49	38.31	21.10	34.46	54.20	96.93	54.97	55.61

The mean daily fish catch per household from July 2015 to April 2023 are displayed in **Figure 2.3-5** and the mean fish catch per household per fishing day for the month of April from 2016 to 2023 are shown in **Table 2.3-6**.

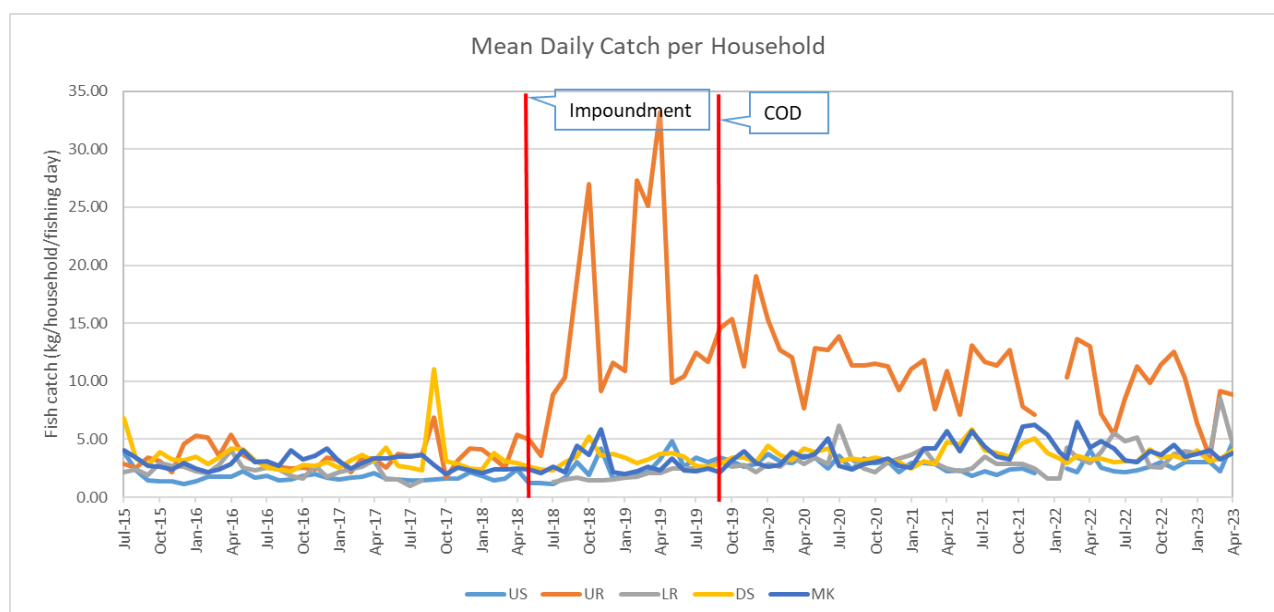


Figure 2.3-5: Mean Daily Fish Catch per Household from July 2015 to April 2023

Table 2.3-6: Mean Daily Fish Catch per Household for the month of April from 2016 to 2023

Fishing Zone	April 2016 (kg)	April 2017 (kg)	April 2018 (kg)	April 2019 (kg)	April 2020 (kg)	April 2021 (kg)	April 2022 (kg)	April 2023 (kg)
Upstream	1.80	2.11	2.43	3.27	3.54	2.24	4.01	4.82
Upper reservoir	5.40	3.33	5.41	33.23	7.65	10.86	13.03	8.83
Lower reservoir	4.02	3.20	NA	2.10	2.89	2.45	2.91	4.49
Downstream	4.18	3.07	2.93	3.70	4.23	4.74	3.24	4.08
Mekong	2.87	3.32	2.46	2.35	3.39	5.71	4.28	3.82

The survey results in April 2023 indicate that reservoir is the main fishing habitat for the upstream and upper reservoir zone, while the main fishing habitat for the lower reservoir, downstream and Mekong zones are tributaries and streams, Nam Ngiep and Mekong respectively. The proportion of fishing habitats in April 2023 are displayed in **Table 2.3-7**.

