NAM NGIEP1 POWER COMPANY

Nam Ngiep 1 Hydropower Project

Quarterly Environment Monitoring Report
Second Quarter of 2022

April to June 2022

Rev	Date	Author	Checked	Approved	Modification Details
A	11 January 2023				Final
A0	15 December 2022	Hendra WINASTU	Wanidaporn RODE	Khamlar PHONSAVAT	To ADB and LTA for Review

Accessibility	
☑	Public
☐	Internal
☐	Confidential

Document No.

NNP1-O-J0905-RP-006-A

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

ABBREVIATIONS / ACRONYMS

AIP	Annual Implementation Plan
ADB	Asian Development Bank
BAC	Biodiversity Advisory Committee
BOF	Biodiversity Offset Framework
BOMC	Biodiversity Offset Management Committee
BOMP	Biodiversity Offset Management Plan
BOMU	Biodiversity Offset Management Unit
BSP	Biodiversity Service Provider
CA	Concession Agreement between the NNP1PC and GOL
CAP	Corrective Action Plan
CCA	Community Conservation Agreement
CDP	Community Development Plan
COD	Commercial Operation Date
CVC	Conventional Vibrated Concrete
CWC	Civil Works Contract
DAFO	District Agriculture and Forestry Office
DD	Data Deficient of IUCN conservation status
DOF	Department of Forestry of Ministry of Agriculture and Forestry
EC	Electrolytic Conductivity
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
ESD	Environmental and Social Division of NNP1PC
ESMMP	Environmental and Social Monitoring and Management Plan
FMM	Financial Management Manual
GOL	Government of Lao PDR
GIS	Geographic Information Systems
HMWC	Hydraulic Metal Works Contract
HR	Human Resources
IAP	Independent Advisory Panel

IEE	Initial Environmental Examination
IMA	Independent Monitoring Agency
INRMP	Integrated Natural Resources Management Plan
IUCN	International Union for Conservation of Nature
ISP	Intergraded Spatial Planning
kV	kilo-Volt
LC	Least Concern of IUCN conservation status
LTA	Lender's Technical Advisor
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mines, Lao PDR
MOM	Minutes of Meeting
MONRE	Ministry of Natural Resource and Environment, Lao PDR
MOU	Memorandum of Understanding
NC-NX	Nam Chouane-Nam Xang
NCR	Non-Compliance Report
NNP1PC	Nam Ngiep 1 Power Company Limited
OAA	Other aquatic animals
OC	Obayashi Corporation
ONC	Observation of Non-Compliance
OSOV	Owners' Site Office and Village
PAFO	Provincial Department of Agriculture and Forestry
PONRE	Provincial Department of Natural Resource and Environment, MONRE
RCC	Roller Compacted Concrete
SIR	Site Inspection Report
SMO	Social Management Office of ESD within NNP1PC
SMART	Spatial Monitoring and Reporting Tool
SOP	Standard Operating Procedure
SS-ESMMP	Site Specific Environmental and Social Monitoring and Management Plan
TOR	Terms of Reference
TPZ	Totally Protected Zone
TSS	Total Suspended Solids
UAE	United Analysis and Engineering Consultant Company Ltd.
VU	Vulnerable of IUCN conservation status
WCS	Wildlife Conservation Organization

WMF	Watershed Management Fund
WMP	Watershed Management Plan
WRPC	Watershed and Reservoir Protection Committee
WRPO	Watershed and Reservoir Protection Office
WWTS	Wastewater Treatment System

1 EXECUTIVE SUMMARY

The quarterly environment monitoring report of Nam Ngiep 1 Hydropower Project provides information and analysis of compliance with the environmental and social obligations of the Project stipulated in the Concession Agreement between the Nam Ngiep 1 Power Company (NNP1PC) and the Government of Lao PDR (GOL), and as required by environmental legislation of the Lao PDR, the ADB Safeguard Policy Statement and IFC Performance Standards. The Company ensures compliance with these requirements through implementation of project specific sub-plans, programmes and activities prepared as part of the Environmental and Social Management and Monitoring Plan for the Operation Phase (ESMMP-OP).

During Q2 2022, SGS (Lao) Sole Co., Ltd. submitted the ISO14001:2015 certification to NNP1PC on 25 April 2022 confirming that NNP1PC has been assessed and certified meeting all the requirements of ISO14001:2015 for the activities of the Generation and Distribution of Electricity from the 290 MW Hydropower Project. The certification is valid from 15 March 2022 until 15 March 2025 subject to satisfactory surveillance audits which are scheduled to take place in March 2023 for the first surveillance audit. NNP1PC continued activities related to ISO14001:2015 implementation such as revising and updating the environmental aspects according to the external auditor's comments, following up on the progress of Environmental Management Plans achievements and preparation of the internal audit plan for the coming session in August 2022.

EMO received one Detailed Work Program (DWP) & Site Specific Environmental and Social Management and Monitoring Plans (SS-ESMMP) and one Site Decommissioning Plan for review and approval. EMO did not issue any Site Inspection Report of Observation of Non-Compliance (ONC) or Non-Compliance Reports (NCR) to the Contractor. One NCR relating to Wastewater Treatment Systems (WWTSs) operation and maintenance at the two camps (OSOV1 and OSOV2), and the Main Powerhouse was unresolved and will be carried over to Q3 2022.

The operation and adjustment of the constructed wastewater treatment systems including the trial of bacteria seeding for the Sequencing Batch Reactor (SBR) system at OSOV2 continued in Q2 2022. The results of the effluent analyses after the trial indicated that the reduction of nitrogen and phosphorus had improved. Based on monitoring and adjustments over a couple months, it was found that the SBR system could not generate the sludge quantities in the reactor tank that were expected in accordance with the design specifications. In this regard, EMO is preparing to collect sludge from the septic biofilm tanks (aeration tanks) of OSOV1 to be added into the SBR system of OSOV2. It is expected that the operation of the system can be adjusted to meet the effluent standards by Q4 2022

During Q2 2022, EMO continued to monitor the progress of revegetation at 31 sites. There were no significant issues of land disturbance, erosion or vegetation destruction found during the quarterly inspection. NNP1PC received the signed memo of land use handover from the District Office of Energy and Mines confirming their acceptance of the land use handover to GOL. The handover is currently being reported to the higher government levels.

A total of 37.99 m^3 solid waste from NNP1 project sites and camps was disposed of at the NNP1 Project Landfill, a decrease of 26.71 m^3 compared with Q1 2022. The handover of the community solid waste management program, Houay Soup landfill operation and the community waste bank is in process by the Bolikhan Environment Management Unit (EMU). A total of 29.7 m^3 of solid waste from Phouhomxay's Health Centre, school and the NNP1PC Resource Centre was disposed

of at Houay Soup Landfill with support by NNP1PC after the local waste collection contractor's contract ended on 15 April 2022. No recyclable waste was stored at the Community Waste Bank as no recyclables were received in Q2 2022.

The environmental flow requirements have been monitored in accordance with the ESMMP-OP and the results show full compliance with the requirements, except for the Thalweg water depth measurements that indicated some depths below the required 0.5 m at 5.7 km from the Re-regulation Dam during times with dam discharge less than 30 m^3/s but the monitoring team had no difficulties navigating the river and there were no complaints from the downstream villagers.

The concentration of dissolved oxygen (DO) at the surface level in R05 (Main Reservoir immediately upstream of the main dam) ranged between 6.7 mg/L and 8.1 mg/L. In addition, the DO concentrations in Nam Chian, Nam Phouan, Nam Xao and Nam Houay Soup were above 6 mg/L.

The DO concentrations in the Re-regulation Reservoir showed no significant changes over the course of the quarter with a mean concentration of about 2.5 mg/L over the entire water column. The DO levels in Nam Ngiep downstream the Re-regulation Dam (NNG05) during the quarter (except late June 2022) were between 6.3 mg/L and 9.2 mg/L. In late June 2022, during periods with turbine discharge the DO Levels in the first 5.2 kilometres were about 3.5 mg/L gradually increasing to around 5.5 mg/L over the following 42 km.

The depth profile monitoring during the period indicates formation of oxyclines in the Main Reservoir at the monitored stations at varying depths.

The management activities as per the approved Watershed Management AIP2022 were delayed due the long GOL internal document process for the fund transfer to Bolikhamxay Watershed and Reservoir Protection Office (WRPO).

The management activities as per the approved NC-NX Biodiversity Offset Management AIP2021 under the component of law enforcement and community outreach progressed during this reporting period.

The five species that dominated the fish catch by weight in Q2 2022 include one species *Oreochromis niloticus* and four species group of Hampala, Poropuntius*, Sikukia gudgeri* and *Amblyrhynchichthys truncates* and Barbonymus and Hypsibarbus that are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Sikukia gudgeri* which is classified as Data Deficient species (DD). The recorded catch of threatened species includes three Vulnerable species (VU): *Cirrhinus cirrhosis*, *Scaphognathops bandanensis*, and *Tor sinensis*.

2 INTRODUCTION

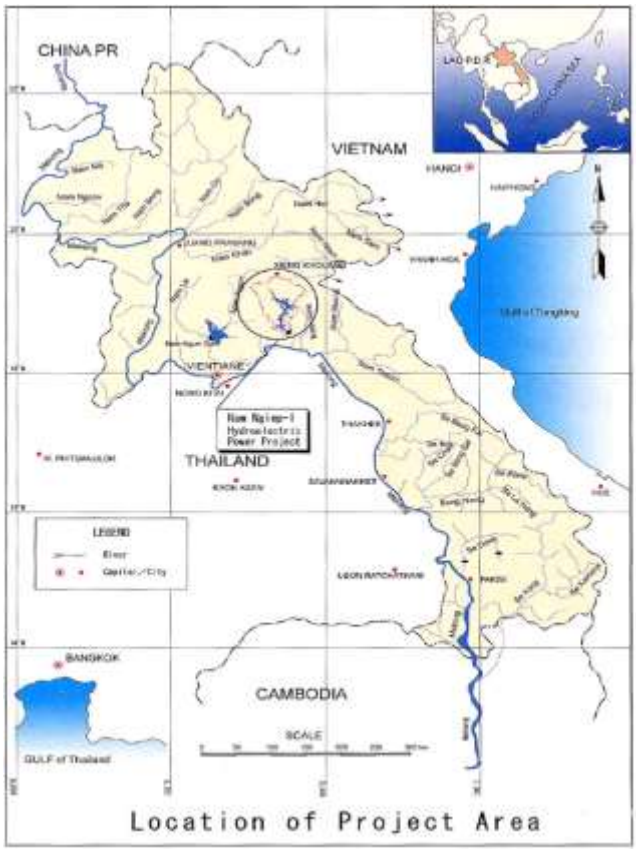
The Nam Ngiep originates in the mountains of Xiengkhouang Province, flowing through Khoun District into Thathom District of Xaysomboun Province, through Hom District and into Bolikhan District of Bolikhamxay Province. The Nam Ngiep meets the Mekong River just upstream from Pakxan in Bolikhamxay Province.

Two dams and power stations were constructed along the Ngiep River in Bolikhamxay. At the main dam site, a primary power station generated around 1,546 GWh of electricity for export to Thailand and release water to a regulating pond where a second dam and power station generate around 105 GWh of electricity for local use.

The Project Commercial Operation Date was achieved on 05 September 2019.

This Quarterly Environment Report provides a summary of environmental monitoring activities and mitigation actions during **Q2 2022**. The report is published on the Company website (https://namngiep1.com/).

Related construction Site Specific Environmental and Social Monitoring and Management Plans (SS-ESMMPs) are also publicly disclosed on the Company website as required under the Concession Agreement.



3 ENVIRONMENTAL MANAGEMENT AND MONITORING

The environmental management and monitoring activities reported in this section document the implementation of the relevant sub-plans and programmes of the Environmental and Social Management and Monitoring Plan for the Operation Phase during Q2 2022.

3.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

During Q2 2022, SGS (Lao) Sole Co., Ltd. submitted the ISO14001:2015 certification to NNP1PC on 25 April 2022 confirming that NNP1PC has been assessed and certified meeting all the requirements of ISO14001:2015 for the activities of the Generation and Distribution of Electricity from the 290 MW Hydropower Project. The certification is valid from 15 March 2022 until 15 March 2025 subject to satisfactory surveillance audits which are scheduled to take place in March 2023 for the first surveillance audit. NNP1PC continued activities related to ISO14001:2015 implementation such as revising and updating the environmental aspects according to the external auditor's comments, following up on the progress of Environmental Management Plans achievements and preparation of the internal audit plan for the coming session in August 2022

The progress on establishing the EMS according to ISO14001:2015 follows the tentative work plan as shown in **Table 3-1.**

TABLE 3-1: *ENVIRONMENTAL MANAGEMENT SYSTEM WORK PLAN*

Item	ISO14001:2015 Work Plan	Year 2020		Year 2021				Year 2022	
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
1	Continue to prepare EMS documents								
2	**NNP1PC Environmental Policy announcement**								
3	NNP1PC ISO Committee establishment								
4	Training relevant staff on: - Requirement and Interpretation of ISO14001:2015 - Organization Context and Risk Management for ISO14001 - ISO14001:2015 Document Information - ISO14001:2015 Internal Audit								
5	Implement the EMS procedures and processes								
6	ISO14001:2015 Internal Audit								
7	Implement the corrective actions and preventive actions according to the Internal Audit								
8	Management Review by NNP1PC Management								
9	ISO 14001:2015 Assessment and Certification Audit – **Stage 1** (***remote audit*** on the documentation review)								
10	Implement the corrective actions and preventive actions according to the Stage 1 Audit								
11	ISO 14001:2015 Assessment and Certification Audit – **Stage 2** (***remote audit, 4 man-days***)								
12	Implement the corrective actions and preventive actions according to the Stage 2 Audit – No Corrective Action Request raised during the Stage 2 Audit								
13	**Certify of ISO14001:2015 with a successful completion of the audit**								
	Completed activities per the plan								
	Plan to achieve the activities								

FIGURE 3-1*: ISO 14001:2015 CERTIFICATION VALID FROM 15 MARCH 2022 UNTIL 15 MARCH 2025*

Certificate TH22/00000262

The management system of

Nam Ngiep 1 Power Company

Owner's Site Office and Village, Hat Gniun Village, Bolikhan District, Bolikhamsay Province, Lao PDR

has been assessed and certified as meeting the requirements of

ISO 14001:2015

For the following activities

The Generation and Distribution of Electricity from 290 MW Hydropower Project

This certificate is valid from 15 March 2022 until 15 March 2025 and remains valid subject to satisfactory surveillance audits.

Issue 1. Certified since 15 March 2022.

Authorised by

SGS United Kingdom Ltd

Rossmore Business Park, Ellesmere Port, Cheshire, CH65 3EN, UK

t +44 (0)151 350 6666 - www.sgs.com

This document is issued by the Company subject to its General Conditions of Certification Services accessible at www.sgs.com/terms_and_conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein. The authenticity of this document may be verified at http://www.sgs.com/en/certified-clients-and-products/certified-client-directory. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Page 1 / 1

3.2 CONTRACTOR SS-ESMMPS

During Q2 2022, the Environment Management Office (EMO) of NNP1PC received one Detailed Work Program (DWPs) & Site Specific Environmental and Social Management and Monitoring Plans (SS-ESMMPs), and one Site Decommissioning Plan for review and approval. All of these submitted documents were cleared as shown in **Table 3-2** and more details can be found in **Appendix 1**.

TABLE 3-2*: DOCUMENTS REVIEWED DURING Q2 2022*

Document Name	Rev. 1	Rev. 2	Rev. 3	Approved
DWP SS-ESMMP for Maintenance Works 2022	√	√		√
Site Decommissioning Plan for KEBER's Camp and Associate Facilities	√	√	√	√

The operation and adjustment of the constructed wastewater treatment systems including the trial of bacteria seeding for the Sequencing Batch Reactor (SBR) system at OSOV2 continued in Q2 2022. The results of the effluent analyses after the trial indicated that the reduction of nitrogen and phosphorus had improved. Based on monitoring and adjustments over a couple months, it was found that the SBR system could not generate the sludge quantities in the reactor tank that were expected in accordance with the design specifications. In this regard, EMO together with Admin Division are preparing to collect sludge from the septic biofilm tanks (aeration tanks) of OSOV1 to be added into the SBR system of OSOV2. It is expected that the operation of the system can be adjusted to meet the effluent standards by Q4 2022.

3.3 RESULTS OF COMPLIANCE INSPECTIONS AT CONSTRUCTION SITES

During Q2 2022, EMO conducted weekly site inspections and bi-weekly joint EMO, TD and the Contractor site inspections at a total of 10 sites. These included the four main operation sites, two landfills, one contractor camp (rental houses), and three construction sites. A decrease of 4 monitoring sites compared with Q1 2022. EMO has also conducted a quarterly site visit and monitoring of the 31 rehabilitated sites.

One Non-Compliance Report (NCR) was active (carried over from last quarter) during Q2 2022. This unresolved NCR is related to non-compliance with wastewater discharge and it will be carried over to the next quarter as EMO needs more time to study and adjust the operation and maintenance of the systems, and the microorganisms also need time to adapt to the wastewater characteristics. The progress of corrective actions is presented in **Appendix 2**.

The status of the ONCs and NCRs is summarized in **Table 3-3**, and **Figure 3-1** and **Figure 3-2.**

TABLE 3-3: *STATUS OF NON-COMPLIANCE REPORT DURING Q2 2022*

Status	ONC	NCR-Level 1	NCR-Level 2	NCR-Level 3	Incident Report
Carried over ONC/NCR from the previous quarter	0	1	0	0	0
Newly opened ONC/NCR	0	0	0	0	0
Total No. of ONC/NCR	**0**	**1**	0	0	0
Resolved ONC/NCR	0	0	0	0	0
Unresolved ONC/NCR carried forward to the next quarter	**0**	**1**	0	0	0

Document Number / Date of Issue	Subject Description	Current Status at the end of June 2022
NC No. 01/22 Issued Date: 13-02-22 (NCR Level 1)	Some effluent discharge parameters continue to exceed the standards for almost 9 months following the completion of the improvement and modification in September 2021	• Adding the proper sludge/seeds into the Aeration Tank at OSOV2 WWTS and in the Biofilm Septic Tank at the Main Powerhouse System has reduced the concentrations of nitrogen and phosphorus in the effluent. • Monitoring and adjusting the bacteria seeding process will continue. • Monitoring of the influent and the effluent to check the treatment effectiveness will continue.

FIGURE 3-2 *STATUS OF NCRS DURING Q2 2022*

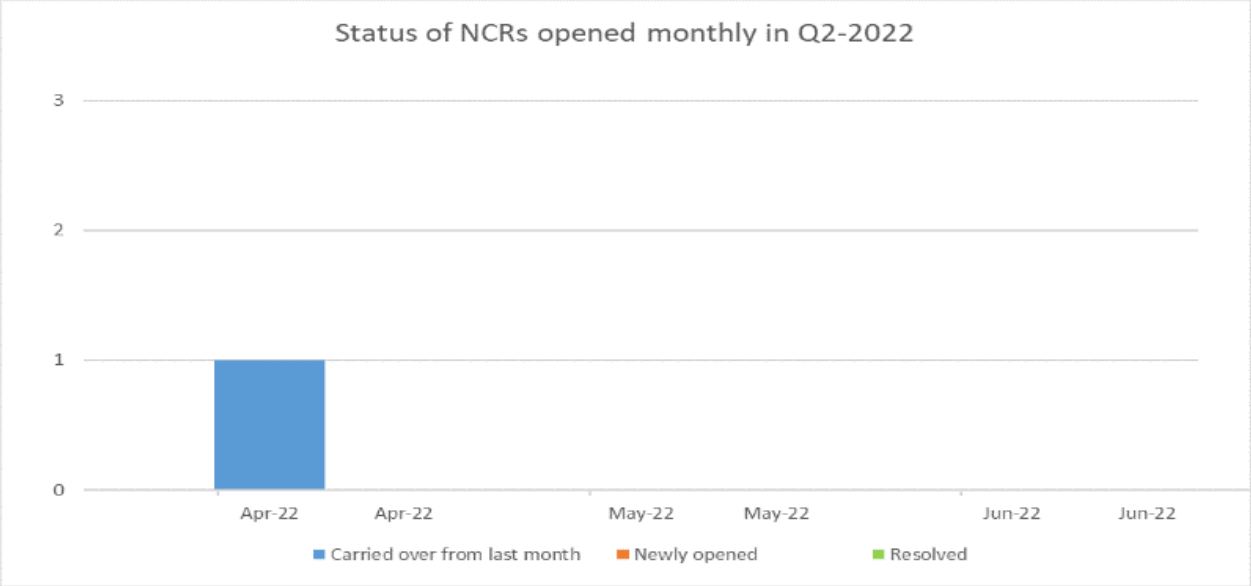


FIGURE 3-3*: PHOTOS OF SITE INSPECTION DURING THE Q2 2022*

PHOTOGRAPH 1: JOINT SITE INSPECTION AND HAZARDOUS MATERIAL MANAGEMENT AUDIT AT OSOV1, TEMPORARY WAREHOUSE, MAIN POWERHOUSE AND RE-REGULATING POWERHOUSE 28 JUNE 2022	
	

3.4 RESULTS OF SITE DECOMMISSIONING AND REHABILITATION

During Q2 2022, EMO continued to monitor the progress of revegetation at 31 sites. There were no significant issues of land disturbance, erosion or vegetation destruction found during the quarterly inspection. NNP1PC received the signed memo of land use handover from the District Office of Energy and Mines confirming their acceptance of the land use handover to GOL. The handover is currently being reported to the higher provincial government levels.

The status of site rehabilitation and revegetation is summarized in **Table 3-4** and indicated in **Figure 3-3** As indicated in the Table, the revegetation has increased steadily since rehabilitation was initiated and rehabilitation has now been completed for all sites except for two sites that have reached 75-80% vegetation cover. EMO is therefore considering only to carry out one more final monitoring of site rehabilitation and revegetation status before the official handover to the GOL.