Table 2.3-7: Proportion of the catch reported by main habitats (%) in April 2023

Habitats	US	UR	LR	DS	MK
Mekong	0.0%	0.0%	0.0%	1.9%	90.8%
Nam Ngiep	36.9%	11.1%	0.0%	59.2%	1.2%
Nam Xan	0.0%	0.0%	0.0%	0.0%	0.0%
Reservoir	44.0%	88.9%	41.7%	0.0%	0.0%
Tributaries and streams	19.1%	0.0%	57.0%	26.8%	0.0%

Habitats	US	UR	LR	DS	MK
Wetlands	0.0%	0.0%	1.2%	6.2%	8.1%
Others	0.0%	0.0%	0.0%	5.9%	0.0%

Total proportion of other aquatic animals (OAA) in the total reported catch of fish and OAA for the same 7-day period from July 2015 to April 2023 are presented in **Figure 2.3-6** and the proportion of OAA catch for the month of April from 2016 to 2023 are shown in **Table 2.3-8**.

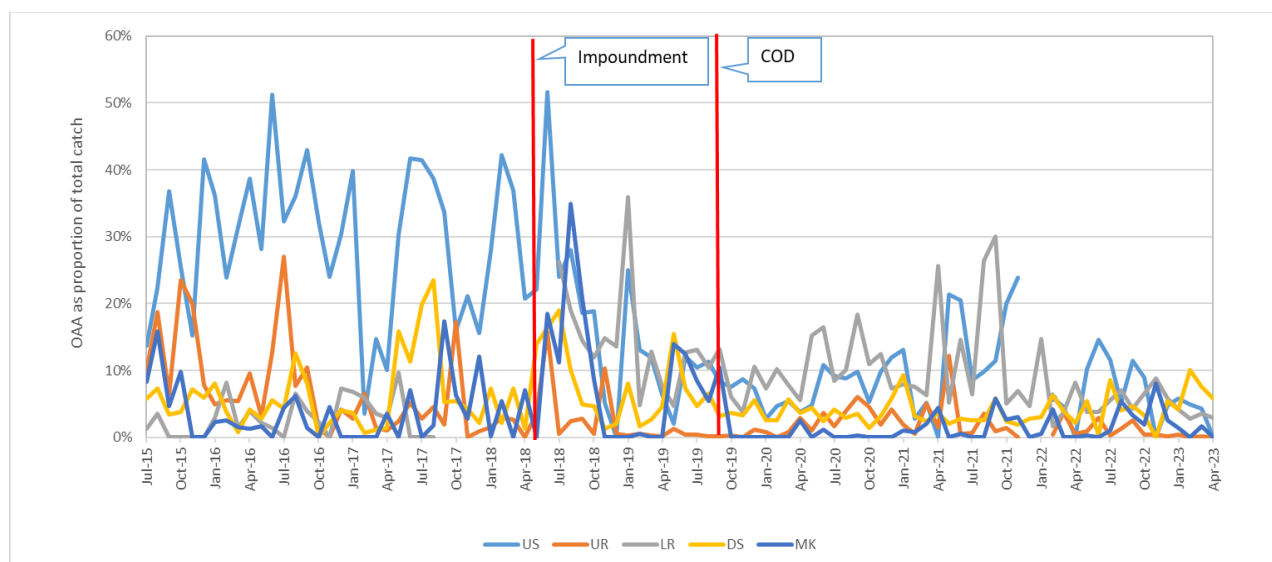


Figure 2.3-6: Proportion of OAA to the total reported number of fish and OAA for a 7-day period by fishing zone from July 2015 to April 2023

Table 2.3-8: Proportion of OAA to the total reported number of fish and OAA for the month of April from 2016 to 2023

Fishing Zone	April 2016	April 2017	April 2018	April 2019	April 2020	April 2021	April 2022	April 2023
Upstream	38.71%	10.11%	20.71%	6.43%	3.77%	0.00%	0.00%	0.00%
Upper reservoir	9.58%	1.06%	0.00%	0.16%	2.92%	1.49%	0.57%	0.00%
Lower reservoir	3.98%	2.89%	0.00%	7.68%	5.51%	25.69%	8.16%	2.91%
Downstream	4.23%	1.39%	1.32%	4.61%	3.65%	3.70%	2.18%	5.82%
Mekong	1.30%	3.57%	7.11%	0.00%	2.57%	4.40%	0.00%	0.00%

3 EXTERNAL MISSIONS AND VISITS

The joint environmental mission of ADB-IAP-LTA was conducted on 22-27 May 2023. The mission visited the NC-NX offset site village (Vangphieng), the NC-XN patrol sub-stations at Nam Ma and Nam San, the NNP1 Project sites, NNP1 reservoir, as well as having discussion with Xaysomboun WRPO, Bolikhamxay WRPO, NC-NX BOMU, and relevant GOL offices.

ANNEXES

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

Date	Parameters (Unit)	River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Reg Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Guideline																		
2-May-23	pH	5.0 - 9.0		7.15	6.7	6.65												
3-May-23	pH	5.0 - 9.0					6.65	6.79	6.88	6.9								
9-May-23	pH	5.0 - 9.0		6.88	6.74	6.6												
10-May-23	pH	5.0 - 9.0					6.57	6.71	6.85	6.77								
16-May-23	pH	5.0 - 9.0	6.74												6.91			
17-May-23	pH	5.0 - 9.0		6.92	6.79	6.65										7.15		
18-May-23	pH	5.0 - 9.0					6.88	6.9	6.6	6.85								
19-May-23	pH	5.0 - 9.0									6.52	6.63	6.85	6.96			7.12	6.9
24-May-23	pH	5.0 - 9.0					6.55	6.73	6.87	6.91								
25-May-23	pH	5.0 - 9.0		6.57	6.7	6.66												
29-May-23	pH	5.0 - 9.0					6.8	6.88	6.58	6.67								
30-May-23	pH	5.0 - 9.0		6.8	6.77	6.72												
2-May-23	Sat. DO (%)			80.4	110.7	108												
3-May-23	Sat. DO (%)						96.6	89.3	23.5	32.9								
9-May-23	Sat. DO (%)			89.3	110.9	111.3												
10-May-23	Sat. DO (%)						118.1	110.1	25.3	26.6								
16-May-23	Sat. DO (%)		97.9												89.4			
17-May-23	Sat. DO (%)			90.7	113	107.3										100.6		
18-May-23	Sat. DO (%)						106.6	111.4	16.8	22.5								
19-May-23	Sat. DO (%)										53.4	49	68.1	71.5			87.3	62.1
24-May-23	Sat. DO (%)						95.4	98.8	14.3	27.8								
25-May-23	Sat. DO (%)			81.5	93.3	97.7												
29-May-23	Sat. DO (%)						111	107.6	18.5	35.4								
30-May-23	Sat. DO (%)			94.1	125.7	128.4												
2-May-23	DO (mg/L)	>6.0		6.43	8.24	8.08												
3-May-23	DO (mg/L)	>6.0					7.38	6.87	1.98	2.76								
9-May-23	DO (mg/L)	>6.0		7.27	8.32	8.35												
10-May-23	DO (mg/L)	>6.0					8.88	8.26	2.14	2.26								

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Reg Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
16-May-23	DO (mg/L)	>6.0	7.72											6.42				
17-May-23	DO (mg/L)	>6.0		7.14	8.37	8.08									7.99			
18-May-23	DO (mg/L)	>6.0					8.02	8.39	1.43	1.9								
19-May-23	DO (mg/L)	>6.0						8.39	1.43	1.9	4.47	4.06	5.59	5.82			6.73	5.04
24-May-23	DO (mg/L)	>6.0					7.15	7.45	1.18	2.28								
25-May-23	DO (mg/L)	>6.0		6.64	7.01	7.28												
29-May-23	DO (mg/L)	>6.0					8.02	7.94	1.53	2.91								
30-May-23	DO (mg/L)	>6.0		7.08	9.1	9.36												
2-May-23	Conductivity (µs/cm)			112	96	86												
3-May-23	Conductivity (µs/cm)						82	82	87	87								
9-May-23	Conductivity (µs/cm)			102	97	85												
10-May-23	Conductivity (µs/cm)						82	82	87	86								
16-May-23	Conductivity (µs/cm)		104											121				
17-May-23	Conductivity (µs/cm)			103	102	87									99			
18-May-23	Conductivity (µs/cm)						82	81	88	88								
19-May-23	Conductivity (µs/cm)										88	89	89	89			171	64
24-May-23	Conductivity (µs/cm)						82	81	88	87								
25-May-23	Conductivity (µs/cm)			103	98	88												
29-May-23	Conductivity (µs/cm)						83	81	89	88								
30-May-23	Conductivity (µs/cm)			124	98	89												
2-May-23	Temperature (°C)			26.81	30.66	30.55												
3-May-23	Temperature (°C)						29.33	28.86	23.73	24.45								
9-May-23	Temperature (°C)			25.71	30.42	30.44												
10-May-23	Temperature (°C)						30.36	30.14	23.79	24.16								
16-May-23	Temperature (°C)		27.61											33.11				
17-May-23	Temperature (°C)			27.86	30.93	30.16									27.07			
18-May-23	Temperature (°C)						30.22	30.1	24.21	24.95								
19-May-23	Temperature (°C)										24.41	24.9	25.25	25.62			30.38	28.59
24-May-23	Temperature (°C)						30.4	30.22	24.72	25.6								
25-May-23	Temperature (°C)			27.69	30.49	30.85												
29-May-23	Temperature (°C)						32.51	31.34	24.84	25.18								
30-May-23	Temperature (°C)			30.68	32.46	32.24												