TABLE 3-4*: SUMMARY STATUS OF CONSTRUCTION SITES REHABILITATION AS OF JUNE 2022*

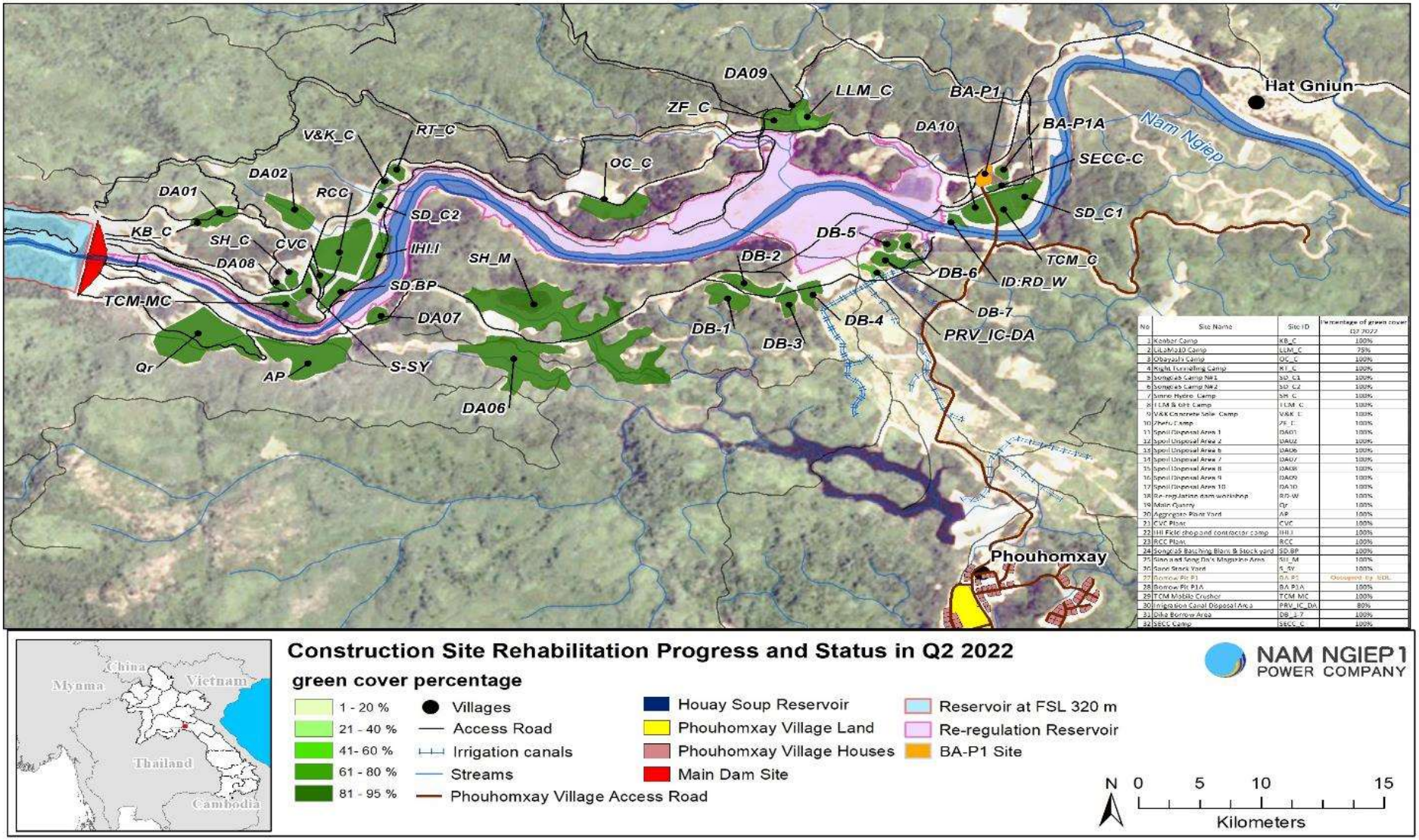
No	Site Name	Status of Decommissioning	Percentage of Vegetation Cover Evaluation						
			Jun-2020	Sep-2020	Dec-2020	Mar-2021	Jun-2021	Sep-2021	Jun-2022
01	TCM & GFE Camp	Completed	70%	90%	90%	90%	100%	100%	100%
02	Spoil Disposal Area 7	Completed	-	98%	98%	98%	100%	100%	100%
03	Spoil Disposal Area 9	Completed	-	75%	75%	75%	90%	95%	100%
04	Spoil Disposal Area 10	Completed	80%	95%	95%	95%	100%	100%	100%
05	Borrow Pit P1A	No need for decommissioning	-	80%	80%	80%	95%	100%	100%
06	TCM Mobile Crusher	Completed	-	90%	90%	90%	100%	100%	100%
07	Dike Borrow Areas	No need for decommissioning	-	75%	75%	75%	85%	90%	100%
08	SECC camp	Completed	-	90%	90%	90%	100%	100%	100%
09	KENBER Camp	Completed	80%	95%	95%	95%	100%	100%	100%
10	LILAMA10 Camp	Completed	5%	20%	40%	45%	50%	65%	75%
11	Obayashi Camp	Completed	80%	90%	90%	90%	95	100%	100%
12	Right Tunnelling Camp	Completed	70%	90%	90%	90%	95	100%	100%
13	Songda5 Camp N#1	Completed	90%	98%	98%	98%	100%	100%	100%
14	Songda5 Camp N#2	Completed	80%	95%	95%	95%	100%	100%	100%
15	Sino Hydro Camp	Completed	80%	95%	95%	95%	100%	100%	100%
16	V&K Concrete Sole Camp	Completed	50%	70%	70%	70%	85%	95%	100%
17	Zhefu Camp	Completed	60%	75%	75%	75%	100%	100%	100%
18	Spoil Disposal Area 1	Completed	80%	90%	90%	90%	100%	100%	100%

No	Site Name	Status of Decommissioning	Percentage of Vegetation Cover Evaluation						
			Jun-2020	Sep-2020	Dec-2020	Mar-2021	Jun-2021	Sep-2021	Jun-2022
19	Spoil Disposal Area 2 & main dam workshop	Completed	60%	75%	75%	75%	90%	95%	100%
20	Spoil Disposal Area 6	Completed	70%	75%	75%	75%	90%	95%	100%
21	Spoil Disposal Area 8	No need for decommissioning	40%	60%	60%	60%	100%	100%	100%
22	Re-regulation dam workshop	Completed	80%	85%	85%	85%	95%	100%	100%
23	Main Quarry	Completed	50%	70%	70%	70%	85%	90%	100%
24	Aggregate Plant Yard	Completed	80%	85%	85%	85%	95%	100%	100%
25	CVC Plant	Completed	60%	70%	70%	70%	85%	95%	100%
26	IHI Field shop and contractor camp	Completed	70%	85%	85%	85%	95%	95%	100%
27	RCC Plant	Completed	50%	70%	70%	70%	80%	95%	100%
28	Songda5 Batching Plant & Stock yard	Completed	80%	95%	95%	95%	100%	100%	100%
29	Sino and Song Da's Magazine Area	Completed	70%	80%	80%	80%	95%	100%	100%
30	Sand Stock Yard	No need for decommissioning	-	60%	60%	60%	75%	90%	100%
31	Phouhomxay Village's Irrigation Canal Spoil Disposal Area	No need for decommissioning	-	5%	10%	15%	20%	70%	80%

Note:

- No need for decommissioning' means no construction site or installed equipment to be removed.
- The figures in red mean the unsatisfactory revegetation.

FIGURE 3-4*: REVEGETATION SITES MAP DURING Q2 2022*



No	Site Name	Site ID	Percentage of green cover EQ 2022
1	Kenber Camp	KB_C	100%
2	LiLaMa10 Camp	LLM_C	75%
3	Obayashi Camp	OC_C	100%
4	Right Tunnelling Camp	RT_C	100%
5	Songcas Camp №1	SD_C1	100%
6	Songcas Camp №2	SD_C2	100%
7	Sinno Hydro Camp	SH_C	100%
8	LLM & Obt Camp	LLM_C	100%
9	V&K Concrete Sole Camp	V&K_C	100%
10	Zhefu Camp	ZF_C	100%
11	Spoil Disposal Area 1	DA01	100%
12	Spoil Disposal Area 2	DA02	100%
13	Spoil Disposal Area 6	DA06	100%
14	Spoil Disposal Area 7	DA07	100%
15	Spoil Disposal Area 8	DA08	100%
16	Spoil Disposal Area 9	DA09	100%
17	Spoil Disposal Area 10	DA10	100%
18	Re-regulation dam workshop	RD-W	100%
19	Main Quarry	Qr	100%
20	Aggregate Plant Yard	AP	100%
21	CVC Plant	CVC	100%
22	IHI Fcic shop and contractor camp	IHI.I	100%
23	RCC Plant	RCC	100%
24	Songcas Batching Plant & Stock yard	SD:BP	100%
25	Sinno and Song Da's Magazine Area	SH_M	100%
26	Sand Stock Yard	S_SY	100%
27	Borrow Pit P1	BA-P1	Occupied by EDL
28	Borrow Pit P1A	BA-P1A	100%
29	TCM Mobile Crusher	TCM-MC	100%
30	Irrigation Canal Disposal Area	PRV_IC_DA	80%
31	Dike Borrow Area	DB_1-7	100%
32	SECC Camp	SECC_C	100%

The photos below present the overall status of vegetation cover percentage in Q2 2022 as of June 2022. It can be said that the vegetation increases compared with Q1 2022.

MAIN DAM INDUSTIAL AND ASSOCIATE AREAS	**RE-REGULATION DAM INDUSTRIAL AND ASSOCIATE AREAS**
	
AGGREGATE PLANT YARD AND QUARRY SITE	**EARTH DIKE BORROW PITS**
	
SPOIL DISPOSAL NO.6	**SPOIL DISPOSAL NO.9 AND CONTRACTOR'S CAMPS**
	

The Provincial Department of Energy Business has submitted a handover plan containing the site inspection results and the department's recommendations to accept the decommissioned and rehabilitated sites to the Provincial Governor for the Governor's consideration and approval.

3.5 WASTE MANAGEMENT AT THE CONSTRUCTION SITES

3.5.1 General Waste Management

A total of 37.99 m^3 solid waste from NNP1 project sites and camps was disposed of at the NNP1 Project Landfill, a decrease of 26.71 m^3 compared with Q1 2022.

During this reporting period, 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 included waste segregation and disposal, waste cover, grass cutting and repairing of perimeter fences.

During the Q2 2022, 498 kg of recyclable waste was sold to an authorized recycle waste trading company. The amounts of recyclable waste managed on site during the reporting period are shown in **Table 3-5**.

TABLE 3-5*: AMOUNTS OF RECYCLABLE WASTE DURING Q2 2022*

Source and Type of Recyclables		Unit	Total in Q2 2022 (A)	Sold (B)	Remaining Amount (A - B)
Construction activity					
1	Scrap metal	kg	0	0	0
Sub-Total 1		**kg**	**0**	**0**	**0**
Operation camp					
2	Plastic bottle	kg	110	80	30
3	Aluminium Can	kg	5	5	0
4	Paper/Cardboard	kg	138	130	8
5	Glass	kg	152	83	69
7	Scrap metal	Kg	200	200	0
Sub-Total 2		**kg**	**605**	**498**	**107**
Grand Total 1+2		**kg**	**605**	**498**	**107**

3.5.2 Hazardous Waste Management

The amounts of hazardous waste and hazardous materials that were collected, stored and disposed of during Q2 2022 are shown in **Table 3-6.**

TABLE 3-6*: HAZARDOUS MATERIAL AND HAZARDOUS WASTE RECORDED DURING Q2 2022*

No.	Type of Hazardous Material	Unit	Total in Q2 2022	Used/ Disposed	Remaining
1	Diesel	Litre	16,587	12,207	**4,380**
2	Gasoline	Litre	2,061	1,353	**708**
3	Lubricant (Turbine oil)	Litre	16,348	11,268	**5,080**
4	Colour paint	Litre	302	3	**299**
5	Tinner	Litre	17	7	**10**
6	Grease oil	Litre	795	642	**153**
7	Gear Oil	Litre	442	7	**435**

No.	Type of Hazardous Material	Unit	Total in Q2 2022	Used/ Disposed	Remaining
8	Chlorine Liquid	Litre	231	161	**70**
9	Chlorine Powder	Kg	65	0	**65**
10	Colour Spray	Piece	5	2	**3**
11	Sika	Litre	7	7	**0**
12	HA Cut AF	Litre	3,925	0	**3,925**
13	HA Cut Cat AF	Litre	373	0	**373**
	Type of Hazardous Waste				
14	Used Oil (Hydraulic + Engine)	Litre	522.3	196.3	**326**
15	Used oil mixed with water	Litre	4,400	4400	**0**
16	Empty used oil drum/container (drum 200L)	Unit	62	9	**53**
17	Use Oil Filter	Unit	6	3	**3**
18	Contaminated soil, sawdust and textile material	M3	5.51	5	**0.51**
19	Used tyre	Piece	16	2	**14**
20	Empty used chemical drum/container (drum 20L)	Unit	19	13	**6**
21	Lead acid batteries	Unit	9	0	**9**
22	Empty paint and spray cans	Can	175	1	**174**
23	Halogen/fluorescent bulbs	Unit	321	253	**68**
24	Empty cartridge (Ink)	Piece	170	0	**170**
25	Clinic Waste	Kg	11.5	10	**1.5**

3.5.3 Animal Fodder (Pig Feed) Collection Programme

During Q2 2022, local villagers collected 1,115 kg food waste from the Owner's Site Office and Village (OSOV) for feeding their animals.

3.5.4 Community Solid Waste Management and Recycling Programme

The handover of the community solid waste management program, Houay Soup landfill operation and the community waste bank is in process by the Bolikhan District EMU. No recyclable waste trade activities in the community recyclable waste bank as no recyclables were received in Q2 2022.

3.5.5 Houay Soup Landfill

A total of 29.7 m^3 of solid waste from Phouhomxay's Health Centre, school and the NNP1PC Resource Centre was disposed of at Houay Soup Landfill with a support by NNP1PC after the local waste collection contractor's contract ended on 15 April 2022.

COMMUNITY SOLID WASTE DISPOSAL AND HOUY SOUP LANDFILL OPERATION ON THE LAST DAY OF CONTRACTOR'S SERVICE CONTRACT 15 APRIL 2022

EMO'S SUPPORT WASTE COLLECTION AT PHHOUHOMXAY VILLAGE'S HEALTH CENTER AND SCHOOL

EMU'S COMMUNITY CONSULTATION IN THE THREE VILLAGES FOR THE HANDOVER OF THE COMMUNITY SOLID WASTE MANAGEMENT PROGRAM, HOUY SOUP LANDFILL OPERATION AND COMMUNITY WASTE BANK

Thaheua Village

Hat Gniun Village

Phouhomxay Village

3.6 RESERVOIR OPERATIONS

3.6.1 Main Reservoir

The water level in the main reservoir, inflow to the reservoir and discharge from the reservoir since January 2020 are displayed in the graphs in **Figure 3-5** and **Figure 3-6**.

During Q2 2022, the mean daily inflow to the main reservoir was 102 m^3/s. The minimum daily inflow was 41 m^3/s, maximum daily inflow was recorded at 349 m^3/s, and 25th percentile of 57 m^3/s and 75th percentile of 123 m^3/s. As indicated in **Figure 3-5,** the inflow during the Q2 2022 was higher compared to the same period in 2021.

The water level in the main reservoir decreased with 1.30 m from El. 299.42 m asl (01 April 2022) to El. 298.12 m asl. (15 May 2022) and then increased with 3.26 m to reach 301.56 m asl. at the end of June 2022.

FIGURE 3-5: ***INFLOW TO THE MAIN RESERVOIR***

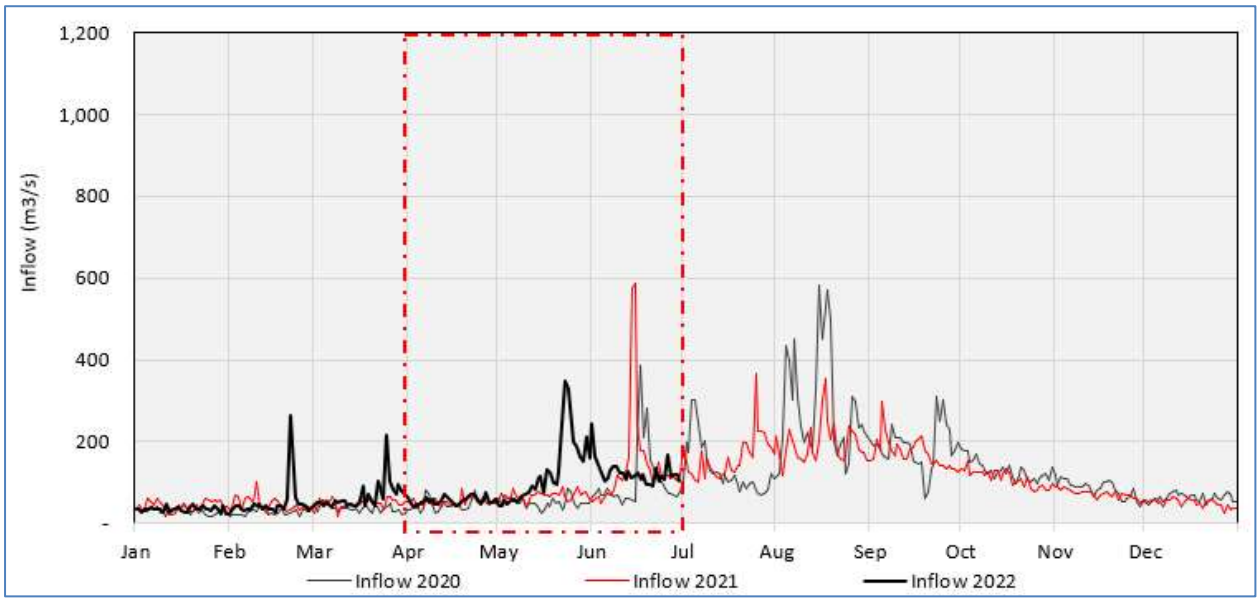
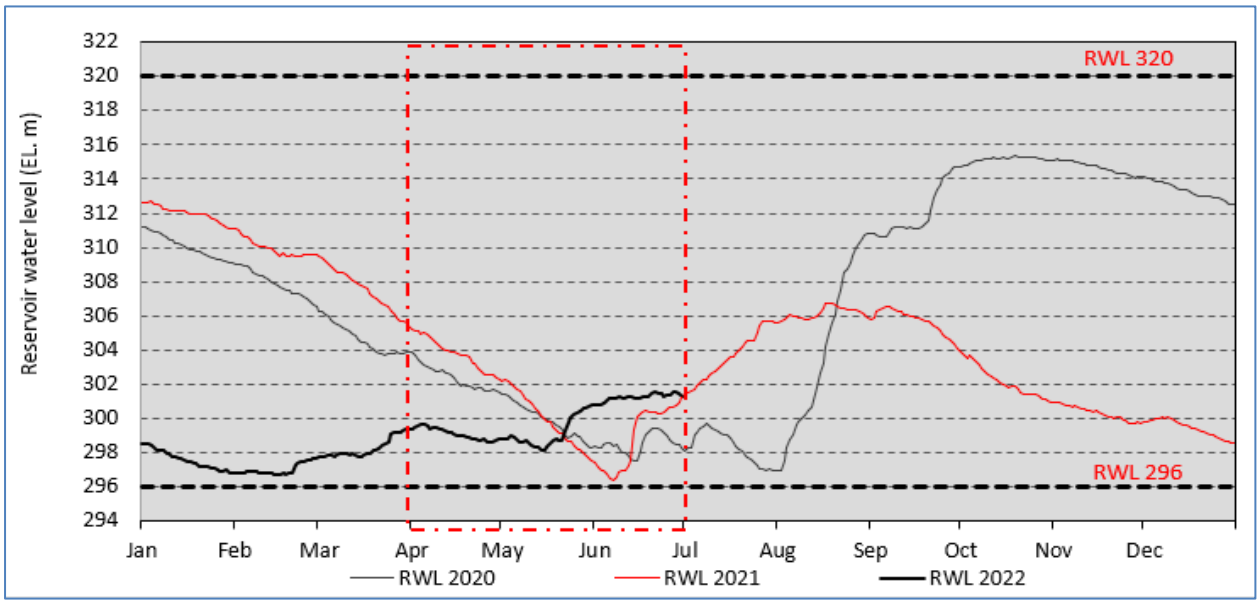


FIGURE 3-6: ***WATER LEVEL OF THE MAIN RESERVOIR***



3.6.2 Environmental Flow Requirements (EFRs) for the Operation Phase

NNP1PC has monitored compliance with the Environmental Flow Requirements (EFRs) stipulated in the CA, Annex C, Clause 53 (g) and as further modified in the Environmental Flow Assessment Report of July 2014 approved by MONRE. The EFRs have been monitored in accordance with the monitoring programme outlined in the ESMMP-OP 2019 (Vol. II, Part 2 on Subplan 1 on Reservoir and River Health Management).

The results of the EFR compliance monitoring during Q2 2022 are summarized in **Table 3-7**.

TABLE 3-7: *SUMMARY OF EFRS COMPLIANCE MONITORING IN Q2 2022*

No	EFRs in the Downstream of the Re-regulation dam	EFRs compliance
1	Min flow 27 m^3/s at all times	100% of observations comply
2	Thalweg water depth at least 0.5 m in the entire reach from immediately downstream of the Re-regulation dam until 4.3 km downstream the dam (measured at cross-sections where visual observations or boat navigation indicate shallow waters)	Seven measurements at 4 measuring points located within 5.7 km from the re-regulation dam did not comply during times with dam discharge less than 30 m^3/s
3	Maximum rate of change (both rise and fall, separately) in stage of 0.6 m per hour	100% of hourly fluctuations comply
4	Maximum fluctuation in stage of 1.7 m over 24-hour (this requirement is about range and determines the maximum difference in stage height over 24-hour periods)	100% of 24-hour fluctuations comply
5	Maximum fluctuation in stage of 1.7 m over 7-days (this requirement is about range and determines the maximum difference in stage height over 7-day periods)	All 7-day fluctuations comply

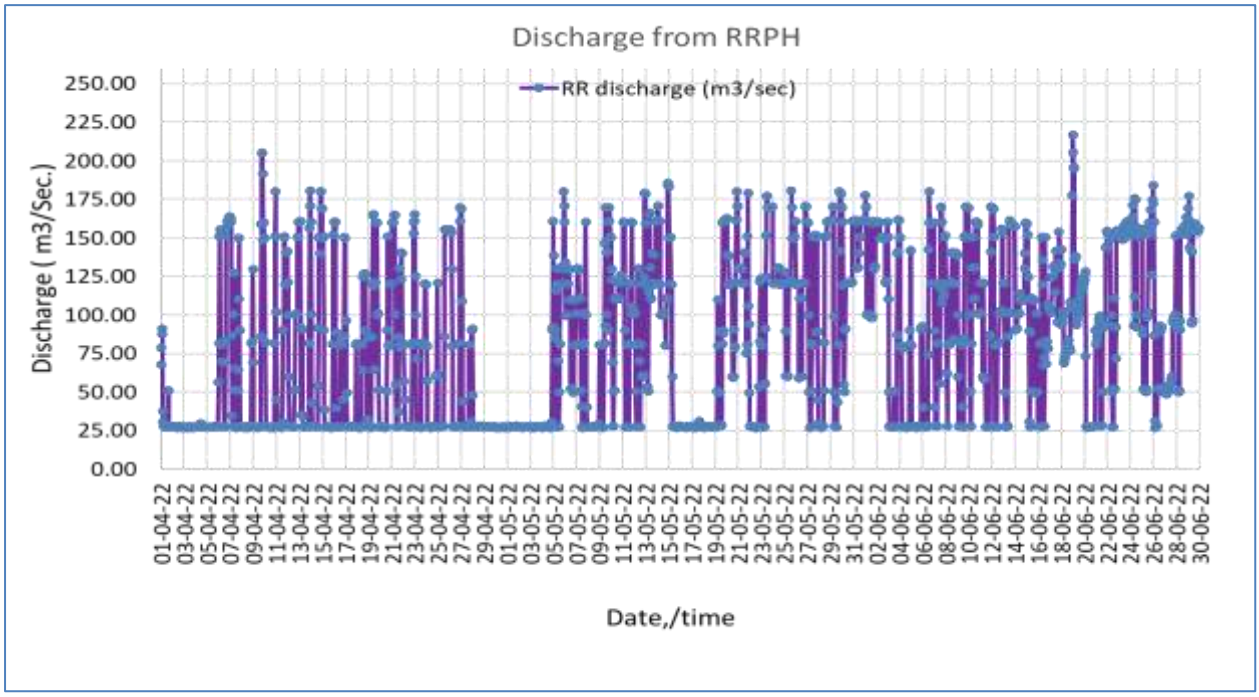
3.6.2.1 Minimum Flow Requirements

The discharge monitoring data for the re-regulation dam during Q2 2022 indicates that the minimum flow requirement of 27 m^3/s has been met at all times. The Re-regulation Dam discharge graph can be found in **Figure 3-7.**

During Q2 2022, the mean discharge from the re-regulation dam was about 57 m^3/s in April 2022 and about 81 m^3/s and 101 m^3/s in May and June 2022 respectively.

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. There were no complaints related to the flow discharges or fluctuation levels downstream the Re-regulation dam during the reporting period.

FIGURE 3-7: *DISCHARGE FROM THE RE-REGULATION DAM DURING Q2 2022*



3.6.2.2 Minimum Water Depth

Since 18 July 2018, NNP1PC has carried out weekly monitoring of river depths at 19 locations downstream the re-regulation dam as shown on **Figure 3-8.** These locations represent cross-sections with possible shallow water depths at low discharge rates.

The monitoring is undertaken to confirm compliance with the water depth requirements in the Concession Agreement, Annex C, and the approved Environmental Flow Assessment (Thalweg water depth at least 0.5 m in the entire reach from immediately downstream of the Re-regulation dam until 4.3 km downstream the re-regulation dam).

Starting in December 2020, the water depths were measured across the river channel where visual observations or boat navigation indicate shallow waters to ensure that the measurements represent the river thalweg.