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Reg Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
2-May-23	Turbidity (NTU)			38.6	2.55	1.51												
3-May-23	Turbidity (NTU)						2.48	1.66	1.17									
9-May-23	Turbidity (NTU)			112	2.61	2.46												
10-May-23	Turbidity (NTU)						2.98	1.77	1.39	1.43								
16-May-23	Turbidity (NTU)		54.5											53.6				
17-May-23	Turbidity (NTU)			234	10.3	2.75									54.4			
18-May-23	Turbidity (NTU)						2.57	1.84	1.75	1.69								
19-May-23	Turbidity (NTU)										2.69	2.59	2.44	10.2		5.63	4.74	
24-May-23	Turbidity (NTU)						3.24	1.91	2.2	2.12								
25-May-23	Turbidity (NTU)			353	6.12	2.72												
29-May-23	Turbidity (NTU)						3.08	1.68	2.6	3.96								
30-May-23	Turbidity (NTU)			862	4.44	2.35												
16-May-23	TSS (mg/L)		216											54.76				
17-May-23	TSS (mg/L)			351.6		<5									78.46			
18-May-23	TSS (mg/L)						<5	<5	<5	<5	<5	<5	6.8			<5	<5	
19-May-23	TSS (mg/L)						<5	<5	<5	<5								
16-May-23	BOD ₅ (mg/L)	<1.5	2.71											2.63				
17-May-23	BOD ₅ (mg/L)	<1.5		1.17		<1									1.03			
18-May-23	BOD ₅ (mg/L)	<1.5					<1	<1	<1	<1								
19-May-23	BOD ₅ (mg/L)	<1.5									<1	<1	<1	<1		<1	<1	
16-May-23	COD (mg/L)	<5.0																
17-May-23	COD (mg/L)	<5.0	19.2											12.8				
18-May-23	COD (mg/L)	<5.0							6.4	12.8					28.8			
19-May-23	COD (mg/L)	<5.0									16	12.8	6.4	16		22.4	16	
16-May-23	NH ₃ -N (mg/L)	<0.2	0.3											0.4				
17-May-23	NH ₃ -N (mg/L)	<0.2		<0.2		<0.2									<0.2			
18-May-23	NH ₃ -N (mg/L)	<0.2					<0.2	<0.2										
16-May-23	NO ₃ -N (mg/L)	<5.0	0.33											0.17				
17-May-23	NO ₃ -N (mg/L)	<5.0		0.27		0.06									0.07			
18-May-23	NO ₃ -N (mg/L)	<5.0					0.07	0.06										
16-May-23	Faecal coliform (MPN/100 mL)	<1,000	540											130				
17-May-23	Faecal coliform (MPN/100 mL)	<1,000													110			