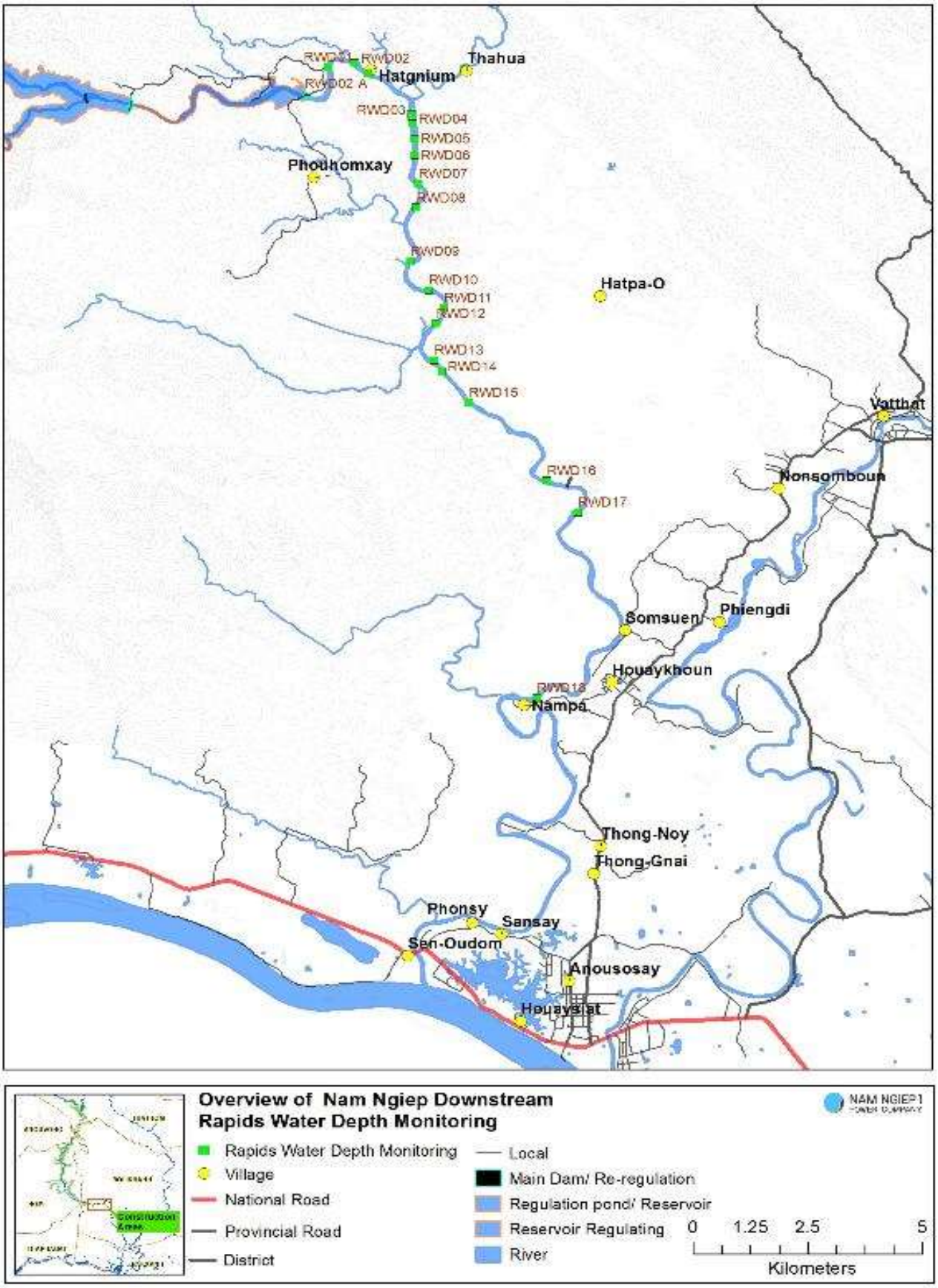
The results of the monitoring during Q2 2022 are presented in **Table 3-8**. The seven monitoring missions during times with low discharge (<30 m^3/s) recorded that four measuring points located within 5.7 km downstream of the re-regulation dam had a depth of less than 0.5 m but there were no difficulties navigating the boat except at station RWD05 (5.7 km downstream the Re-regulating Dam). There were no complaints related to the water depth less than 0.5 m downstream the Re-regulation dam during the reporting period.

According to the recommendation by Lenders' Technical Advisor (LTA) during the virtual site visit on 21 to 26 November 2021, NNP1PC will continue to monitor the situation at the critical sites during times with discharge less than 30 m^3/s for detecting the navigation problems and also monitor whether any complaint is raised to consider the methodologies for solving where necessary. NNP1PC tried to modify the riverbed in order to provide a channel for boats to pass these sites in Q2 of 2022, however, this was not possible with the equipment used due to the rocky riverbed. NNP1PC plans to use heavy machinery to remove rocks in the next dry season.

TABLE 3-8: *RIVER DEPTH MEASUREMENTS IN NAM NGIEP DOWNSTREAM THE RE-REGULATION DAM*

Station ID		RWD 01	RWD 02	RWD 02.a	RWD 03	RWD 04	RWD 05	RWD 06	RWD 07	RWD 08	RWD 09	RWD 10	RWD 11	RWD 12	RWD 13	RWD 14	RWD 15	RWD 16	RWD 17	RWD 18
Distance from Re-regulation Dam (km)		1.55	2.43	2.97	4.9	5.2	5.7	6.16	7.13	8.01	9.97	11.31	12.08	12.62	14.1	14.49	15.77	19.76	21.58	30.09
Date	Discharge (m3/s)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)
25-Apr-22	27.4	0.44	0.38	0.46	0.51	0.55	0.28	0.56	0.58	0.66	0.52	0.57	0.68	0.6	0.76	0.89	0.96	1	1.05	0.7
7-May-22	110	1.28	1.25	1.3	1.35	1.39	1.33	1.45	1.48	1.56	1.5	1.66	1.78	1.82	1.9	2.02	2.08	2.25	2.3	2.05
13-May-22	165	1.61	1.58	1.63	1.68	1.72	1.66	1.78	1.81	1.89	1.83	1.9	1.83	1.91	1.95	1.98	2.05	2.1	2.03	1.9
19-May-22	49.5	0.69	0.63	0.71	0.76	0.8	0.53	0.82	0.88	0.96	0.85	0.93	1	0.96	1.05	1.22	1.34	1.42	1.5	1.1
28-May-22	27.9	0.49	0.43	0.51	0.56	0.6	0.33	0.62	0.68	0.76	0.65	0.73	0.8	0.76	0.85	1.02	1.14	1.22	1.3	0.9
10-Jun-22	130.6	1.71	1.68	1.73	1.78	1.82	1.76	1.88	1.91	1.99	1.93	1.96	1.93	1.97	2.02	2.05	2.1	2.17	2.2	1.98
16-Jun-22	150.5	1.56	1.53	1.58	1.63	1.72	1.65	1.76	1.83	1.93	1.88	1.91	1.89	2.04	2.07	2.13	2.23	2.3	2.35	2.14
23-Jun-22	149.2	1.55	1.52	1.57	1.62	1.71	1.64	1.75	1.82	1.92	1.95	1.98	2	2.16	2.2	2.31	2.46	2.56	2.62	2.34

FIGURE 3-8: ***LOCATION MAP OF RIVER DEPTH MONITORING POINTS***



3.6.2.3 Stage Height Fluctuations

The requirements on stage height fluctuations constitute a rise or a fall in water elevation and include two aspects:

1. A requirement on the rate of change which is set at 0.6 m per hour.
2. Requirements on the range in fluctuations over 24-hour periods and 7-day periods respectively, which is set at a maximum of 1.7 m for both periods. In other words, the range requirements determine the maximum difference in stage height over 24-hour periods and 7-day periods respectively.

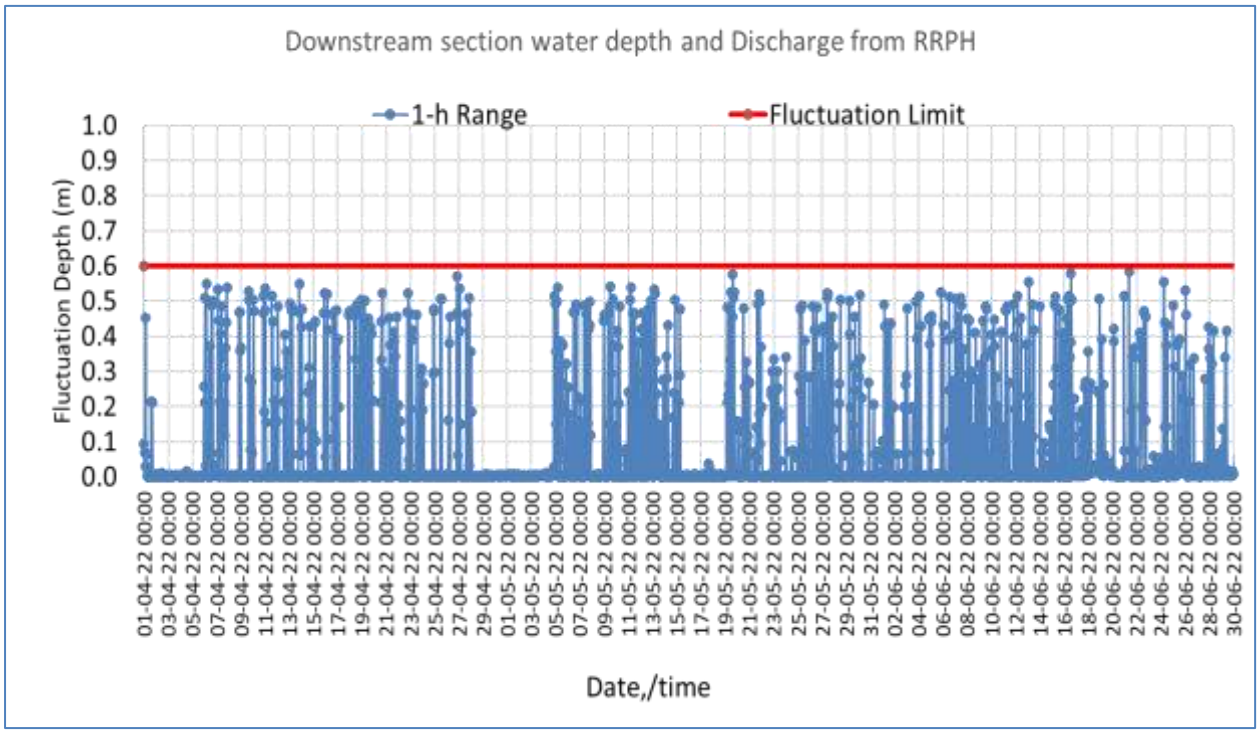
For the 0.6 m in 1-hour maximum fluctuation EFR, the cumulative rises and falls are calculated from the hourly water level recordings.

Compliance with the 24-hour maximum fluctuation EFR is determined by calculating the difference between the maximum and the minimum stage height over each 24-hour period. In the same way, the 7-day maximum fluctuation EFR, is determined by calculating the difference between the maximum and the minimum stage height over each 7-day period. There is no compulsion for the Company to meet the stage height fluctuation EFRs after a high flow event passes over the Re-regulation dam spillway.

In practice, meeting stage height fluctuation EFRs are managed through controlling the rate of change in discharge from the re-regulation dam/powerhouse. This is done using established rating relationships between stage height and discharge, as set out in the Re-regulation dam operation manual. These relationships are regularly checked and revised as necessary, as they would change whenever the channel morphology changes due to significant erosion or deposition.

During Q2 2022, the maximum rate of change of 0.6 m over 1-hour periods was complied with for 100% of the hourly fluctuations. The results are presented in **Figure 3-9**.

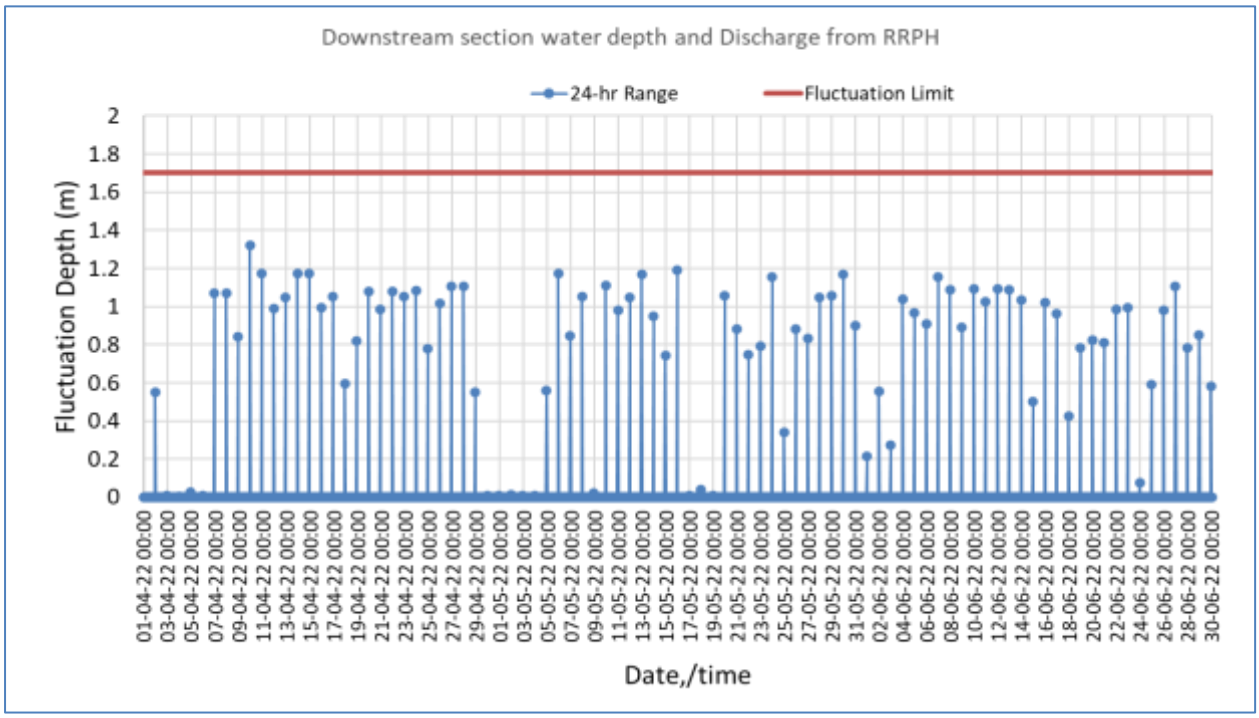
FIGURE 3-9: *HOURLY STAGE HEIGHT FLUCTUATIONS DURING Q2 2022*



During Q2 2022, the maximum range in stage of 1.7 m over 24-hour periods was complied with for all 24-hour periods (00:00 – 23:00).

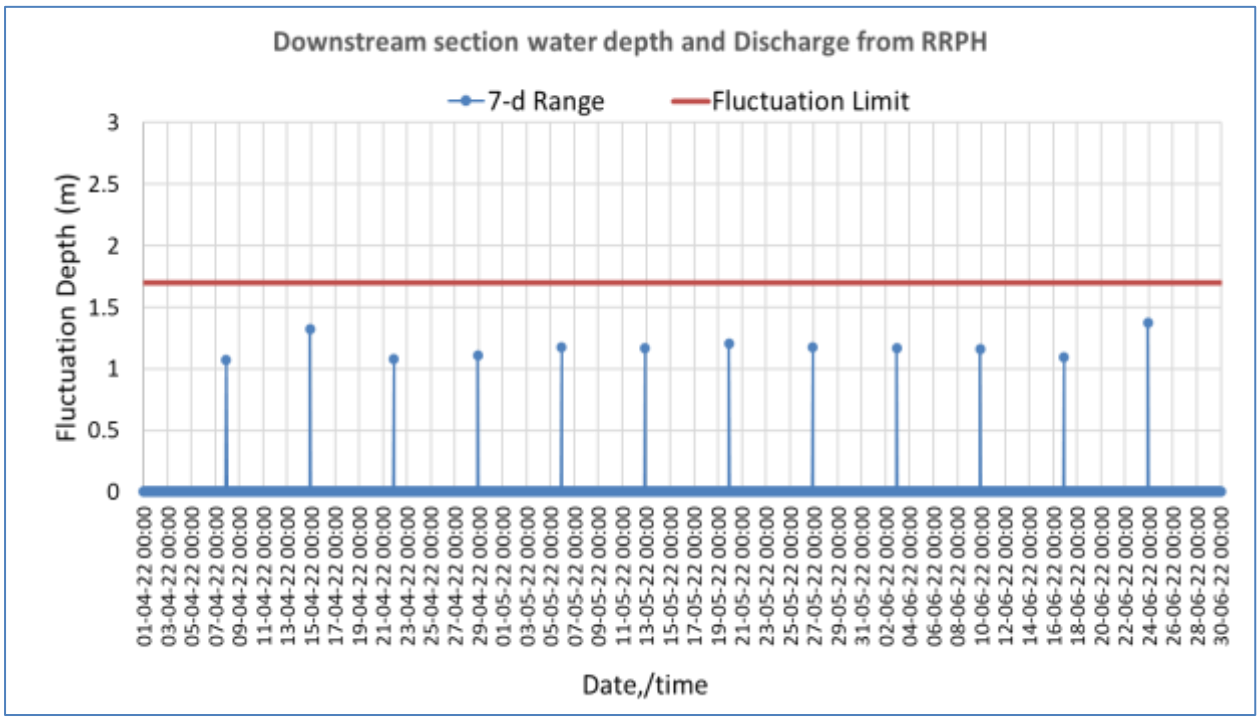
The results of the monitoring are presented in **Figure 3-10.**

FIGURE 3-10: *24-HOUR STAGE HEIGHT DIFFERENCE (M) DURING Q2 2022*



During Q2 2022, the maximum range in stage of 1.7 m over 7-day periods was complied with for all 7-day periods. The results are presented in **Figure 3-11: 7-day Stage Height Difference (M) during Q2 2022**

FIGURE 3-11: 7-DAY STAGE HEIGHT DIFFERENCE (M) DURING Q2 2022



3.7 WATER QUALITY MONITORING

3.7.1 Surface Water (River) and Depth Profile Water Quality

Descriptions of each monitoring station, surface water and depth profile water quality monitoring parameters, and the location of sampling map can be found in **Appendix 3** and all surface water quality data for Q2 2022 are listed in **Appendix 5.1**

Dissolved Oxygen (DO)

The results of DO measurements for the station immediately upstream of the main dam (R05 – surface and intake at 276 m asl.) and station R07 in the re-regulation dam (surface) and immediately downstream of the re-regulation dam (NNG05) are presented in **Figure 3-12,** the DO long profile measurement as timeseries are presented in **Figure 3-13**, and the full set of DO surface water quality data are shown in **Table 3-9.**

The water temperature and DO depth profiles in the main reservoir at R05 during Q2 2021, Q1 2022 and Q2 2022 are presented in **Figure 3-14** to **Figure 3-16.**

FIGURE 3-12: ***DISSOLVED OXYGEN IMMEDIATELY UPSTREAM AND DOWNSTREAM OF THE MAIN DAM***

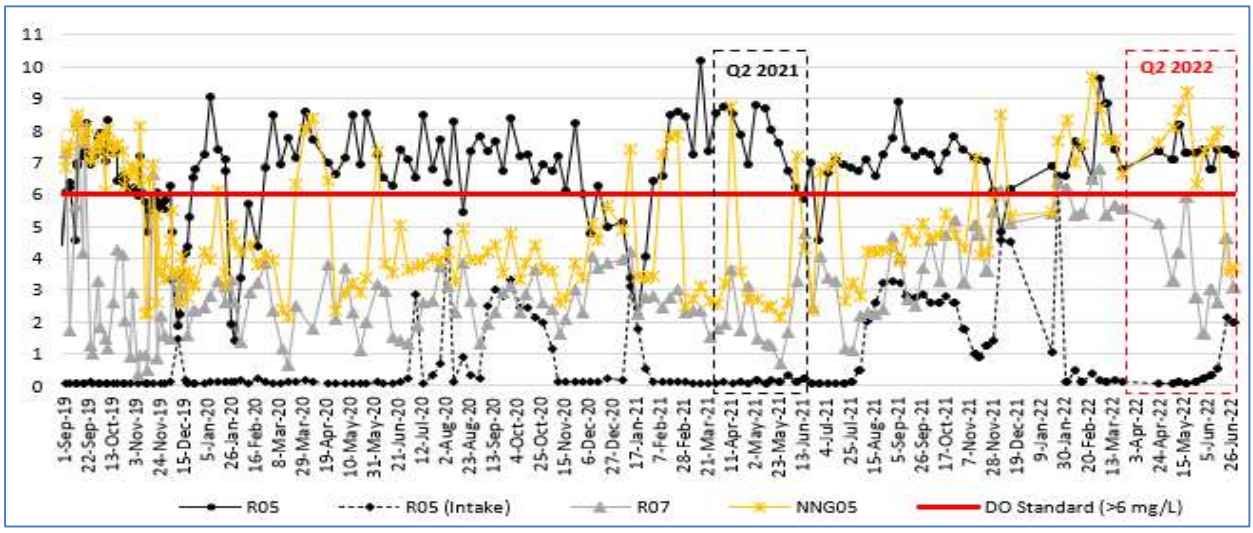
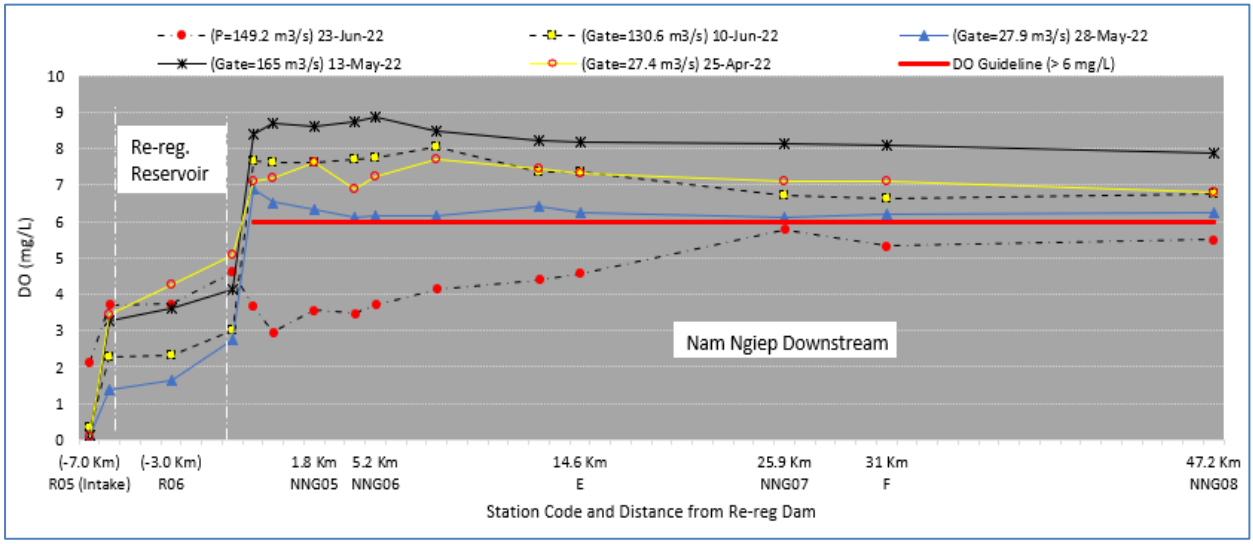


FIGURE 3-13: ***DISSOLVED OXYGEN LONG PROFILE MEASUREMENT FROM IMMEDIATELY UPPER MAIN DAM TO LOWER NAM NGIEP***



Main Reservoir

Figure 3-16 presents the DO and water temperature depth profile timeseries in the Main Reservoir (R04 and R05) from September 2018 to June 2022, the graphs clearly show seasonal variations in water temperatures and a deepening of the thermocline during periods with cooler water leading to a corresponding deepening of the oxycline.

The depth profile monitoring during Q2 2022 indicates formation of oxyclines in the main reservoir at the monitored stations at varying depths.

When comparing Q2 2022 with Q1 2022 and Q2 2021, overall, Q2 2022 shows a slightly deeper thermocline and a corresponding deeper oxycline.

At R05 (the station closest to the main dam), the mean DO concentration was 7.0 mg/L in the upper 8.0 m (slightly lower than in both Q1 2022 and Q2 2021) and generally varied between 3.3 mg/L to 8.6 mg/L. DO concentrations below 2 mg/L were measured at depths starting from 13 m during April 2022, 16 m during May 2022 and 28 m during late June 2022. The DO concentration at intake level had monthly mean DO concentrations that increased slightly from 0.09 mg/L in April 2022, to 0.1 mg/L in May 2022 and 1.1 mg/L in June 2022. Anoxic levels were measured from 18 m in April 2022 (corresponding to just at the intake level) to 32 m in June 2022 corresponding to 6.0 m below the intake.

Anoxic conditions were found at R02 in the depths between 3.0 m and 3.5 m, at R03 in the depths between 5.0 m and 8.0 m, and at R04 in the depths between 6.5 m and 8.0 m during the Q2 2022.

Re-regulation Reservoir (R6 and R7)

The depth profiles at R06 and R07 in the Re-regulation Reservoir showed no indications of a thermocline, because the Re-regulation Reservoir behaves more like a river than a lake.

The DO concentrations at R06 show no significant changes over the course of the quarter from a monthly average over the entire water column of 2.9 mg/L in April, 2.6 mg/L in May and 2.4 mg/L in June 2022. A similar pattern was found at R07. This corresponds well with the increase in DO concentrations at the intake level in the main reservoir although the DO concentrations in R06 and R07 occasionally were slightly higher than the corresponding DO concentrations at or near the intake level in R05. However, it should be noted that the actual flow patterns and movements of water from R05 to the intake is not known and is likely rather complex with circulation patterns or other complex water movements near the intake, which adds uncertainties to correlating water quality data at or near the intake depth at R05 in the main reservoir with water quality data in the Re-regulation Reservoir.

Nam Ngiep Upstream and Tributaries

The Nam Ngiep Upstream station, NNG01, R01 in the upper end of the Main Reservoir, and the reservoir tributaries Nam Chian (NCH01) and Nam Phouan (NPH01) had DO concentrations above 6 mg/L during Q2 2022.

Downstream Stations

During Q2 2022, the discharge from the Re-regulation Dam mainly went through the gate and occasionally through the turbine (on 23 and 30 June 2022).

During gate discharge, Nam Ngiep downstream DO concentrations were above 6 mg/L (the National Surface Water Quality Standard). Further downstream from the dam, the DO concentrations generally increased reaching about 8 mg/L at NNG07 located 25 km from the dam.

During periods with turbine discharge, the DO concentrations in Nam Ngiep downstream the Re-regulation Dam were about 3.5 mg/L in the first 5.2 km gradually increasing to around 5.5 mg/L over the following 42 km thus not complying with National Surface Water Quality Standard. However, no dead fish was observed in Nam Ngiep downstream during Q2 2022.

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.

FIGURE 3-14: ***MAIN RESERVOIR DISSOLVED OXYGEN AT THE END OF Q2 2022***

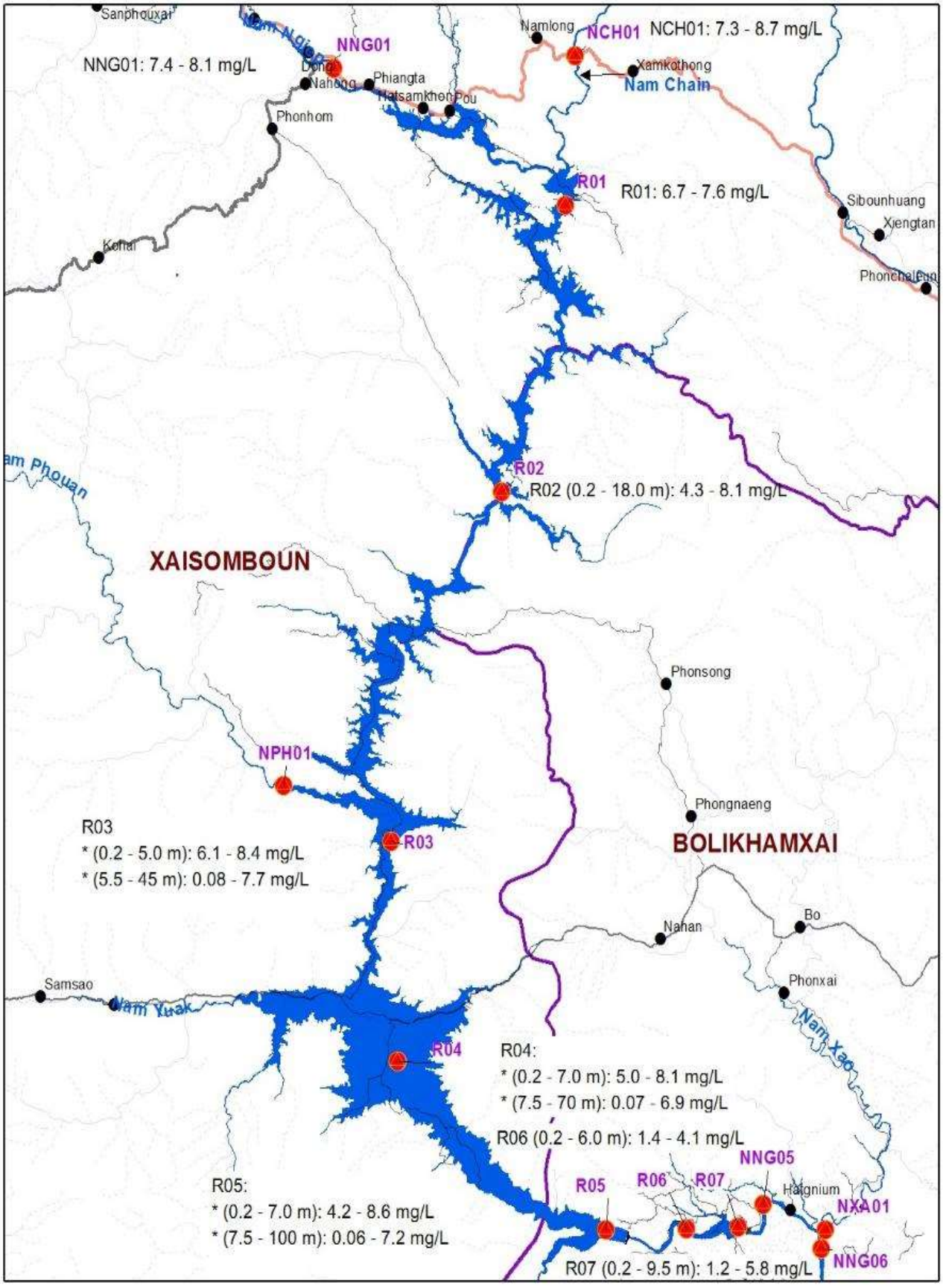


FIGURE 3-15: ***WATER TEMPERATURE AND DISSOLVED OXYGEN – DEPTH PROFILES IN THE MAIN RESERVOIR IMMEDIATELY UPSTREAM OF THE MAIN DAM (R05)***

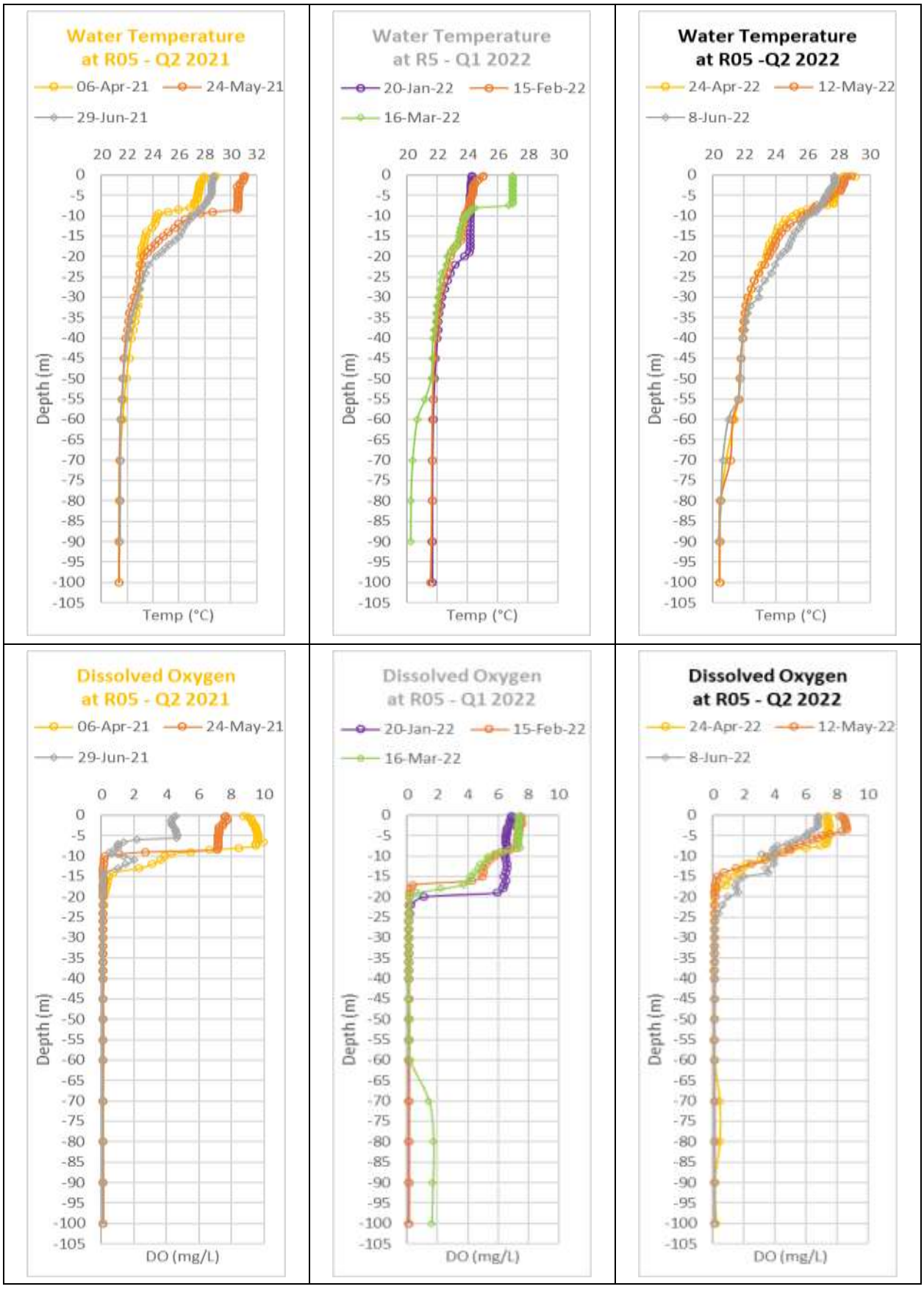


FIGURE 3-16: ***WATER TEMPERATURE AND DO DEPTH PROFILES IN THE MAIN RESERVOIR (R04 - R05), WITH POSITION OF INTAKE AT THE ACTUAL WATER LEVEL DURING SEPTEMBER 2018 – JUNE 2022***

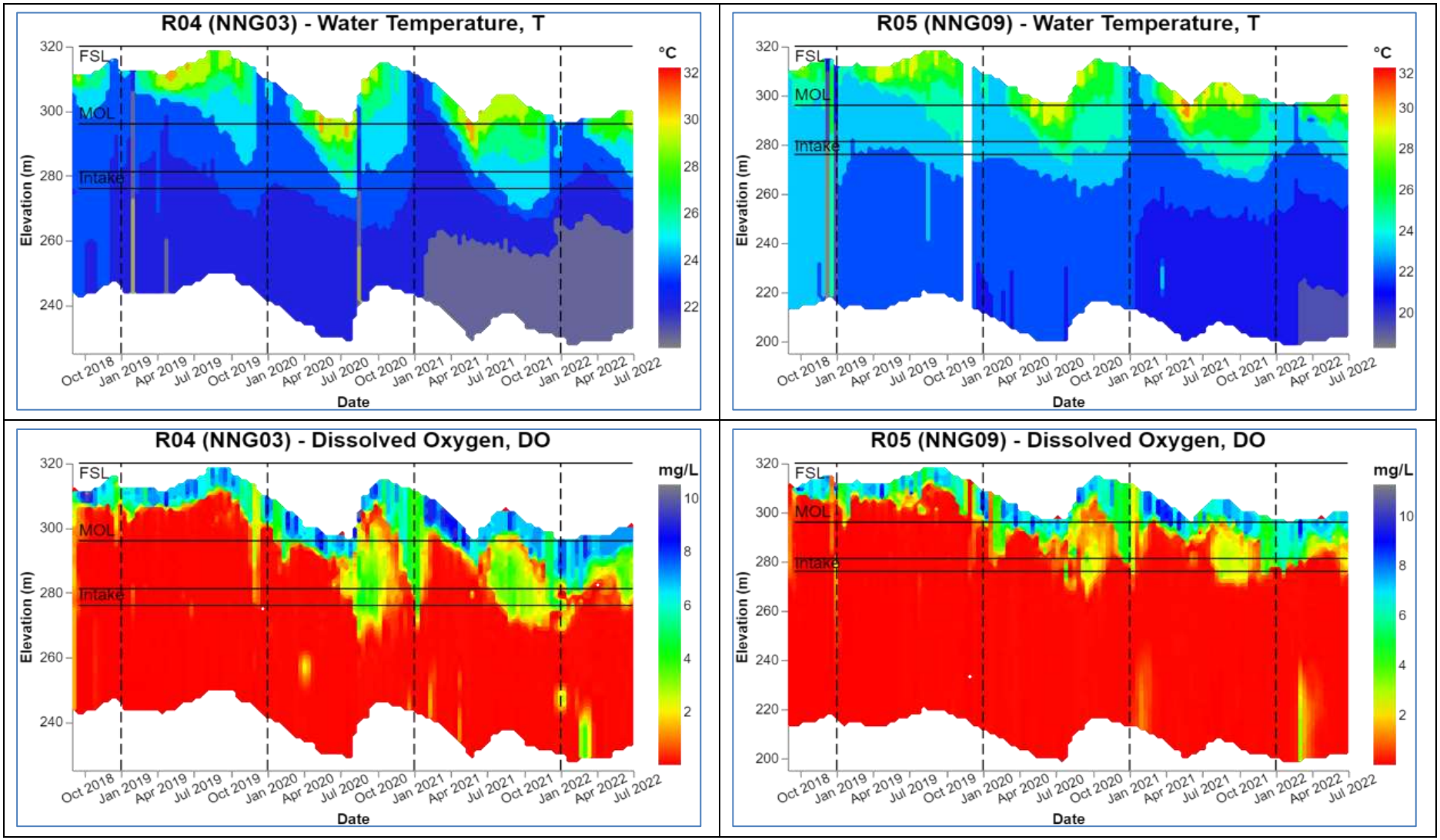


TABLE 3-9: ***DO (MG/L) RESULTS OF SURFACE WATER IN MAIN RESERVOIR, RE-REGULATION RESERVOIR, NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED IN Q2 2022***

(NATIONAL SURFACE WATER QUALITY STANDARD FOR DISSOLVED OXYGEN: ≥6 MG/L)

Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
1-Apr-22	7.62												7.61			
23-Apr-22		7.64	7.15	7.81										7.95		
24-Apr-22					7.52	7.35	4.24	5.09								
25-Apr-22									7.6	7.22	7.08	6.79			6.02	6.63
5-May-22		7.68	7	7.89										7.09		
6-May-22					7.25	7.09	2.61	3.29								
7-May-22									8.1	8.09	7.24	7.61			6.16	6.35
10-May-22	8.16												8.76			
12-May-22						8.16	3.6	4.15								
13-May-22									8.63	8.87	8.13	7.87			7.06	6.62
16-May-22	7.79												8.36			
17-May-22		7.76	7.28	7.63										8.38		
18-May-22					7.38	7.29	4.08	5.89								
19-May-22									9.2	8.61	8.05	7.66			6.69	7.53
27-May-22					7.27	7.28	1.64	2.74								
28-May-22									6.34	6.14	6.12	6.25			6.78	6.11
1-Jun-22		7.43	7.44	7.73										7.75		
2-Jun-22					7.18	7.39	1.67	1.62								
3-Jun-22									7.38	6.77	6.45	6.15			6.36	6.24
6-Jun-22	7.44												7.34			
7-Jun-22		6.7	7.08	7.59										7.41		
8-Jun-22					7.29	6.78	2.31	3.01								
10-Jun-22									7.6	7.74	6.73	6.76			6.19	6.44
14-Jun-22		7.01	7.24	7.87										7.63		
15-Jun-22					7.4	7.4	2.74	2.6								
16-Jun-22									7.97	7.66	6.67	6.34			6.49	6.44
20-Jun-22	7.57												7.77			

Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
21-Jun-22		7.5	7.61	7.68										7.68		
22-Jun-22					7.6	7.41	3.73	4.61								
23-Jun-22									3.57	3.72	5.77	5.5			6.42	6.13
28-Jun-22		7.37	6.94	6.94										7.09		
29-Jun-22					7.26	7.25	2.45	3.05								
30-Jun-22									3.7		5.15	5.53			6.48	7.17

Ammonia Nitrogen

In Q2 2022, Ammonia Nitrogen complied with the National Surface Water Quality Standard (<0.2 mg/L) in all monitored stations.

TABLE 3-10: ***AMMONIA NITROGEN (MG/L) RESULTS FOR THE SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED IN Q2 2022***

(NATIONAL SURFACE WATER QUALITY STANDARD FOR AMMONIA NITROGEN: <0.2 MG/L)

Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
22-Apr-22	<0.2												<0.2			
23-Apr-22		<0.2		<0.2										<0.2		
24-Apr-22					<0.2	<0.2										
10-May-22	<0.2												<0.2			
17-May-22		<0.2		<0.2										<0.2		
18-May-22					<0.2	<0.2										
6-Jun-22	<0.2												<0.2			
7-Jun-22		<0.2		<0.2										<0.2		
8-Jun-22					<0.2	<0.2								<0.2		

Biochemical Oxygen Demand (BOD_5)

Since 2014, the Biochemical Oxygen Demand (BOD_5) values in the Nam Ngiep River and its tributaries have generally been below the detection limit (< 1 mg/L) with some measurements exceeding the National Surface Water Quality Standard (< 1.5 mg/L). The results for Q2 2022 indicate that the BOD_5 levels are in compliance with the standard. In addition, 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.

TABLE 3-11: ***BOD_5 (MG/L) RESULTS FOR THE SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED IN Q2 2022***

(NATIONAL SURFACE WATER QUALITY STANDARD FOR BOD_5: <1.5 MG/L)

Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
1-Apr-22	<1												<1			
23-Apr-22		<1		<1										<1		
24-Apr-22					<1	<1	<1	1.19								
25-Apr-22									<1	<1	<1	<1			<1	<1
10-May-22	<1												<1			
17-May-22		<1		<1										<1		
18-May-22					<1	<1	<1	<1								
19-May-22									<1	<1	<1	<1			<1	<1
6-Jun-22	<1												<1			
7-Jun-22		<1		<1										<1		
8-Jun-22					<1	<1	<1	<1								
10-Jun-22									<1	<1	<1	<1			<1	<1

Chemical Oxygen Demand (COD)

The COD measurements in Q2 2022 are presented in ***Table 3-12***.

TABLE 3-12: ***COD (MG/L) RESULTS FOR THE SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES IN Q2 2022 (NATIONAL SURFACE WATER QUALITY STANDARD FOR COD: < 5 MG/L)***

Station Code	NNG 01	R0 1	R0 2	R0 3	R0 4	R0 5	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
22-Apr-22	<5												<5			
23-Apr-22														<5		
24-Apr-22							<5	<5								
25-Apr-22									<5	<5	<5	<5			6.4	<5
10-May-22	<5												<5			
17-May-22														<5		
18-May-22							<5	<5								
19-May-22									<5	<5	<5	<5			<5	<5
6-Jun-22	<5												<5			
7-Jun-22														<5		
8-Jun-22							<5	<5								
10-Jun-22									<5	<5	<5	<5				

Faecal Coliform Bacteria

The results of the faecal coliform analyses in Q2 2022 are presented in **Table 3-13**.

Faecal coliform complied with the standard in the most stations during Q2 2022, except for the stations in Nam Ngiep upstream the main reservoir, Nam Chian and Nam Houaysoup.

TABLE 3-13: ***FAECAL COLIFORMS (MPN/100 ML) RESULTS IN NAM NGIEP AND ITS MAIN TRIBUTARIES IN Q1 2022 (NATIONAL SURFACE WATER QUALITY STANDARD FOR TOTAL COLIFORMS: <1,000 MPN/100 ML)***

Station Code	NNG 01	R0 1	R0 2	R0 3	R0 4	R0 5	R0 6	R0 7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
1-Apr-22	540												110			
23-Apr-22														33		
24-Apr-22							14	27								
25-Apr-22									14	170	170	920			920	540
10-May-22	1,600												1,600			
17-May-22														17		
18-May-22							14	9								
19-May-22									27	26	22	79			27	22
6-Jun-22	1,600												1,600			
7-Jun-22														350		
8-Jun-22							70	49								
10-Jun-22									33	23	23	70			920	1,600

Total Coliform Bacteria

The results of measurements for total coliform bacteria are presented in **Table 3-14.** The results indicate a similar pattern and same tendency as for faecal coliform bacteria. There were no exceedances of the National Surface Water Quality Standard (<5,000 MPN/100 mL) for total coliform bacteria.

TABLE 3-14: *TOTAL COLIFORM (MPN/100 ML) RESULTS IN NAM NGIEP AND ITS MAIN TRIBUTARIES IN Q2 2022 (NATIONAL SURFACE WATER QUALITY STANDARD FOR TOTAL COLIFORMS: <5,000 MPN/100 ML)*

Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
1-Apr-22	1,600												1,600			
23-Apr-22														27		
24-Apr-22							14	11								
25-Apr-22									7	14	26	540			70	49
10-May-22	1,600												1,600			
17-May-22														70		
18-May-22							130	22								
19-May-22									170	70	79	110			79	79
6-Jun-22	1,600												1,600			
7-Jun-22														920		
8-Jun-22							1,600	350								
10-Jun-22									220	920	540	540			1,600	1,600

3.7.2 Compliance Monitoring of Effluents from Camps

A total of 03 sites discharged effluents in Q2 2022, including 02 camps (OSOV1 and OSOV2) and from the Wastewater Treatment System of the Main Powerhouse**.** The effluent monitoring location sites can be found in **Figure 3-17.**

The results are described in Error! Reference source not found. and the full data set is in **Appendix 5.2**.

The status of compliance as of 30 June 2022 can be summarized as follows:

- Non-compliance with Ammonia-Nitrogen, Total Nitrogen, Total Phosphorus for Wastewater Treatment Systems in the Main Powerhouse (EF19) and OSOV2 Camp (EF13);
- Non-compliance with Faecal Coliform and Total Coliform at OSOV1 (EF01) and the Main Powerhouse (EF19).