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Reg Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
19-May-23	Faecal coliform (MPN/100 mL)	<1,000								27	22	49	240			540	920	
16-May-23	Total Coliform (MPN/100 mL)	<5,000	920											540				
17-May-23	Total Coliform (MPN/100 mL)	<5,000													170			
19-May-23	Total Coliform (MPN/100 mL)	<5,000								110	79	79	350			920	1,600	
16-May-23	TKN		5.1											<1.5				
17-May-23	TKN														<1.5			
18-May-23	TKN					<1.5	<1.5											
16-May-23	TOC (mg/L)		3.29											3.25				
18-May-23	TOC (mg/L)							1.11	0.92						3.9			
19-May-23	TOC (mg/L)									1.52	1.43	1.44	1.54			3.86	3.5	
16-May-23	Total Phosphorus (mg/L)		0.02											0.03				
17-May-23	Total Phosphorus (mg/L)			0.03		0.02									0.03			
18-May-23	Total Phosphorus (mg/L)						0.01	0.01										
16-May-23	Total Dissolved Phosphorus (mg/L)		<0.01											0.01				
17-May-23	Total Dissolved Phosphorus (mg/L)			0.01		<0.01									0.01			
18-May-23	Total Dissolved Phosphorus (mg/L)						<0.01	<0.01										
17-May-23	Turbidity (NTU)-bottom					7.67												
18-May-23	Turbidity (NTU)-bottom						1.18	1.21										
17-May-23	TSS (mg/L)-bottom					11.4												
18-May-23	TSS (mg/L)-bottom						14.28	<5										
17-May-23	BOD ₅ (mg/L)-bottom					5.68												
18-May-23	BOD ₅ (mg/L)-bottom						5.18	6.12										
17-May-23	NH ₃ -N (mg/L)-bottom					0.5												
18-May-23	NH ₃ -N (mg/L)-bottom						0.6	0.3										
17-May-23	NO ₃ -N (mg/L)-bottom					0.07												
18-May-23	NO ₃ -N (mg/L)-bottom						0.06	0.07										
17-May-23	TKN-bottom					<1.5												
18-May-23	TKN-bottom						<1.5	<1.5										
17-May-23	Total Dissolved Phosphorus (mg/L)-bottom					0.01												

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Reg Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
18-May-23	Total Dissolved Phosphorus (mg/L)-bottom						0.02	0.05										
17-May-23	Total Phosphorus (mg/L)-bottom					0.03												
18-May-23	Total Phosphorus (mg/L)-bottom						0.04	0.08										
17-May-23	Chlorophyll-A-bottom					1.64												
18-May-23	Chlorophyll-A-bottom						1.36	0.47										
17-May-23	Chlorophyll-A			4.55		2.31												
18-May-23	Chlorophyll-A						0.94	0.88										

TABLE A-2: RESULTS OF CAMP EFFLUENTS IN MAY 2023

	Site Name	OSO V1 (Owner's Site Office and Village)		OSO V2 (ESD Camp)		Main Powerhouse	
	Station Code	EF01		EF13		EF19	
	Date	15-May-23	22-May-23	15-May-23	22-May-23	15-May-23	22-May-23
Parameters (Unit)	Guideline						
pH	6.0 - 9.0	6.86	6.89	7.1	7.1	6.8	7.3
Sat. DO (%)		61.8	91.5	89.6	116.9	51.4	90.6
DO (mg/L)		4.82	6.9	6.97	8.85	3.88	6.64
Conductivity (µs/cm)		317	345	570	609	897	815
Temperature (°C)		28.16	30.06	28.22	29.92	30.42	31.68
Turbidity (NTU)		1.11	0.81	6.15	6.11		12.5
TSS (mg/L)	<50	<5	<5	5.2	<5	11.4	14.0
BOD ₅ (mg/L)	<30	<6	<6	<6	<6	<6	6.7
COD (mg/L)	<125	<25	<25	<25	26	34	36
NH ₃ -N (mg/L)	<10.0	<10	<10	23.2	25.8	16.5	5.2
Total Nitrogen (mg/L)	<10.0	1.52	1.55	36.3	38.1	44.7	6.3
Total Phosphorus (mg/L)	<2	0.9	0.99	2.0	11.1	2.6	0.9
Oil & Grease (mg/L)	<10.0	<1		<1		<1	
Total coliform (MPN/100 mL)	<400	920	1,600	33	2	54,000	5,400
Faecal Coliform (MPN/100 mL)	<400	130	170	0	0	35,000	5,400
Residual Chlorine (mg/L)	<1.0	N/A	N/A	0.68	0.40	0.05	0.05