FIGURE 3-17: ***LOCATION OF EFFLUENT MONITORING POINTS***

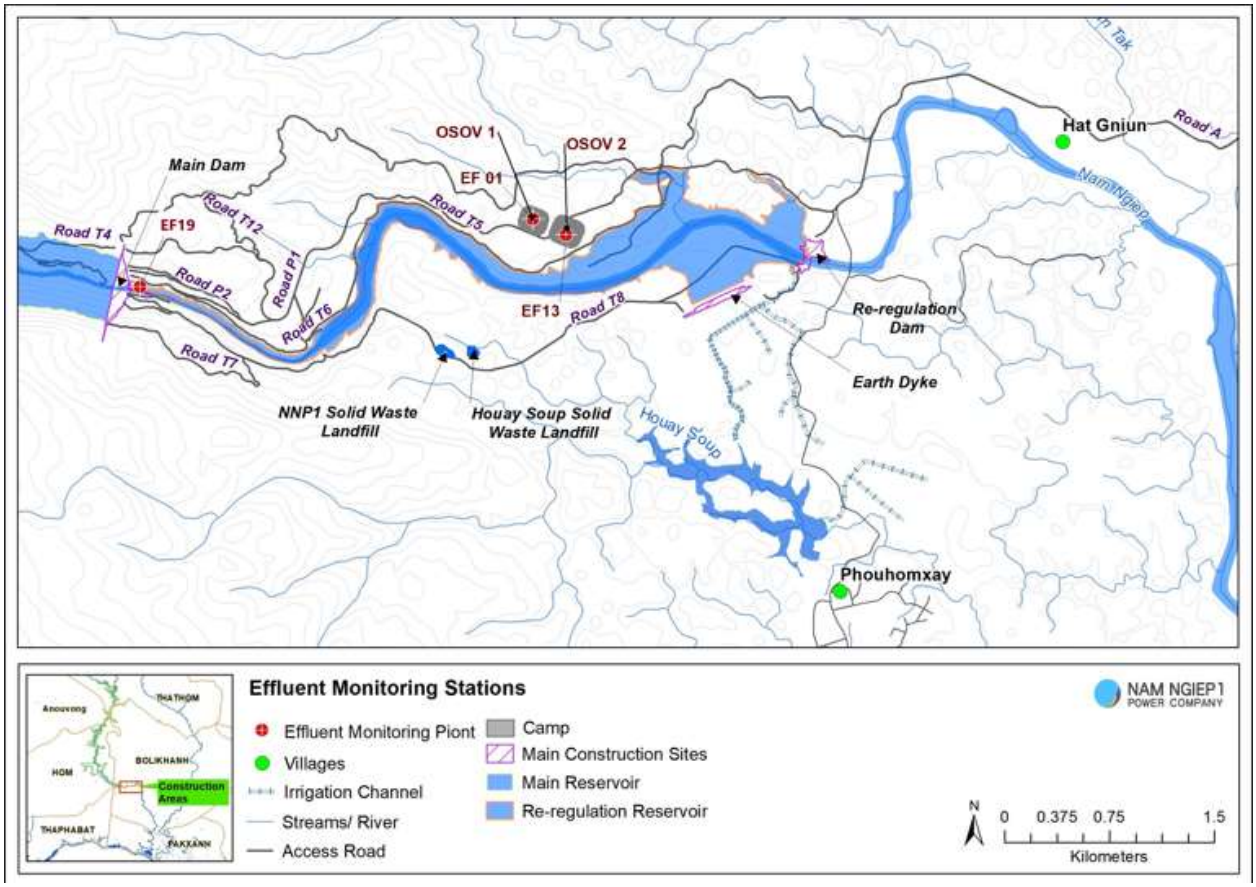


TABLE 3-15: ***RESULTS OF THE EFFLUENT WATER QUALITY MONITORING OF THE CAMPS IN Q2 2022 (NON-COMPLIANCE PARAMETERS ONLY)***

		Site Name	OSOV1 (Owner's Site Office and Village)	OSOV2 (ESD Camp)	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameters (Unit)	Guideline			
2-Apr-22	NH3-N (mg/L)	<10.0	<2	22.5	7.3
26-Apr-22	NH3-N (mg/L)	<10.0	<2	21.5	8.6
4-May-22	NH3-N (mg/L)	<10.0	<2	22.6	18.3
25-May-22	NH3-N (mg/L)	<10.0	<2	9.7	15.8
2-Jun-22	NH3-N (mg/L)	<10.0	<2	13.5	37.5
9-Jun-22	NH3-N (mg/L)	<10.0	<2	29.1	27.8
17-Jun-22	NH3-N (mg/L)	<10.0	<2	20.8	70.8
23-Jun-22	NH3-N (mg/L)	<10.0	2.1	15.9	65.8
2-Apr-22	Total Nitrogen (mg/L)	<10.0	0.5	24.3	8.38
26-Apr-22	Total Nitrogen (mg/L)	<10.0	0.52	23	9.86
4-May-22	Total Nitrogen (mg/L)	<10.0	0.51	24.3	19.8
25-May-22	Total Nitrogen (mg/L)	<10.0	0.52	10.5	16.1

		Site Name	OSOV1 (Owner's Site Office and Village)	OSOV2 (ESD Camp)	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameters (Unit)	Guideline			
2-Jun-22	Total Nitrogen (mg/L)	<10.0	1.01	14	40.2
9-Jun-22	Total Nitrogen (mg/L)	<10.0	1.92	31.1	28.8
17-Jun-22	Total Nitrogen (mg/L)	<10.0	0.43	22.7	76.4
23-Jun-22	Total Nitrogen (mg/L)	<10.0	2.3	16.9	71.1
2-Apr-22	Total Phosphorus (mg/L)	<2	1.33	2.2	7.43
26-Apr-22	Total Phosphorus (mg/L)	<2	1.39	2.05	4.97
4-May-22	Total Phosphorus (mg/L)	<2	1.9	2.17	6.75
25-May-22	Total Phosphorus (mg/L)	<2	0.92	1.18	6.72
2-Jun-22	Total Phosphorus (mg/L)	<2	0.97	1.68	7.66
9-Jun-22	Total Phosphorus (mg/L)	<2	1.03	2.54	7.46
17-Jun-22	Total Phosphorus (mg/L)	<2	1.01	2.0	7.86
23-Jun-22	Total Phosphorus (mg/L)	<2	0.96	1.9	3.64
2-Apr-22	Total coliform (MPN/100mL)	<400	5400	22	0
26-Apr-22	Total coliform (MPN/100mL)	<400	350	110	49
4-May-22	Total coliform (MPN/100mL)	<400	1600	0	1600
25-May-22	Total coliform (MPN/100mL)	<400	1600	0	0
2-Jun-22	Total coliform (MPN/100mL)	<400	1600	0	0
9-Jun-22	Total coliform (MPN/100mL)	<400			
17-Jun-22	Total coliform (MPN/100mL)	<400	920	2	0
23-Jun-22	Total coliform (MPN/100mL)	<400	3500	0	240
2-Apr-22	Faecal Coliform (MPN/100mL)	<400	1600	0	0
26-Apr-22	Faecal Coliform (MPN/100mL)	<400	350	110	49
4-May-22	Faecal Coliform (MPN/100mL)	<400	540	0	1600
25-May-22	Faecal Coliform (MPN/100mL)	<400	1600	0	0
2-Jun-22	Faecal Coliform (MPN/100mL)	<400	1600	0	0
9-Jun-22	Faecal Coliform (MPN/100mL)	<400			
17-Jun-22	Faecal Coliform (MPN/100mL)	<400	130	0	0
23-Jun-22	Faecal Coliform (MPN/100mL)	<400	3500	0	240

TABLE 3-16: *COMPLIANCE STATUS OF EFFLUENT DISCHARGE FROM THE CAMPS IN Q2-2022*

Site	ID	WWTS	Key Non-Compliance Issues[1] in Q2-2022	Corrective Actions
OSOV 1 (Owner's Site Office and Village)	EF01	Septic tanks (kitchen and black water) and wetland (grey water), discharge: 70 m^3/day	- Faecal coliform (<400 MPN/100 mL): Non-compliance in 5 out of 7 samplings. Q2 mean 1,331 MPN/100 mL. - Total coliform (<400 MPN/100 mL): Non-compliance in 6 out of 7 samplings. Q2 mean 2,138 MPN/100 mL.	The construction of the improved Wastewater Treatment System was completed at the end of August 2021 and the operation of the system is undergoing adjustments.
OSOV 2 (ESD Camp)	EF13	Septic tanks (kitchen and black water) and SBR with chlorination system.	- Ammonia-nitrogen (<10 mg/L): Non-compliance in 8 out of 9 samplings. Q2 mean 19.4 mg/L. - Total nitrogen (<10 mg/L): Non-compliance in all 8 samplings. Q2 mean 20.8 mg/L. - Total Phosphorus (<2 mg/L): Non-compliance in 4 out of 8 samplings. Q2 mean 1.9 mg/L.	As above.
Main Powerhouse	EF19	Septic tanks (grey and black water), biofilm tank and chlorination tank.	- Ammonia-nitrogen (<10 mg/L): Non-compliance in 6 out of 8 samplings. Q2 mean 31.4 mg/L. - Total nitrogen (<10 mg/L): Non-compliance in 6 out of 8 samplings. Q2 mean 33.8 mg/L. - Total Phosphorus (<2 mg/L): Non-compliance in all 8 samplings. Q2 mean 6.5 mg/L. - Faecal coliform (<400 MPN/100 mL): Non-compliance in 1 out of 8 samplings. Q2 mean 269 MPN/100 mL. - Total coliform (<400 MPN/100 mL): Non-compliance in 1 out of 8 samplings. Q2 mean 269 MPN/100 mL.	As above

[1] The values in brackets indicate the applicable standard

3.7.3 Groundwater Quality Monitoring

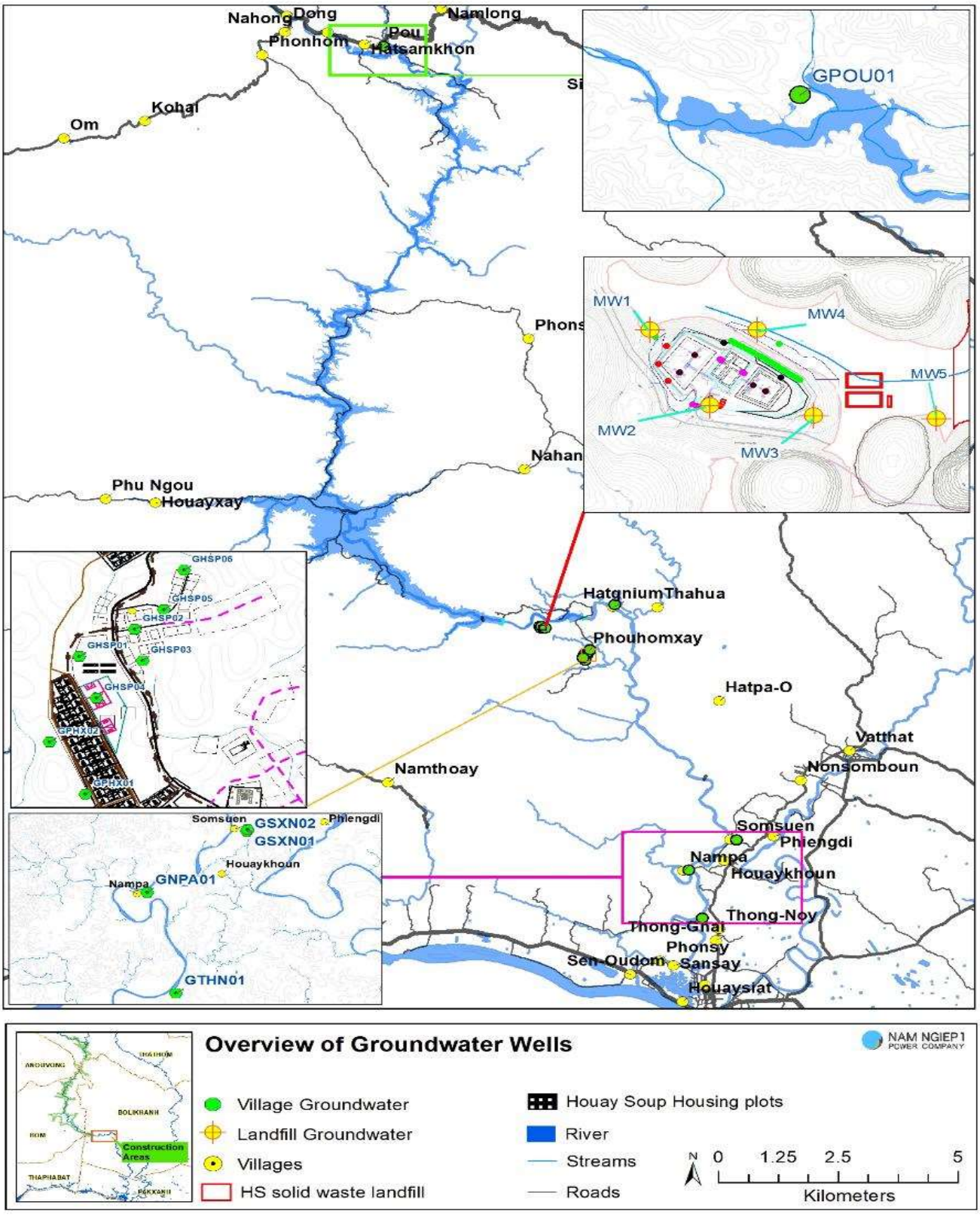
During Q2 2022, a total of seven boreholes at Somseun, Nam Pa, Thong Noy, (one borehole in each village), Pou Villages (two boreholes) and Phouhomxay Village (two boreholes) have been monitored for the following parameters:

a. *Monthly:* pH, DO (%), DO (mg/L), Conductivity (µs/cm), Temperature (°C), Turbidity (NTU), Faecal Coliform (MPN/100 mL) and *E. coli* (MPN/100 mL);

b. *Annually (Not for This Quarter)*: Arsenic (mg/L), Total Iron (mg/L), Magnesium (mg/L), Fluoride (mg/L), Total Hardness (mg/L), Nitrate (mg/L), Nitrite (mg/L) and Lead (mg/L).

The groundwater sampling locations are displayed in ***Figure 3-18*** and the groundwater monitoring data is presented in ***Appendix 5.3.***

FIGURE 3-18*: GROUNDWATER SAMPLING LOCATIONS*



Key findings from the groundwater quality monitoring are summarized as the follows:

Thong Noy Village: all monitored parameters complied with the standard, except for faecal coliform and Ecoli bacteria.

Somsuen Village: all monitored parameters complied with the standard, except for faecal coliform (09 May 2022).

NamPa Village: all monitored parameters complied with the standard, except for faecal coliform.

Pou Village: GPOU01 (10 May 2022) and GPOU02 (10 May and 06 June 2022) did not comply with the standard for faecal coliform and *E.coli*.

Phouhomxay Village: All parameters complied with the standard.

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.

There are two types of water supply systems in Lao PDR:

(A) Nam Papa systems (water supply) – water from natural water sources that has gone through a treatment process to become clean and safe water in compliance with the drinking water quality standards. These systems are managed by the Department of Water Supply, Ministry of Public Works and Transport; and

(B) Nam Saat Systems (domestic water supply) – provide water to rural areas that are not connected to Nam Papa systems. Nam Saat systems include gravity fed systems and boreholes with motorised pumps or hand pumps. These systems are managed by the Centre for Environmental Health and Water Supply (Nam Saat) under the Department of Hygiene and Health Promotion, Ministry of Health.

The community water supply systems related to the NNP1 hydropower project are under Nam Saat systems with the monitoring requirements identify in the Minister's Decision on the Water Quality Standard Management for Drinking and Domestic Use, No. 561/MoH dated 27 February 2014.

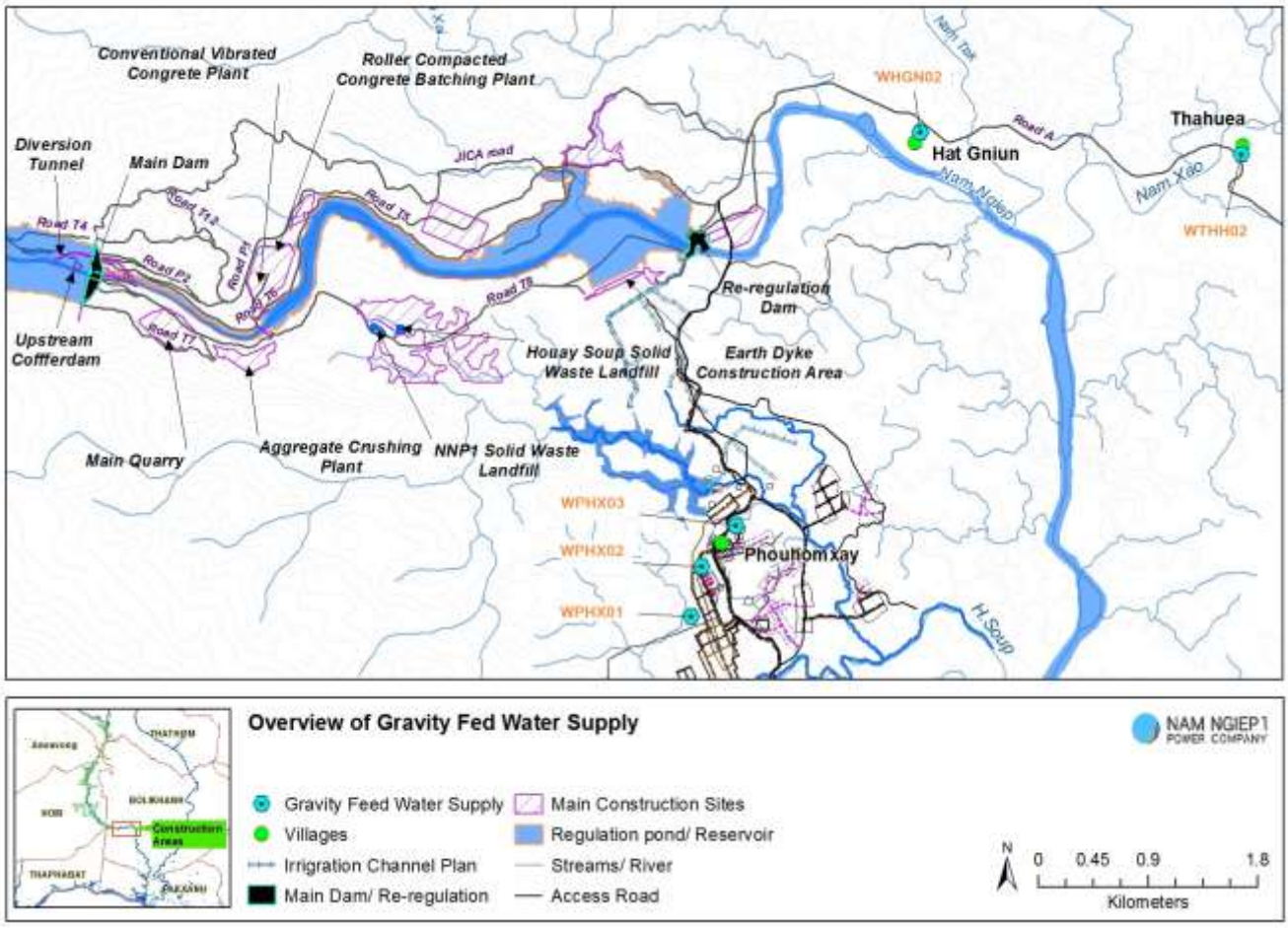
The issue of bacterial contamination in the communities' water supply have been investigated by ESD team together with the respective local authorities and the villagers to find the potential root causes. A series of actions have been taken to prevent the contamination according to the Water Safety Plans (WSP); however, the Project, Nam Saat (GOL) and the villagers considered that disinfection treatment processes (e.g., chlorination, ceramic filtration) would not be sustainable and cost effective in a long run. It is well understood and agreed with the villagers that the water shall be boiled before drinking as mentioned above. It is also noted that boiling of water from domestic water supply (Nam Saat) systems before drinking is a general practice in the rural areas of Lao PDR.

3.7.4 Gravity Fed Water Supply (GFWS) Monitoring

The monitoring of the GFWS aims to assess the quality of water that is being used for bathing and washing by villagers at Hat Gniun, Thahuea and Phouhomxay villages. The gravity fed water supply system at Phouhomxay Village has been in use since December 2017. Commencing in October 2020,

two new boreholes in Phouhomxay Village were put in use as a source of water supply instead of the previous gravity fed water supply system.

FIGURE 3-19: *OVERVIEW OF GRAVITY FED WATER SUPPLY*



Water samples were taken from the taps for analysis during the reported period and selected results are shown in ***Table 3-17***. The full set of data is presented in ***Appendix 5.4.***

TABLE 3-17*: THE GFWS MONITORING RESULT IN Q2 2022*

Date	Parameter (Unit)	Site Name	Tha Heua Village	Hat Gniun Village	Phouhomxay Village	
		Station	WTHH02	WHGN02	WPHX02	WPHX03
		Guideline				
26-Apr-22	E. Coli (MPN/100 mL)	0	49	49	22	6.8
09-May-22		0	7	49	70	49
13-Jun-22			13	130	0	2
26-Apr-22	Faecal coliform (MPN/100 mL)	0	79	79	26	9.3
09-May-22			7	70	70	49
13-Jun-22		0	13	130	0	2

Thahuea Village (WTHH02): all parameters complied with the standard, except for faecal coliform and *E.coli*.

Hat Gniun Village (WHGN02): all parameters complied with the standard, except for faecal coliform and *E.coli*.

Phouhomxay Village (WPHX02-tap water at primary school; and **WPHX03**-tap water at the villager's house**):** all parameters complied with the standard, except for faecal coliform and *E.coli* in all Q2 2022 samples. Note here that during sampling of tap water in Phouhomxay Village, surface water from Houay Soup Stream was still supplied into the system and the samples likely represent a mixture of surface water and groundwater from the boreholes *(GPHX01 and GPHX02),* which may explain the bacteria contamination in the tap-water at Phouhomxay.

As observed in the field during water sample collection, livestock is roaming around in the water intake areas which may have contributed to the presence of Faecal Coliform Bacteria and *E.coli* in GFWS samples. The villagers generally use tap water for washing and cleaning. They were informed about the monitoring results and were advised to prevent the bacterial contamination by removing livestock from the intake areas and 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.

As mentioned in section **3.7.3**, the gravity fed system is a domestic water supply under Nam Saat System managed by the Centre for Environmental Health and Water Supply (Nam Saat) under the Department of Hygiene and Health Promotion, Ministry of Health. It is well understood and agreed with the villagers that the water shall be boiled before drinking.

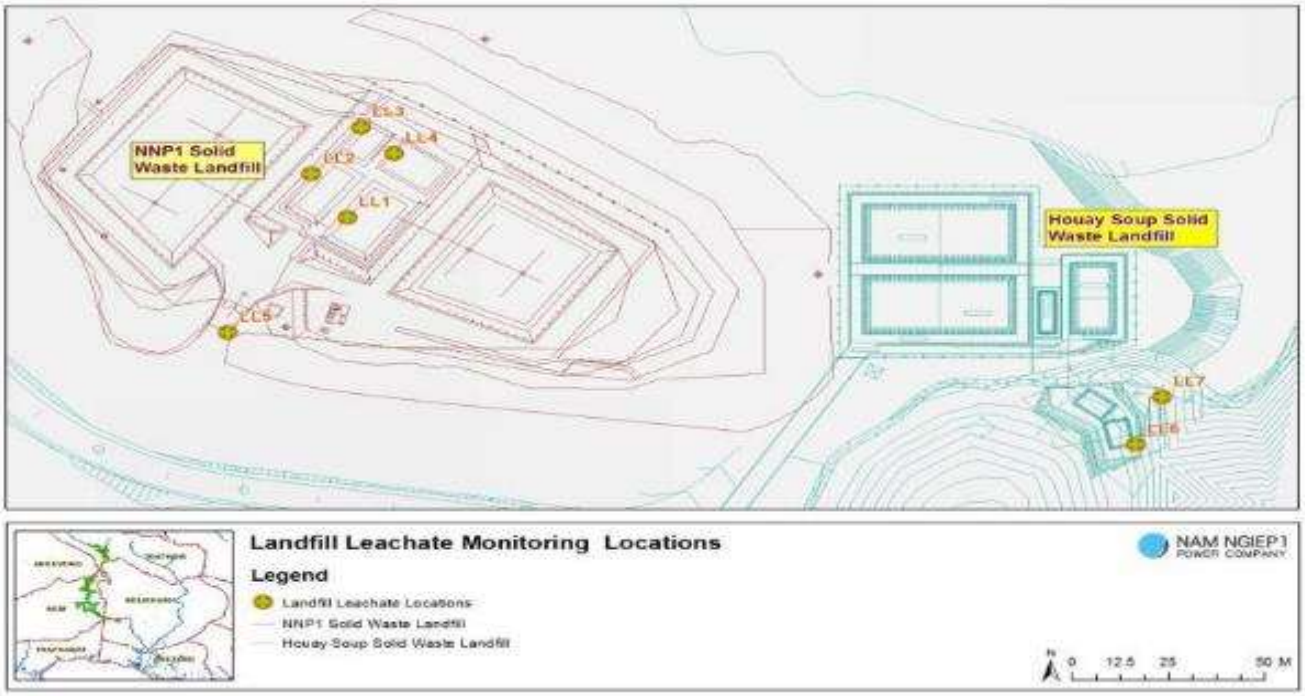
For Phouhomxay Village, the villagers requested NNP1PC and the District Water Supply Office during a meeting in March 2022 to reuse the Gravity Fed System (GFS) as a main supply and reserve the existing ground water supply system for times when the GFS would have to be repaired. The water from the gravity fed system needs to be boiled before drinking, but may be used for other purposes such as washing, feeding animals, watering the garden, and other households' activities.

In addition, to ensure sufficient water quantity, the ESD will work with the District Water Supply Office to improve the water intake of the GFS under NNP1PC's Corporate Social Responsibility (CSR). For the presence of bacteria, the community confirmed that they will boil water before drinking. It is also noted that boiling domestic water supply (Nam Saat) before drinking is a general practice in the rural areas of Lao PDR.

3.7.5 Landfill Leachate Monitoring

The landfill leachate treatment systems at NNP1 Project landfill and Houay Soup landfill are monitored to control the functioning of the treatment process and ensure compliance with effluent standards. The monitoring locations are presented in the ***Figure 3-20***.

FIGURE 3-20*: LANDFILL LEACHATE MONITORING LOCATION*



The monitoring results in Q2 2022 indicate compliance with the applicable standards for all monitored parameters. The monitoring data can be found in ***Appendix 5.6***.

3.7.6 Water Quality Compliance Monitoring

The water quality non-compliance issues in Q2 2022 are summarized in **Table 3-18**.

TABLE 3-18*: NON-COMPLIANCES RELATING TO WATER QUALITY MONITORING IN Q2 2022*

No	Non-compliance Issues	Corrective Actions	Status
1	Dissolved Oxygen (DO) in the Nam Ngiep River downstream the Re-regulation Dam was lower than the National Surface Water Quality Standard (6 mg/L)	- NNP1PC is still in the process of compiling and analysing the water quality data and evaluating if additional aeration to improve the DO level at downstream would be warranted. - Preliminary studies have been conducted on the feasibility and costs (including implications for electricity generation) of various aeration systems. The summary of preliminary study result is presented in **Appendix 5.6.**	- NNP1PC has proposed to ADB and LTA to keep monitoring the water quality in the Reservoir, Re-regulation Reservoir, and the Nam Ngiep downstream the Re-regulation Dam to study the changes and take actions where necessary. - A trial to operate the labyrinth spillway at the Re-regulation Dam was

No	Non-compliance Issues	Corrective Actions	Status
			implemented in November 2021 to see the improvement of DO values downstream and the report was prepared by TD and shared to LTA and ADB during the mission in Q4 2021. - It is also worth noting that over the course of the last three years, no fish kill has been observed or reported
2	Effluents discharged from the Wastewater Treatment Systems (WWTS) at OSOV1, OSOV2 and the Main Dam exceeded the National Effluent Standard Guideline for some parameters	The systems were studied and NNP1PC management agreed on improvement and modification as follows: - **OSOV1** – new construction of the 2nd wetland pond to be a concrete type for a longer-term service and full maintenance by replacing the filtering system of 2 wetland ponds and their piping; - **OSOV2** – new construction of the Sequencing Batch Reactor (SBR) system to replace the under-designed wetland pond; - **The Main Dam** – modifying the piping system to extend the treatment time of wastewater including the automatic Chlorine dosing system installation.	- The WWTS improvement work was completed by the end of August 2021 and the treatment systems have since then been adjusted to ensure compliance with the effluent standards. - In Q1 2022, the monitoring frequency was increased from fortnightly to weekly to obtain more data to support the system adjustments. - The adjustment continued in Q2 2022. - In Q3 2022, sludge cake is planned to be added into SBR system to activate the system to reduce ammonia and total nitrogen.
3	Groundwater quality monitored for the communities (Thong Noy, Som Seun, Nam Pa, and Pou Villages) were not complied with the National Groundwater	- A full inspection of the water supply systems in Som Seun, Nam Pa and Thong Noy Village was conducted in September 2020 by NNP1PC team including consultations with the Village Water Use Committee (VWUC) and also	- The villagers were advised/encouraged to boil water before drinking. - Continue to monitor.

No	Non-compliance Issues	Corrective Actions	Status
	Quality Standard for drinking purpose on Faecal Coliform and E.*coli* parameters	interviews with some consumers (detailed in Q4 2020 Report). - Potential contamination sources of coliform were identified and recommendations on operation and maintenance of the water supply system were provided to the involved parties. - The villagers were informed about the monitoring results and were advised to boil water before drinking 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.	
4	Gravity Fed Water Supply monitored for the communities (Tha Heua, Hat Gniun, and Phouhomxay Village) were not complied with the National Drinking Water Quality Standard on Faecal Coliform and E.*coli* parameters	- Site observations were conducted during the routine water sampling, it was observed that livestock was roaming around the water intake areas and faeces from livestock and birds may contribute to the presence of bacterial contamination. - The villagers were informed about the monitoring results and were advised to boil water before drinking.	- The villagers generally use tap water for washing and cleaning, and were encouraged to boil water before drinking. - Continue monitoring.

4 WATERSHED AND BIODIVERSITY MANAGEMENT

4.1 WATERSHED MANAGEMENT

4.1.1 Implementation of Watershed Management Plan

4.1.1.1 Xaysomboun Watershed and Reservoir Protection Office (WRPO)

Xaysomboun WRPO planned to conduct the training on Participatory Land Use Planning (PLUP) and LUP improvement for Phonhom Village in the first week of April 2022 but it was postponed because the members responsible for the activity contracted COVID-19. The activity was further discussed during the monthly technical meeting on 11 May 2022. It was agreed that the training may proceed whenever the WRPO and relevant staffs at district level are ready but the work and budget plans for

LUP improvement need to be further revised in collaboration with Thathom District Agriculture and Forestry Office (DAFO) after receiving the AIP 2022 budget.

The Xaysomboun Provincial Governor approved the restructure of Xaysomboun Watershed and Reservoir Protection Office Committee (WRPC) and Watershed and Reservoir Protection Office (WRPO) on 29 March 2022 and an internal meeting among Xaysomboun WRPC and WRPO was organized on 8 April 2022. However, there was no further progress until end of April 2022 and so EMO proposed a bi-weekly technical meeting with Xaysomboun WRPO and BSP-WCS in May 2022.

The bi-weekly technical meeting was organized on 11 May 2022 in Xaysomboun Provincial Agriculture and Forestry Office (PAFO). The meeting was attended by 14 people (included 4 women) comprising 8 representatives from Xaysomboun WRPO/PAFO, 3 representatives from Biodiversity Service Provider (BSP)-Wildlife Conservation Society (WCS), and 3 representatives from EMO. The objectives of the meeting are to discuss the work progress, pending issues and action plan of Xaysomboun WRPO. The results from the meeting are highlighted as follow:

- Xaysomboun WRPO in collaboration with technical staff of Provincial Department of Home Affairs to prepare an Agreement on establishment of a Provincial Task Force for the Provincial Governor's review and approval per recommendations from the meeting on NNP1 watershed management that was organized on 7 February 2022 at Xaysomboun Provincial Administration Office. Xaysomboun WRPO will develop a budget plan for the Provincial Task Force in collaboration with EMO.
- Xaysomboun WRPO to submit the financial report for the implementation of the previous Annual Implementation Plan (AIP) as of 30 April 2022 and a budget plan for organizing a site visit on the ongoing mineral exploration activity in the NNP1 watershed Totally Protected Zone 1 (TPZ1) to EMO by end of May 2022. The site visit is tentatively scheduled to be held in the first week of June 2022.
- Xaysomboun WRPO in collaboration with District Agriculture and Forestry Office (DAFOs) of Hom and Thathom to organize the consultation meeting on role and responsibilities for reservoir fishery management of relevant provincial and district offices at respective district level.
- Xaysomboun WRPO to follow up with the DAFO and relevant GoL agencies at district level on the progress of appointment of staff and officials for sub-station and patrolling teams per recommendation from the meeting on NNP1 watershed management held on 7 February 2022 and 8 April 2022 at Xaysomboun Provincial Administration Office.
- Xaysomboun WRPO to coordinate with the DAFOs and the relevant sectors on resource arrangement and officials to be stationed in the WRPO field sub-office and join the patrol team referring to the Minutes of Meeting of 7 February 2022.
- Xaysomboun WRPO to submit the Monthly Progress Reports (MPR) from June 2021 to April 2022 after Xaysomboun PAFO has provided comments and approved the MPRs.
- Agreed to organize a monthly technical meeting during the 20th to 25th of each month.
- NNP1 has submitted the budget plan of Xaysomboun WRPO AIP 2022 to ADB and IAP for their review and comments and expects to receive their comments within June 2022.

Regrettably, there was no further progress on the actions discussed and agreed during the meeting in May 2022 because the staff of Xaysomboun WRPO are occupied with the Xaysomboun PAFO tree

plantation program and other assignments such as to deal with forest encroachment in other districts. EMO and BSP-WCS proposed to have further discussions with Xaysomboun WRPO during the monthly meeting on 30 June 2022 but the meeting had to be postponed to the first week of July 2022 because the Head of Xaysomboun WRPO took leave for personal reasons.

4.1.1.2 Bolikhamxay Watershed and Reservoir Protection Office (WRPO)

Bolikhamxay WRPO organized the discussion with BSP-WCS to plan for their forest and reservoir patrolling in 2022. However, they could not progress with any activities because they have not received the funds for implementing the activities under the approved AIP2022 from DOF-MAF until end of April 2022 due to the GOL's internal process and their documentation works for the fund disbursement. NNP1 EMO followed up with DOF-MAF and noted that there is long document processing time from DOF-MAF and Ministry of Finance (MoF) office and the process was also delayed during the Lao New Year holidays in the middle of April 2022.

Bolikhamxay WRPO organized a discussion with BSP-WCS on the Law Enforcement strategy on 10 May 2022 and conducted forest and reservoir patrolling between 16-23 May 2022.

Bolikhamxay WRPO planned to conduct forest and reservoir patrolling in June 2022 after the monthly meeting but the meeting was postponed because the members of Bolikhamxay WRPO were occupied with other assignments from Bolikhamxay PAFO. They plan to organize SMART refresher and new standard operation procedure (SOP) training for Bolikhamxay rangers in collaboration with BSP-WCS under NNP1 No Net Loos (NNL) fund in July 2022.

4.1.1.3 NNP1PC EMO

Implementation of the agriculture extension service plan for improving home gardening and Kai Noi rice production by growing vegetable in greenhouse and organic rice farming in Thathom District started on 6 April 2022. Village meetings to present the activities and to select households for a farming demonstration plot were organized at Phonhom and Nahong Village on 6 and 7 April 2022 respectively. Thathom DAFO provided technical support to the six selected rice farmers (three farmers for Phonhom Village and three farmers for Nahong Village) who have started preparing for organic rice farming (Kai Noi Rice) by using their acquired new knowledge and techniques in demonstration plots (1,600 m^2/household).

After consultation meetings in March 2022, Hom DAFO has prepared and submitted the document for establishing cattle and orange production groups to the relevant offices for their review prior to submission and approval by Hom District Governor. Hom District Governor issued agreement and license of group establishment for the cattle production group and orange production group in May 2022. EMO team also had discussions with Thathom DAFO on the plan for establishing the local producer groups at Nahong and Phonhom Village. They confirmed that a kick-off meeting on group establishment can be organized in June or July 2022 subject to the availability of GOL team members.

The training for organic greenhouse gardening and Kai Noi rice production at Nahong and Phonhom Village of Thathom District was organized on 26 and 27 April 2022 respectively. The training at Nahong Village was participated by four rice farmers including three selected farmers for farming demonstration plot. The training organized at Phonhom Village was participated by 11 farmers including three selected farmers for farming demonstration plots and three selected farmers for

greenhouse garden. Noted that many farmers could not participate in the training because they were busy with harvesting their off-season rice and growing casava. The trained farmers have learned methods and techniques to produce different natural-based fertilizers for fertilizing the soil as well as producing organic pesticide for pest control. At the end of the training, all the selected farmers for organic farming demonstration produced natural-based fertilizers and organic pesticides including 1,200 kg of bio-compost fertilizer, 45 litres of bio-extract for enhancing crop growth, 10 litres of bio-extract for enhancing yield and 55 litres of plant herb pesticides. Thathom DAFO organized a second organic farming training at the end of June 2022. EMO team also supported Thathom DAFO on monitoring and providing technical support on the Kai Noi rice farming program for the six selected farmers at the demonstration plots in Ban Nahong and Phonhom.

A field visit by the trainers who are professors from Faculty of Agriculture to Phonhom and Nahong Village, Thathom District and PhouNgou and Houayxai Village in Hom District, Bolikhamxay Province to collect necessary information for planning and designing the training course for the farmers/villagers was organized on 4-8 April 2022. Challenges and issues related to farming (cattle, pineapple and orange) were informed and discussed between farmers/villagers and the professors during the field visit. The trainers finalized and submitted the training and budget plan to EMO team for pineapple and orange farming and cattle fattening program at the end of June 2022.

NNP1 management had a discussion with Vice Minister of Minister of Agriculture and Forestry (MAF) at Vice Minister Office in Vientiane on 30 May 2022 participated by Vice Minister of MAF, representatives of DOF-MAF, NNP1 Managing Director, NNP1 ESD Deputy Managing Director, and NNP1 EMO Manager. The meeting was organized to seek the guidance from the Vice Minister of MAF on the financial and pending issues of the NNP1 watershed and biodiversity program related to NNL in biodiversity including the on-going mining exploration activity in the NNP1 watershed TPZ. The Vice Minister advised DOF-MAF in close collaboration with Ministry of Finance (MoF), relevant GOL committees, and NNP1PC to finalize the Financial Management Manual (FMM) as soon as possible and to ensure that everything is aligned with the GOL financial policy (referring to MoF Decree No. 4000). In addition, the Vice Minister also advised DOF-MAF to obtain more information to better understand the situation on the mining exploration in the province and report back to him so that he can raise the concerns to the GOL planning and investment team in which the vice minister is also a honourable member.

NNP1PC received an official request from the Ministry of Defence (Ref No. 2546/MoD dated 24 May 2022) and DOF-MAF (Ref. No. 3371/DOF dated on 25 May 2022) to provide financial support for the investigation on 128 families who occupied the land within the Samriam area of Hom District that may impact the forest and land within NNP1 watershed TPZ1. A special committee has been established through the agreement issued by MoD office (Ref No. 2454/MoD dated 19 May 2022) comprising representatives from MoD, Xaysomboun Provincial Military office, Hom District governor office, military, and home affair office, Bolikhan District Governor office, DoF and DoFI of MAF, as well as Department of Land (DoL) of Ministry of Natural Resource and Environment (MoNRE) to conduct site inspection, technical analysis, and organize consultation meetings to deal with the threats. NNP1PC has further discussed and agreed with DOF-MAF that the financial support will come under the GOL Concession Agreement (CA) Fund and the activity was scheduled for June or July 2022.

FIGURE 4-1. ***REPRESENTATIVE PHOTOS DURING FIELD VISIT BY TRAINERS FROM FACULTY OF AGRICULTURE OF BOLIKHAMXAY PROVINCE ON 4-8 APRIL 2022***

	
Discussion with farmers/villagers at Phonhom Village of Thathom District	Discussion with farmers/villagers at Nahong Village of Thathom District
	
Discussion with farmers/villagers at Phoungou Village of Hom District	Discussion with farmers/villagers at Houayxai Village of Hom District
	
Site visit at orange plantation in Phoungou Village of Hom District	Site visit at Napier grass cultivation in Phoungou Village of Hom District

FIGURE 4-2. ***REPRESENTATIVE PHOTOS DURING VILLAGE MEETING ON IMPLEMENTATION OF AGRICULTURE EXTENSION SERVICE AT PHONHOM AND NAHONG VILLAGE IN THATHOM DISTRICT ON 6 APRIL 2022***

	
Meeting in Nahong Village of Thathom District	Meeting in Phonhom Village of Thathom District

FIGURE 4-3. ***REPRESENTATIVE PHOTOS DURING ORGANIC FARMING TRAINING IN NAHONG AND PHONHOM VILLAGE OF THATHOM DISTRICT ON 26 AND 27 APRIL 2022***

	
Deliver materials to farmers at Nahong Village of Thathom District	Preparing bio-compost fertilizer at Nahong Village of Thathom District
	
Preparing bio-extract at Phonhom Village of Thathom District	Preparing bio-extract at Nahong Village of Thathom District

Selected plot for building greenhouse garden at Phonhom Village of Thathom District

The progress of actions to deal with the pending issues is summarized in **Table 4-1**.

TABLE 4-1*: THE APPROACHES TO SOLVE THE PENDING ISSUES WITH THE GOL PARTIES ON THE NNP1 WATERSHED AND BIODIVERSITY PROGRAM*

No	Actions	Expected date to be conducted/completed	Remarks	Status as of 30 June 2022
1	Drafting the Financial Management Manual (FMM) for NNP1 Project to share with the GOL parties (DOF-MAF, WRPOs and BOMU) for their review and comments	22 November 2021	The draft was circulated to DOF-MAF, WRPOs, and BOMU on 22 November 2021	Completed
2	The comments from GOL for the draft FMM to be provided to NNP1PC	30 November 2021		Completed: NNP1 received the comments from DOF-MAF and Bolikhamxay Nam Chouane-Nam Xang (NC-NX) Biodiversity Offset Management Unit (BOMU), as well as from Bolikhamxay WRPO on 30 November and 21 December 2021 respectively. The comments from Xaysomboun WRPO were discussed during the workshop on 27 December 2021.
3	Organize a meeting with the central level and provincial level (DOF-MAF, WRPOs, BOMU) to clarify the comments from GOL and finalize the FMM for further approval.	During 13-17 November 2021	It is expected that the pending issues of allowances for field work and the sub-office operation will be agreed and finalized.	The meeting was held but the FMM still could not be finalized: • The meeting was held online via 'meet. Google' on 27 December 2021 with representatives from all relevant parties. • The two issues of the allowances for field work and the sub-office operation are still pending and could not finalized, but the meeting agreed that the FMM should be finalized and approved by DOF with the technical support from NNP1PC and its consultant. • The improved FMM (final draft) after the meeting was shared with DOF on 11 Feb 2022 for their final review and approval. DOF-MAF shared the comments from DOF-MAF and

No	Actions	Expected date to be conducted/completed	Remarks	Status as of 30 June 2022
				Bolikhamxay WRPO and NC-NX BOMU on 4 Apr 2022. • EMO and the Consultant further revised the draft, provided clarification to GOL comments and submitted it back to GOL on 20 May 2022. The revised draft is still being reviewed by GOL.
4	Organize meetings with implementing units (BOMU and WPROs) and BSP-WCS to discuss the way forward to put effort to implement the planned activities if the GOL COVID19 lockdown measures are still extended in December 2021.	7 December 2021		Completed: • The meeting was held on 8 Dec 2021 between NNP1PC and BSP-WCS. • Xaysomboun Province issued an official notification on 3 Dec 2021 to allow the vaccinated persons travelling to the province (except to the red villages). • Xaysomboun WRPO provided confirmation to BSP-WCS team on 20 Dec 2021 that they accepted to participate in the biological surveys that were scheduled for Jan 2022 with the existing allowance rate. However, the head of XSB WRPO re-confirmed again on 30 Dec 2021 after further internal discussion with Xaysomboun WRPO/PAFO team that they cannot accept the proposed activity without additional accommodation allowance and so the survey in NNP1 watershed will be postponed until the meeting with XSB provincial governor was organized. • EMO received confirmation from Department of Forestry (DOF)-Ministry of Agriculture and Forestry (MAF) through an official letter No. 022/PAFO-Xaysomboun dated on 20 January 2022 that the Head of Xaysomboun PAFO and the Head of Xaysomboun WRPO accepted and have no objections on the NNP1 proposed

No	Actions	Expected date to be conducted/completed	Remarks	Status as of 30 June 2022
				allowances for field-office-based staffs, for local villagers who participate in field activity in the forest, and also for the pending issue on the patrolling work as discussed and agreed during the meeting on the Financial Management Manual (FMM) on 27 December 2021.
5	Organize a meeting with the Bolikhamxay Vice Provincial Governor (Chairman of Bolikhamxay Watershed and Reservoir Protection Committee (WRPC) and NC-NX Biodiversity Offset Management Committee (BOMC)) for his guidance on the pending allowance issues.	Within 14 January 2022	May not be necessary if the FMM can be agreed and finalized within action 3.	Referring to the outcomes of the meeting in step 4 that all parties have agreed on the pending allowance issues (per its MOM), the meeting in this step 5 is not needed at this time.
6	Organize a meeting with the Xaysomboun Provincial Governor (PG) for his guidance on the pending allowance issues, Fishery Management Plan (FMP), the threats in the watershed TPZs related with NNL objectives, and the AIP2022 preparation.	Within 14 January 2022	This would be the follow up on the PG recommendation from the meeting in March 2021. The discussion on the allowances might not be necessary if the FMM can be agreed and finalized within action 3.	Completed: The Meeting of NNP1 Resettlement, Livelihood Restoration Committee (PRLRC) and Watershed and Reservoir Protection Committee (WPRC) in Xaysomboun Province was done successfully on 7 Feb 2022 at the Provincial Administration Office of Xaysomboun Province. The MOM is shared on google drive.
7	Organize a meeting with the DOF-MAF and the Ministry level for their guidance on the pending allowance issues.	Within end of January 2022	May not be necessary if the issues can be agreed and finalized within action 5 and 6.	In progress: • NNP1 management (MD, DMD ESD), EMO Manager and a representative of LHSE organized a short discussion with Vice Minister of MAF accompanied by Deputy Director of DOF-MAF and the representatives from Vice Minister Office on 30 May 2022 to discuss on the outstanding issues particularly on the allowances for the field work and the threat to NNP1 NNL program. The Vice Minister advised

No	Actions	Expected date to be conducted/completed	Remarks	Status as of 30 June 2022
				the Deputy Director of DOF-MAF to lead the finalization of the FMM in coordination with relevant agencies (including consultations with MoF) and NNP1PC as soon as possible and to make sure that everything is aligned with the GOL financial policy (referring to MoF Decree No. 4000). The issue is still under discussion internally in GOL. • Vice Minister of MAF also advised DOF-MAF to collect more information on the mining exploration within the NNP1 watershed TPZ as per NNP1 concerns as it is not aligned with the CA between NNP1PC and GOL. It was also noted that the Vice Minister as member of GOL Planning and Investment Team was not aware of the MOU signed between XSB Province and private company as this should have been in the plan and well discussed within the GOL Planning and Investment Team. He will also raise the concern to the Team for the further consideration and actions. • EMO will continue to follow up with the DoF-MAF on the progress of their internal discussions.
8	Organize the Annual Meeting relating to AIP2020 and 2022 including the way forward with Xaysomboun WRPO to be chaired by Xaysomboun PG.	Within end of January 2022	After the approval of AIP2022	Still pending: • Xaysomboun WRPO informed EMO Team in March 2022 that a new Head of Xaysomboun Provincial Agriculture and Forestry Office (PAFO) has been appointed and the internal meeting will be organized to discuss the AIP implementation including the pending progress on the appointment of staffs for WRPO sub-office operation and patrolling program, the establishment of two land-based

No	Actions	Expected date to be conducted/completed	Remarks	Status as of 30 June 2022
				ranger stations in the Totally Protected Zone (TPZ) and two reservoir checkpoints, as well as actions related with reservoir and fishery management. They also informed that a meeting on improvement of institutional arrangement of Watershed and Reservoir Protection Committee (WRPC) and WRPO is scheduled in April 2022. • Xaysomboun WRPO submitted the budget plan of their AIP2022 to EMO on 30 March 2022. The plan is being reviewed by EMO team and is expected to be further discussed and finalized after a meeting on improvement of institutional arrangement of Watershed and Reservoir Protection Committee (WRPC) and WRPO. • EMO submitted the revised draft of XSB AIP2022 to ADB and IAP for review and approval on 10 May 2022. IAP and ADB provided confirmation of no objection on the revised plan to EMO on 7 and 30 Jun 2022 respectively. EMO will communicate further with XSB WRPO for the plan finalization.
9	Organize the Annual Meeting relating to AIP2021 and 2022 including the way forward with Bolikhamxay WRPO to be chaired by Bolikhamxay Vice Governor.	Within end of January 2022	After the approval of AIP2022	Completed: The Meeting was organized on 3 Feb 2022. The MOM is shared on google drive.
10	Organize the annual meeting relating to AIP2021 and 2022 including the way forward with Bolikhamxay NC-NX BOMU to be	Within end of January 2022	After the approval of AIP2022 Note: Action 8 and 9 could be organized at the same day for time efficiency because the Bolikhamxay Vice Governor is	Still pending: • EMO and BOMU organized an online discussion on 9 Feb 2022 to discuss and agree on the key issues for the draft AIP2022 such as field allowance, subsistence allowance, phone

No	Actions	Expected date to be conducted/completed	Remarks	Status as of 30 June 2022
	chaired by Bolikhamxay Vice Governor.		the chairman for both Bolikhamxay WRPC and NC-NX BOMC	cards and etc. The activity schedule was further detailed and communicated with BSP-WCS on 16 Feb 2022 for their inputs. • BSP also recommended to include additional training budget for the patrolling and snare removal team and so the plan was further updated accordingly. The draft was submitted to ADB and IAP on 23 Feb 2022 for their review and approval. • IAP and ADB provided comments with no objection on 7 and 18 March 2022 respectively. However, BOMU confirmed that the FMM should be finalized first before concluding their AIP2022.

4.1.2 Preparation of Annual Implementation Plan (AIP) 2022

4.1.2.1 Xaysomboun WRPO

Xaysomboun WRPO submitted the budget plan of their AIP2022 to EMO on 30 March 2022. EMO team has reviewed the budget plan of Xaysomboun AIP2022 and submitted to ADB and IAP on 10 May 2022 for their review and approval. IAP and ADB provided confirmation of no objection on 7 and 30 June 2022 respectively. EMO team was communicating further with Xaysomboun WRPO on the plan finalization.

4.1.2.2 Bolikhamxay WRPO and DOF-MAF

The funds to cover the implementation of activities during Q1 and Q2 2022 under the approved Bolikhamxay WRPO and DOF-MAF AIP2022 were transferred by NNP1PC to DOF-MAF account at central level on 15 March 2022. They only received their funds in the first week of May 2022 due to the GOL's internal process.

4.2 BIODIVERSITY OFFSET MANAGEMENT

4.2.1 Implementation of Biodiversity Offset Management Plan

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

a. Component 1 - Spatial Planning and Regulation

The Biodiversity Offset Management Unit (BOMU) continued the process of obtaining the official approval from the Bolikhamxay Provincial and District management offices.

b. Component 2 – Enforcement

There was no patrolling in April 2022 because the AIP2022 that includes the budget to continue the patrolling working from April 2022 will not be finalized by Nam Chouane-Nam Xang (NC-NX) BOMU until the discussion of final draft of FMM is organized. Some of the patrol team members were assigned to the patrol sub-stations to safeguard the facility and make observations nearby the sub-station.

There were 3 patrol teams assigned for guarding each patrol sub-station in May 2022. EMO, Nam NC-NX BOMU, and BSP-WCS had a meeting on 20 May 2022 about the continuation of patrolling work. It was agreed that NC-NX BOMU may use the remaining budget from other activities under the previous AIP 2021 such as from the village land use updating activity to continue the patrol sub-station guarding and field patrolling with mobilization of one or two teams if the budget is sufficient.

EMO, NC-NX BOMU, and BSP-WCS agreed to transfer the unused budget for pending activities in the previous AIP to patrolling in June 2022. The patrolling was implemented between 9-28 June 2022 with two patrolling teams focussing on TPZ highest priority area (Nam San and Nam Xi). The results are presented in the following table.

Team	Patrolling Area/distance	Observations/Actions Taken
1	**9-28 June 2022** TPZ highest priority area including Nam San and Nam San Mountain ridges.	**9-28 June 2022** The team did not encounter any threats during patrolling.

Team	Patrolling Area/distance	Observations/Actions Taken
	(16 days covering a distance of 69 km on forest patrolling)	
2	**9-28 June 2022** TPZ highest priority area including Nam Xi, Houay Xai Gnai and Houay Poung. (14 days covering a distance of 48.23 km on forest patrolling)	**9-28 June 2022** The team found and destroyed one old hunting camp located outside the TPZ and one old fishing camp inside the TPZ at Nam Xi. The team also found and removed an old hunting camp inside the TPZ at Houay Xay Gnai.

FIGURE 4-4: ***MAP OF PATROLLING TRACK IN JUNE 2022***

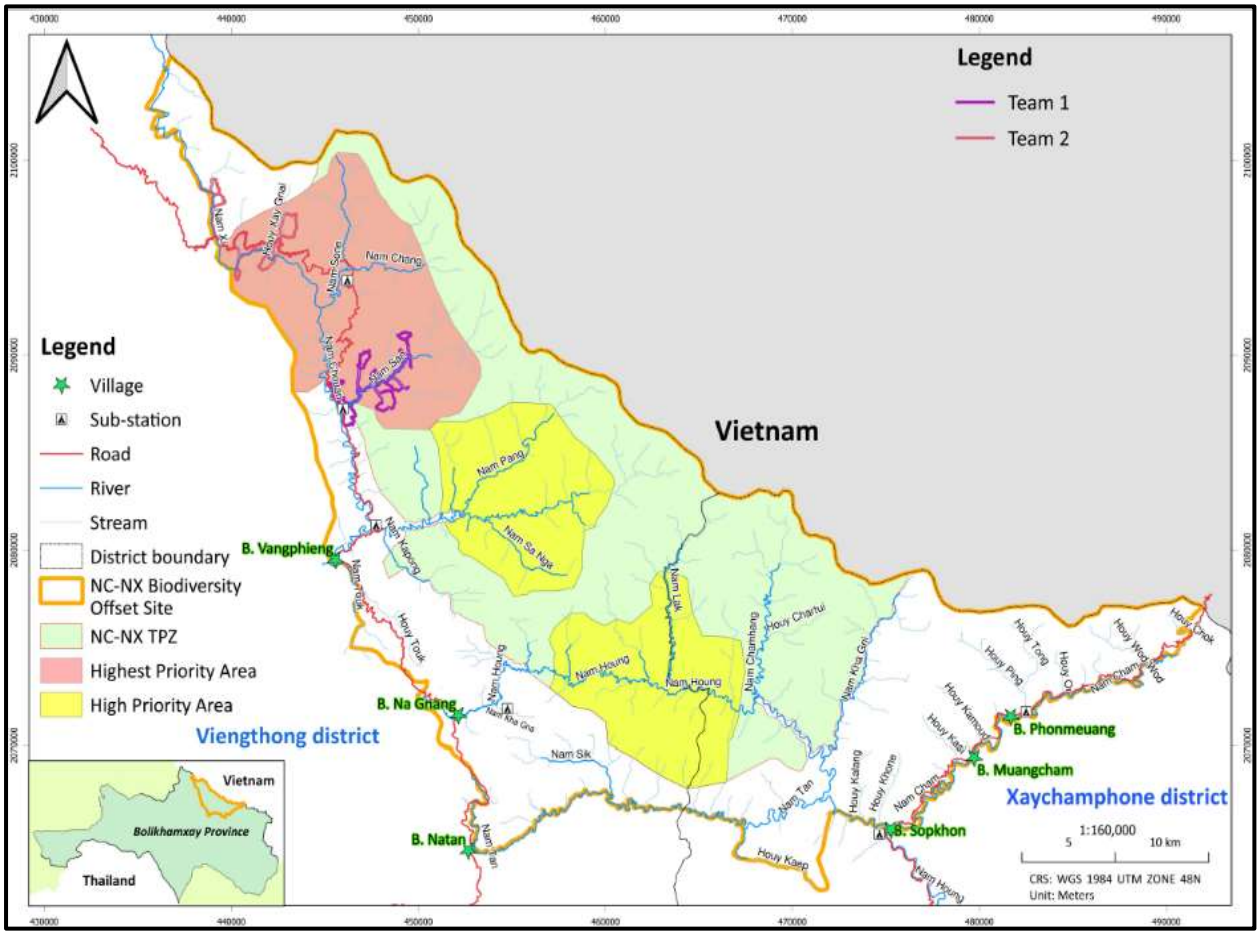


FIGURE 4-5: *MAP OF THREATS IN JUNE 2022*

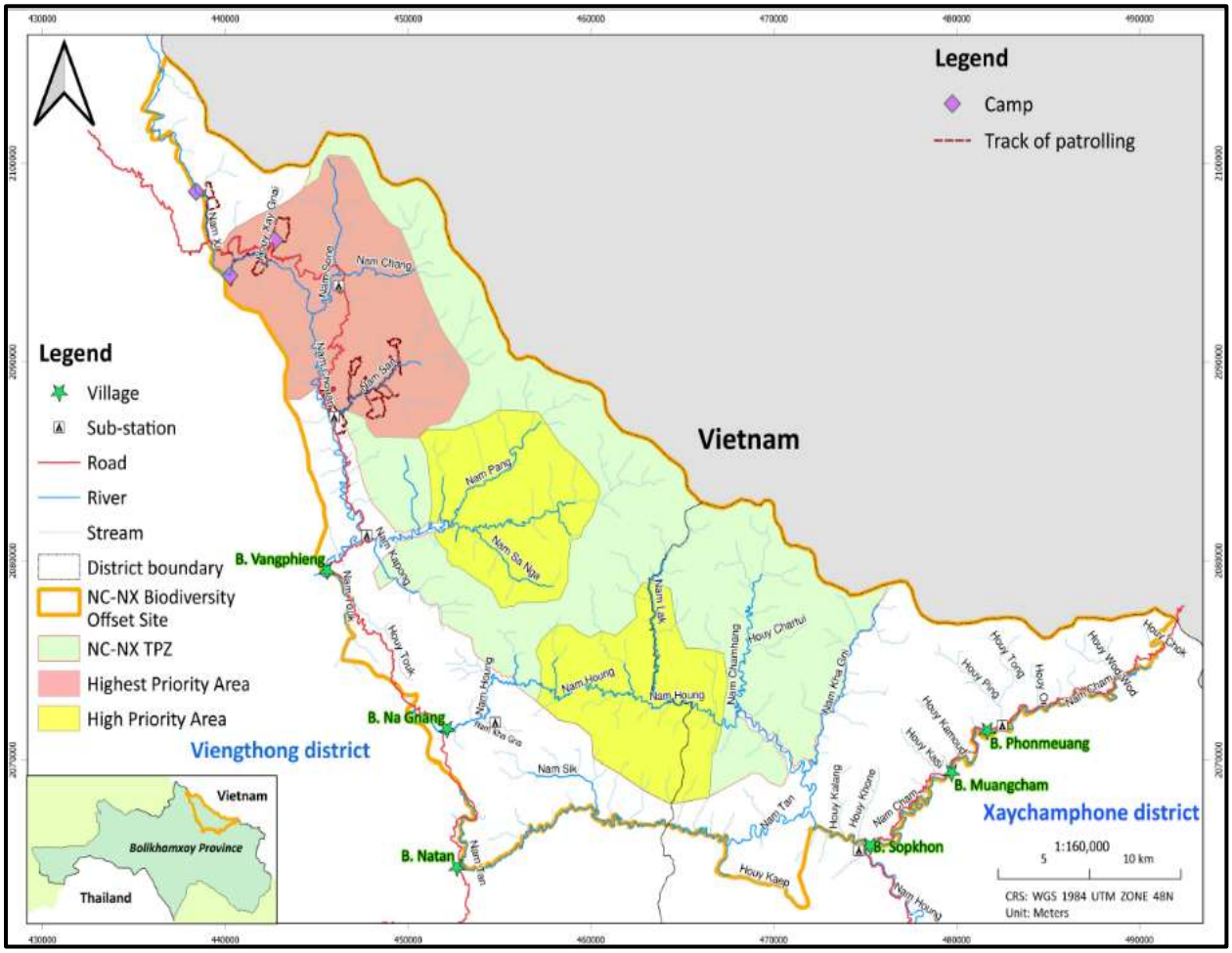


FIGURE 4-6: ***OLD FISHING CAMP FOUND AND DESTROYED BY TEAM 2 AT NAM XI***	**FIGURE 4-7:** ***OLD HUNTING CAMP FOUND AND DESTROYED BY TEAM 2 AT HOUAY XAY GNAI***
	

c. Component 3 – Conservation Outreach

BSP-WCS shared the improved draft NC-NX outreach strategy to EMO on 23 June 2022. The radio-broadcast outreach will continue to be implemented until July 2022.

d. Component 4 – Conservation linked livelihood

EMO, NC-NX BOMU, and BSP-WCS agreed to postpone the activity under the approved Community Development Plan (CDP), because members of NC-NX BOMU responsible for the activities were occupied with other assignments and the access to the site was very difficult after the heavy rain started at the end of May 2022.

BSP-WCS continued improving the Lao version of the draft Community Conservation Agreement (CCA) for BOMU review and comments.

The snare removal activity of June 2022 was implemented between 11-25 June 2022. The team prepared the report which will be discussed during the monthly meeting in July 2022.

4.2.2 Preparation of Annual Implementation Plan (AIP) 2022

The draft AIP 2022 was submitted to ADB and IAP on 23 February 2022. IAP and ADB provided comments with no objection on 7 and 18 March 2022 respectively. However, BOMU confirmed that the FMM should be finalized first before concluding the AIP2022. EMO submitted an official response to the compiled comments from GOL committees on the final draft of FMM to DOF-MAF on 20 May 2022.

5 FISHERY MONITORING

Four species groups and one species dominated the fish catch by weight in Q2 2022 as listed in **Table** 3-18 *Error! Reference source not found.**5-1.*** All species are classified as Least Concern (LC)

according to the IUCN Red List of Threatened Species[2], except *Sikukia gudgeri* is classified as Data Deficient species (DD) and *Oreochromis niloticus* is an exotic species.

TABLE 5-1: *FISH SPECIES DOMINATING THE FISH CATCH IN Q2 2022*

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Oreochromis niloticus	ปานิน	353.7	LC
Hampala dispar, Hampala macrolepidota	ปาสูด	383.9	LC
Poropuntius normani, Poropuntius laoensis, Poropuntius carinatus	ปาจาด	294	LC
Sikukia gudgeri, Amblyrhynchichthys truncatus	ปาขาวขาย	215.5	DD, LC
Barbonymus gonionotus, Hypsibarbus malcomi, Hypsibarbus vernayi, Hypsibarbus wetmorei	ปาปาก	193.5	LC

The recorded catch of Threatened species (IUCN Red List classification) in Q2 2022 are presented in ***Table 5-2.*** The list includes three species that are classified as Vulnerable species (VU).

Table 5-2*: Threatened Species of Q2 2022 Fish Catch*

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Cirrhinus cirrhosus	ปาแกง/ปามอมจัม	0.5	VU
Scaphognathops bandanensis	ปาวรมไฝ/ปาป่รม	28.8	VU
Tor sinensis	ปาแดง	72.8	VU

The occurrence of Threatened species in the fish catch by quarter since the start of species identification in Q3 2015 is displayed in **Table 5-3**. Based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey, no specimens of *Luciocyprinus striolatus* have been reported since Q4 2018.

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

TABLE 5-3: *OCCURRENCE OF THREATENED SPECIES IN THE FISH CATCH*

Species	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022
Bangana behri (VU)	+	+	+	+	+	+	+	+	+			+	+	+		+												
Cirrhinus cirrhosus (VU)	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+		+		+	+	+	+
*Datnioides undecimradiatus **																+												
Epalzeorhynchos munense (VU)												+																
Luciocyprinus striolatus (EN)	+	+	+	+			+	+	+	+			+	+														
Pangasianodon hypophthalmus (EN)	+																											
Probarbus jullieni (EN)	+	+	+			+		+	+	+		+		+			+	+			+	+				+		
Probarbus labeamajor (EN)				+	+			+																				
Scaphognathops bandanensis (VU	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tor sinensis (VU)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

**Datnioides undecimradiatus* was caught in Mekong by DS households

Species abundance and occurrence is based on the 7-day reported catch from the DCL survey in Q2 2022. The catch is divided in 3 areas including above the main dam, below the main dam and Mekong area. Main biodiversity indicators in Q2 2022 for above dam, below dam and Mekong area are presented in ***Table 5-44*** to explain the diversity of fish. This diversity index (Shannon) explains that the high value means high diversity.

TABLE 5-4*: MAIN BIODIVERSITY INDICATORS FOR Q2 2022*

Biodiversity Indicators	Mekong	Below dam	Above dam
Total species and groups	39	48	45
Single species	28	32	30
Species groups	11	16	15
Top 15 species (% total catch weight)	86.59%	81.86%	89.74%
Proportion for species groups	20.15%	65.69%	41.49%
Diversity index (Shannon)	2.8760	2.9500	2.7511

The mean daily fish catch per household from July 2015 to June 2022 is displayed in ***Figure 5-1*** and the mean fish catch per household per fishing day for Q2 from 2016 to 2022 are shown in ***Table 5-55.***

FIGURE 5-1*: MEAN DAILY FISH CATCH PER HOUSEHOLD FROM JULY 2015 TO JUNE 2022*

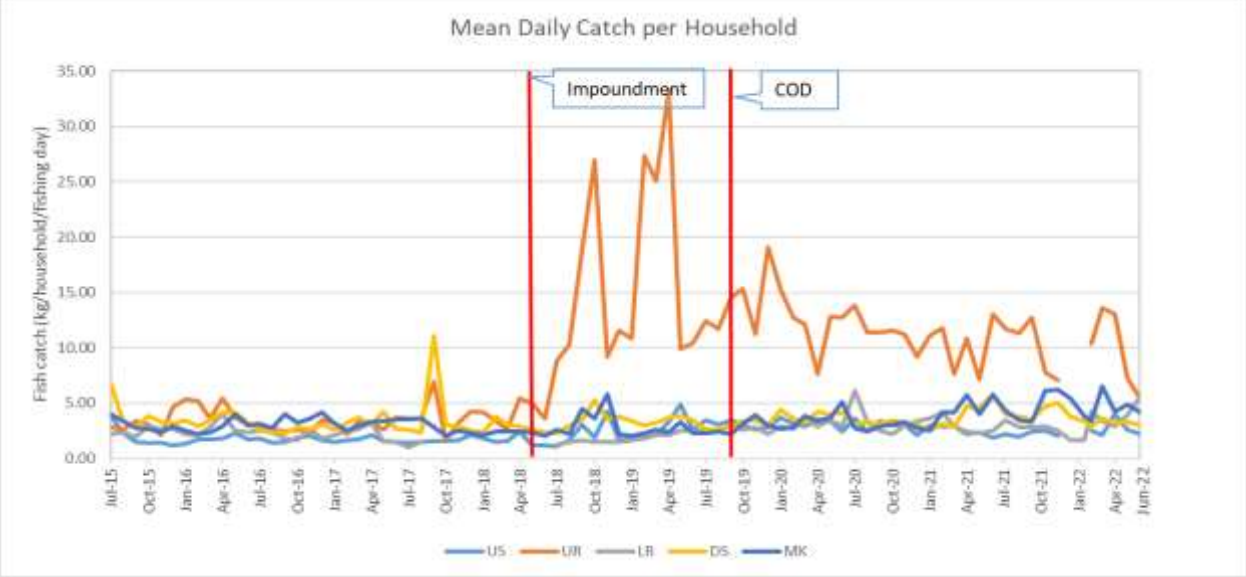


TABLE 5-5*: MEAN DAILY FISH CATCH PER HOUSEHOLD FOR Q2 FROM 2016 TO 2022*

Fishing Zone	Q2 2016 (kg)	Q2 2017 (kg)	Q2 2018 (kg)	Q2 2019 (kg)	Q2 2020 (kg)	Q2 2021 (kg)	Q2 2022 (kg)
Upstream	1.92	1.73	1.61	3.59	3.13	2.14	2.93
Upper reservoir	4.05	3.21	4.66	17.85	11.06	10.34	8.55
Lower reservoir	2.98	2.09	NA	2.37	3.08	2.41	4.13

Fishing Zone	Q2 2016 (kg)	Q2 2017 (kg)	Q2 2018 (kg)	Q2 2019 (kg)	Q2 2020 (kg)	Q2 2021 (kg)	Q2 2022 (kg)
Downstream	3.85	3.35	2.65	3.67	4.10	5.06	3.19
Mekong	3.31	3.39	2.30	2.65	4.06	5.13	4.44

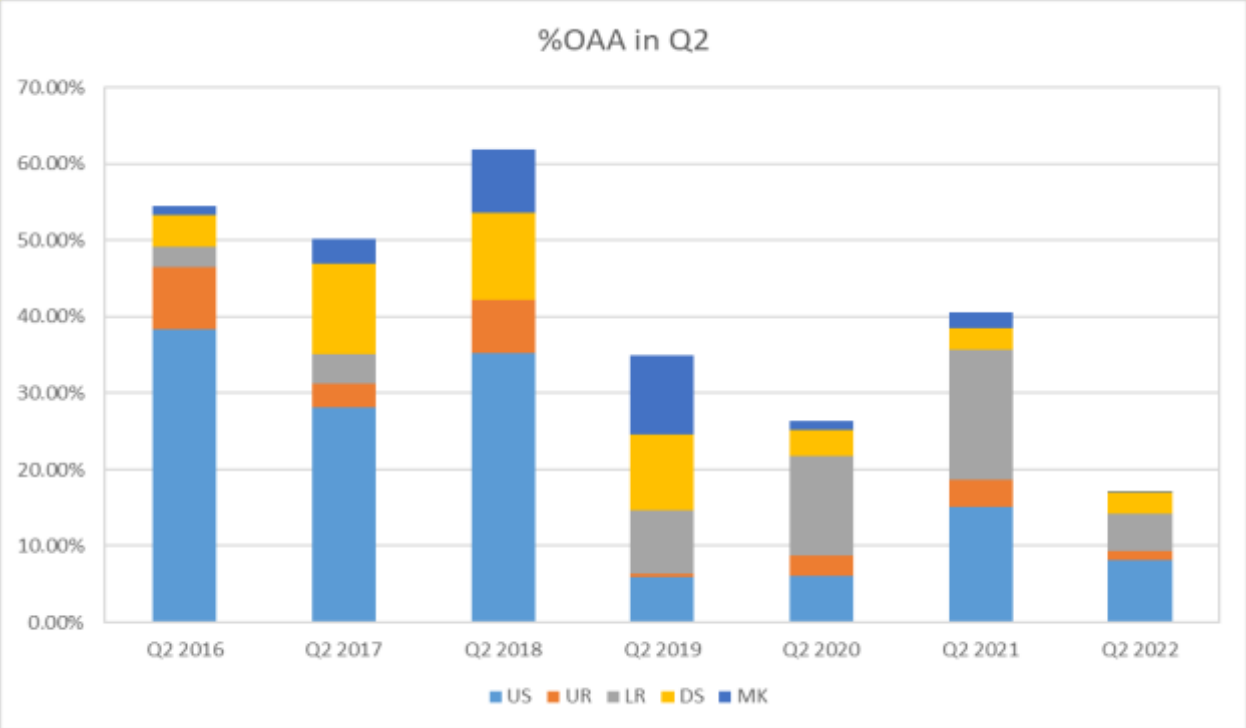
The survey results in Q2 2022 indicate that Nam Ngiep is the main fishing habitat for the upstream and downstream zones, while the main fishing habitat for the upper reservoir, lower reservoir and Mekong zones are the reservoir, tributaries and streams and Mekong respectively. The proportion of fishing habitats in Q2 2022 are displayed in *Error! Reference source not found.**6***.

TABLE 5-6*: PROPORTION OF THE CATCH REPORTED BY MAIN HABITATS (%) IN Q2 2022*

Habitats	US	UR	LR	DS	MK
Mekong	0.0%	0.0%	0.00%	11.94%	86.74%
Nam Ngiep	53.4%	18.2%	0.00%	55.42%	2.08%
Nam Xan	0.0%	0.0%	0.00%	0.00%	0.00%
Reservoir	2.8%	75.2%	41.67%	0.00%	0.00%
Tributary and stream	43.4%	6.1%	54.69%	28.95%	0.50%
Wetland	0.4%	0.5%	3.65%	1.91%	10.68%
Others	0.0%	0.0%	0.00%	1.78%	0.00%

Total reported fish and other aquatic animal (OAA) catch (proportion of OAA) for the same 7-day period in Q2 from 2016 to 2022 are shown in ***Figure 5-12.***

FIGURE 5-2*: PROPORTION OF OAA TO THE TOTAL REPORTED KILOGRAM (KG) OF FISH AND OAA FOR A 7-DAY PERIOD BY FISHING ZONE IN Q2 FROM 2016 TO 2022*



6 Health and Safety

6.1 Related to NNP1PC Health and Safety

A summary of the safety incidents reported during the Construction Phase (up to the end of August 2019) are provided in the *Q4 2020 Environmental Monitoring Report (October to December 2020)*.

A summary of the safety incidents reported during the Operation Phase (September 2019 to June 2022) are provided in **Table 6-1.**

Table 6-1: ***Safety Incidents Reported during the Operation Phase (September 2019 to June 2022)***

Type of Incidents	LTI	RI	NM	PD	FI	MVI	Total
No. of Incidents in Q2 2022	0	0	0	0	0	0	0
Cumulative Total Incidents to 30 Jun 2022	0	3	0	0	0	1	4

LEGEND:
- LTI - Lost Time Incident
- RI - Recordable Injury[3]
- NM - Near Miss
- PD - Property Damage
- FI - Fire Incident
- MVI - Motor Vehicle Incident

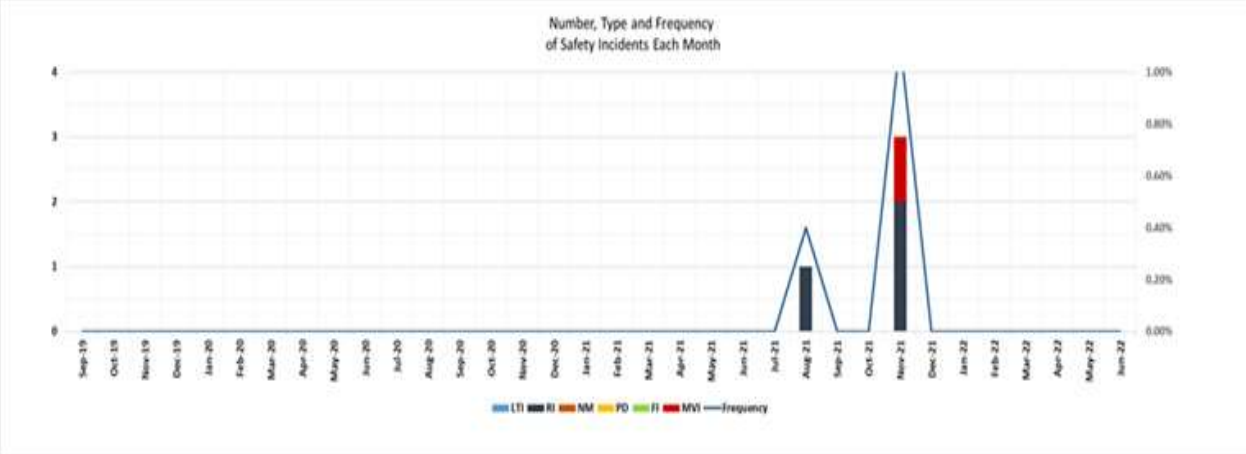
There was no incident or accident reported in Q2 2022.

The histogram below in ***Figure 6-1Error! Reference source not found.*** shows the number of reported incidents occurring in each month since the Operation Phase (September 2019) with the colour indicating the type of incident including near misses. The graph superimposed on the histogram shows the frequency of incidents, including reported near misses, with the number of incidents occurring each month expressed as a percentage of the total number of Project workers employed in each month being the total man-months.

All reported incidents that have involved the Owner and its Contractors and Subcontractors are included in the histogram and shown graphically below. At the end of June 2022, the total number of people employed on Site was 304.

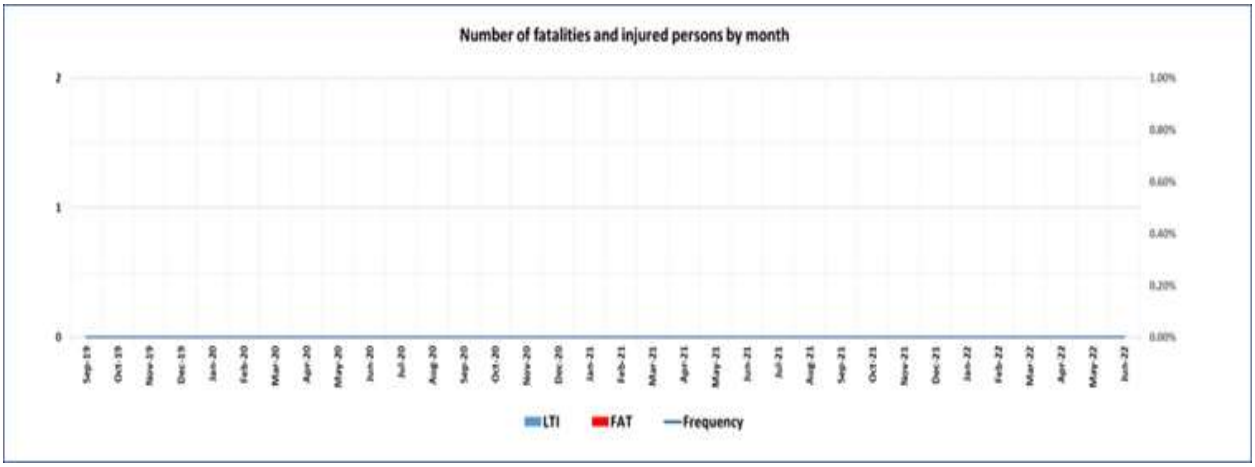
[3] An **injury** or illness is **recordable** if it involves restricted work or transfer to another job. An employee is said to be on "restricted work" when he or she is unable to perform one or more routine functions of the job, beginning on the day after the **injury** or illness occurs

FIGURE 6-1 : ***NUMBER, TYPE AND FREQUENCY OF SAFETY INCIDENTS DURING SEPTEMBER 2019 TO 30 JUNE 2022***



The second histogram in ***Figure 6-2*** shows none of persons who were injured, or lost their lives in the reported Lost Time Incidents during September 2019 to 30 June 2022.

FIGURE 6-2 : ***NUMBER OF FATALITIES AND INJURED PERSONS TO 30 JUNE 2022***



Approximately:

[Incidents = Accidents (with injury) + Near Misses + Other Incidents (with damage, no injury)]

6.1.1 Health and Safety Training and Emergency Drills

During the second quarter 2022, NNP1PC Technical Division emergency response team conducted an Emergency Evacuation Training and Drills on flooding event on 1 and 2 June, 2022 at the NNP1 OSOV and the main power station.

FIGURE 6-3: ***EMERGENCY EVACUATION TRAINING AND DRILLS ON 1 AND 2 JUNE 2022***

6.2 RELATED TO COVID-19

Due to confirmed internal cases of COVID-19 in April 2021 in Laos and following Government of Laos' countermeasure, NNP1PC locked down the site offices. The OSOV1 and OSOV2 have been closed off to outsiders and no external site visit was allowed. COVID-19 countermeasures such as physical distancing, practicing personal hygiene by frequent washing hands with alcohol-based gel, mask wearing in the work place as well as avoiding mass gathering, and limiting physical meeting are encouraged. This lockdown of OSOV1 and OSOV2 - with some relax restriction such as subject to prior approval staff are allowed to return home but need to be self-quarantined when they return to work - has still in place to ensure safe operation of the Project.

In early January 2022, the first COVID-19 cases were confirmed at NNP1 Project site. In April 2022, there were 17 confirmed COVID-19 cases in NNP1 Project. Ten were onsite and seven were in the Vientiane Office. Out of the total number, three were contractors onsite and one trainee at the Vientiane Office. By the end of April 2022, there was no active COVID-19 case in NNP1PC.

The Government of Laos issued announced on 9 May 2022 to ease restriction on COVID-19 preventive measures and allowed unrestricted access to Laos without self-quarantine for all arrivals to Laos if they have fully vaccinated. As a result, NNP1PC ended camp isolation from May 13th, 2022 until further notice, however, preventive measures such as social distancing, mask wearing and practicing personal hygiene will continue in NNP1PC. In May 2022, there was no reported COVID-19 cases in NNP1PC. In June 2022, NNP1PC reported one COVID-19 case onsite involving one foreign contractor who returned from an overseas trip and there was no close contract was made with this case.

6.2.1 NNP1PC COVID-19 Measures

Based on the latest Government of Lao PDR announcement No. 130/PMO dated 3 February 2022 on COVID-19 preventive, control, and containment measures during the new phase of the pandemic, (the "Latest PM Order"), the isolation of OSOV1 and OSOV2 has been extended only until the middle of May 2022. The general preventive measures that are being continuously implemented are as follow:

- All staff are requested to strictly follow preventative measures against COVID-19 such as:
  - getting vaccinated as soon as possible following Governmental guidance on vaccination;
  - keeping physical distance of at least 1 meter from others, even if they don't appear to be sick;

- avoiding the 3Cs, spaces that are closed, crowded or involve close contact;
- wearing a properly fitted mask when physical distancing is not possible and in poorly ventilated settings;
- cleaning your hands frequently with alcohol-based hand rub or soap and water;
- covering your mouth and nose with a bent elbow or tissue when you cough or sneeze. Dispose of used tissues immediately and clean hands regularly; and
- self-isolating until recovery in case of any symptoms or tested positive for COVID-19.

- A disposable medical face mask will be provided for each staff every day and more as appropriate upon agreement by the supervisor for high-risk staff who need to be working with local communities/contact with external stakeholders. Appropriate disposal in the bin is required to avoid possible infection;
- NNP1PC's essential activities such as operation and maintenance of power facilities, social and environmental activities and others can be conducted where permissible by GOL and communities by following GOL's preventative measures strictly;
- Staff have to continuously check their own body temperature using a thermometer provided at the entrance of OSOV1 and OSOV2 at least once a day; and
- Paramedics stationed at the site clinic have to provide a thermometer and body temperature record sheet for self-quarantine and/or self-isolated personnel.

6.2.2 Overview of NNP1PC COVID-19 Measures related to NNP1PC project implementation and monitoring program

Workplace risk assessment	
• The exposure risk for NNP1PC entities (employee, consultant, contractor, sub-contractor) during the increased COVID-19 cases which was started in April 2021 is defined based on the WHO Guideline (2020)[4] that is "medium exposure risk". • The medium exposure risk means that jobs or work tasks with close, frequent contact with the general public, or other co-workers, visitors, clients or customers, or contractors, but that do not require contact with people known to be or suspected of being infected with COVID-19. In areas where COVID-19 cases continue to be reported, this risk level may be applicable to workers who have work-related frequent and close contact with the general public, visitors, or customers in high-population-density work environments (e.g., food markets, bus stations, public transport, and other work activities where physical distancing of at least 1 m may be difficult to observe), or work tasks that require close and frequent contact between co-workers. In areas without community transmission of COVID-19, this scenario may include frequent contact with persons returning from areas with community transmission.	
Risk	**Preventive measures**

[4] Annex to Considerations for public health and social measures in the workplace in the context of COVID-19. WHO (10 May 2020)

Job or work tasks with close or frequent contact in the area where COVID-19 continue to be reported or contact with persons returning from area with community transmission	• Based on the latest Government of Lao PDR announcement No. 130/PMO dated 3 February 2022 on COVID-19 preventive, control, and containment measures during the new phase of the pandemic, (the "Latest PM Order"), the isolation of OSOV1 and OSOV2 has been extended from 23 February 2022 until the middle of May 2022 when the GOL announced to ease restriction on COVID-19 preventive measures and allowed unrestricted access to Laos without self-quarantine for all arrivals to Laos if they have fully vaccinated. • In case of infection, a report will be made to Bolikhan District COVID-19 Committee and the case will be treated at OSOV1 or at home if requested by staff who meet the GOL's conditions for home treatment and approved by the DMD in consultation with the NNP1 COVID-19 Committee and local village authorities for the nearby Villages.
Impact on NNP1 project and OHS	**Mitigation**
• The country wide lockdown measures following PM Order No. 15/PM dated 21 April 2021 is being implemented since 21 April 2021 as well as PM Order No. 130/PMO dated 3 February 2022 on COVID-19 preventive, control, and containment measures during the new phase of the pandemic might impacting the continuation some project implementation activities.	• The project activities within the project area with COVID-19 low-risk of community transmission continues to progress such as Dam operation and maintenance work; EMO environmental monitoring work within the NNP1 reservoir; or SMO livelihood centre operation. • Close coordination with relevant GOL committees related with COVID-19 measures for the implementation and monitoring activities. • Any continuation of project implementation and monitoring activities especially for the field work must comply NNP1PC COVID-19 measures and any with applicable guidelines.
• The site lockdown between April 2021 to middle of May 2022 might impact psychological state of site residents	• NNP1PC COVID-19 measures during this lockdown allow the site residents to leave their respective site in case of emergency such as accidents, health and family related issues and other requests as found reasonable by respective management. • NNP1PC COVID-19 measures during this lockdown period allow for social

	events/gathering but for less than 20 people with mask-wearing and social distancing of at least one meter must be ensured.

Lockdown schedule	Impact on NNP1PC project implementation and monitoring activities		
	TD	SMO	EMO
01 October – until further notice (Ref: PM Order No.1036/PMO dated 19 August 2021, PM Order No. 1094/PMO dated 31 August 2021, and PM Order No. 1177/PMO dated 15 September 2021; PM Order No. 1330/PMO dated 15 October 2021, and PM Order No. 1494/PMO dated 14 November 2021) PM Order No. 130/PMO dated 3 February 2022	No impact on the overall power generation and maintenance work.	To be reported in the SMO Bi-annual Progress Report.	• No impact on EMO environmental monitoring program. • Relevant GOL committees in Xaysomboun and Bolikhamxay confirmed that the implementation activities under watershed and biodiversity monitoring could resume except for further instruction in case of COVID-19 infections.

6.2.3 General situation of COVID-19 in NNP1PC

- Vaccination Rate of NNP1PC staff as of October 2021 – 100%
- Number of positive tests of NNP1PC staff on site in Q2, 2022 – 12 cases

7 External missions and visits

A GOL delegation from Xaysomboun Provincial Offices of Natural Resources and Environment (PONRE) and the EMUs from Thathom and Hom Districts, Xaysomboun Province, conducted a quarterly monitoring mission during 31 May – 1 June 2022 on the reservoir and in Zone 2UR. The GOL did not raise any major comments during the mission.

The priority actions recommended by ADB, IAP, and LTA during the mission in November 2021 are updated and reported separately to ADB, IAP and LTA for review and comments.

APPENDICES

APPENDIX 1: STATUS OF DOCUMENTS REVIEW AND APPROVAL DURING Q2 2022

No	Site name	Document Name	Contractor / Subcontractor	Approval Status by EMO/NNP1 (date)	Detailed Site Information	Monthly Construction & Operation Status as of 30 June 2022
1	NNP1PC's Operation Sites	DWP SS-ESMMP for Maintenance Works 2022	PK Construction Sole Co., Ltd.	2nd submission on 04 May 2022 - No objection with no comments on 04 May 2022.	NNP1PC's operation site's facilities maintenance	In progress
2	Main Dam and Contractor Camp	Site Decommissioning Plan	KENBER Geotech (THAILAND) Co., Ltd.	3rd submission on 28 June 2022 - No objection with no further comment on 30 June 2022.	Main Dam Grouting works	Completed/ **Site closed**

APPENDIX 2: ENVIRONMENTAL MONITORING CORRECTIVE ACTIONS Q4 2021

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow- up Date	Status
1	NCR01/ 2022	13.02.2022	OSOV1 & OSOV2	The Waste Water Treatment Systems at three main operation sites (OSOV1, OSOV2 and Main Powerhouse) are fully operated for almost three months since a significant improvement and modification completed in September 2021. After closely monitoring on their effluents, it is observed some monitoring parameters are sometimes exceeded the effluent guidelines.	- Proper fencing installation to prevent the cattle's encroachment in the OSOV1 wetlands' ponds. - Additional planting of reeds in the OSOV1 wetlands' ponds. - Adding the proper sludges/seeds into the Aeration Tank at OSOV2 WWTS and the Biofilm Septic Tank at the Main Powerhouse System. - Replacing the detergent materials in the Main Powerhouse by using lower Phosphate detergent. - Closely monitor the Residual Chlorine content in the effluents of OSOV2 and the Main Powerhouse WWTS and adjust as necessary. - Closely monitor the Influent to compare with the Effluent for the specific parameters to check their treatment effectiveness.	30.04.2022	30.06.2022 (Carried over from Q1 2022, planned to be resolved by Q4 2022)	**In progress** 1). Adding the proper sludges/seeds into the Aeration Tank at OSOV2 WWTS and the Biofilm Septic Tank at the Main Powerhouse System has reduced the concentrations of nitrogen and phosphorus in the effluent. However, it is found that the system does not generate sludge in the amounts under the design specifications. **Adding Sludge is under preparation** 2). Monitoring and adjusting the bacteria seeding process will continue. 3). Monitoring of the influent and the effluent to check the treatment effectiveness will continue.

APPENDIX 3: SITE CODES, LOCATIONS, MONITORING PARAMETERS AND ITS MAP OF THE SURFACE WATER QUALITY MONITORING

SITE CODES AND LOCATION STATION FOR SURFACE WATER QUALITY MONITORING

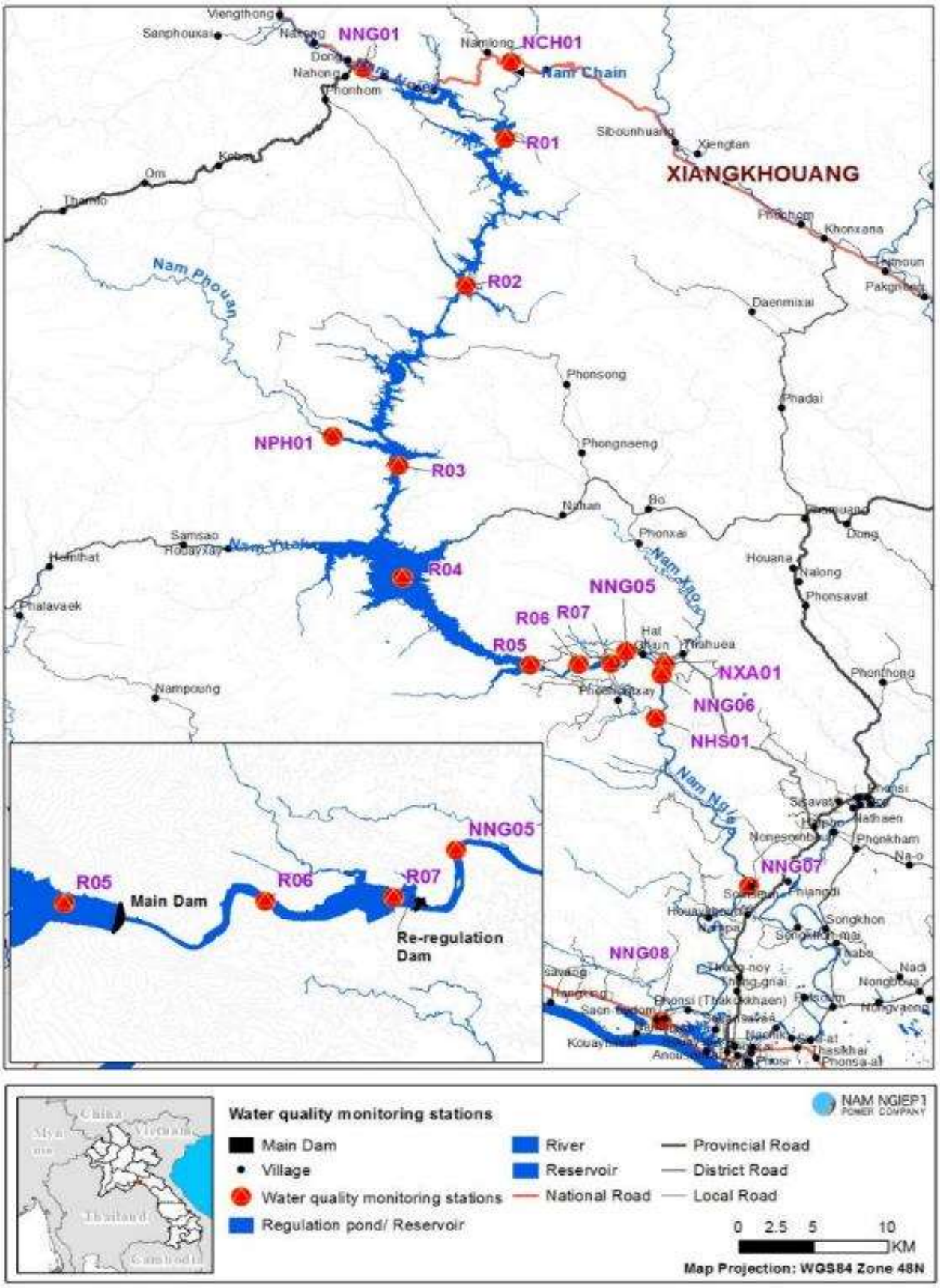
Site Code	Location station	Zone
NNG01	Nam Ngiep Upstream of Phiengta Village	Upstream Project Construction Site
R01	Main reservoir upstream main dam approx. 50 Km.	
R02	Main reservoir upstream main dam approx. 35 Km.	
NNG02/R03	Nam Ngiep Upstream of Nam Phouan Confluence / Main reservoir upstream main dam approx. 21 Km.	
NNG03/R04	Nam Ngiep Downstream of Sopyouak Village/ Main reservoir upstream main dam approx. 13 Km.	
NNG09/R05	Nam Ngiep Upstream Main Dam / Main reservoir upstream main dam approx. 0.5 Km	
NNG04 / R06	Nam Ngiep Downstream RT Camp (Middle Re-regulation Reservoir)	Within Project Construction Site
R07	Reservoir Upstream Re-Regulation Dam	
NNG05	Nam Ngiep Upstream of Hat Gniun Village	Downstream Project Construction Site
NNG06	Nam Ngiep Downstream of Nam Xao Confluence	
NNG07	Nam Ngiep at Somsuen Village	
NNG08	Nam Ngiep at the Bridge of Road 13	
NCH01	Nam Chiane at the Bridge of Road 1D	Tributaries Upstream of Project Construction Site
NPH01	Nam Phouan Upstream of Nam Ngiep Confluence	
NXA01	Nam Xao Upstream of Nam Ngiep Confluence	Tributaries Downstream of Project Construction Site
NSH01	Nam Houay Soup Upstream Nam Ngiep Confluence	

MONITORING FREQUENCY FOR SURFACE WATER QUALITY PARAMETERS

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Weekly	pH, DO (%), DO (mg/L), Conductivity (µs/cm), Temperature (°C), Turbidity (NTU).	- Main Reservoir: R01, R02, R03, R04, R05; - Nam Ngiep downstream: NNG05, NNG06, NNG07 and NNG08; - Tributaries: Nam Phouan [NPH01], Nam Xao [NXA01] and Nam Houay Soup [NHS01].
Fortnightly	pH, DO (%), DO (mg/L), Conductivity (µs/cm), Temperature (°C), Turbidity (NTU)	All stations

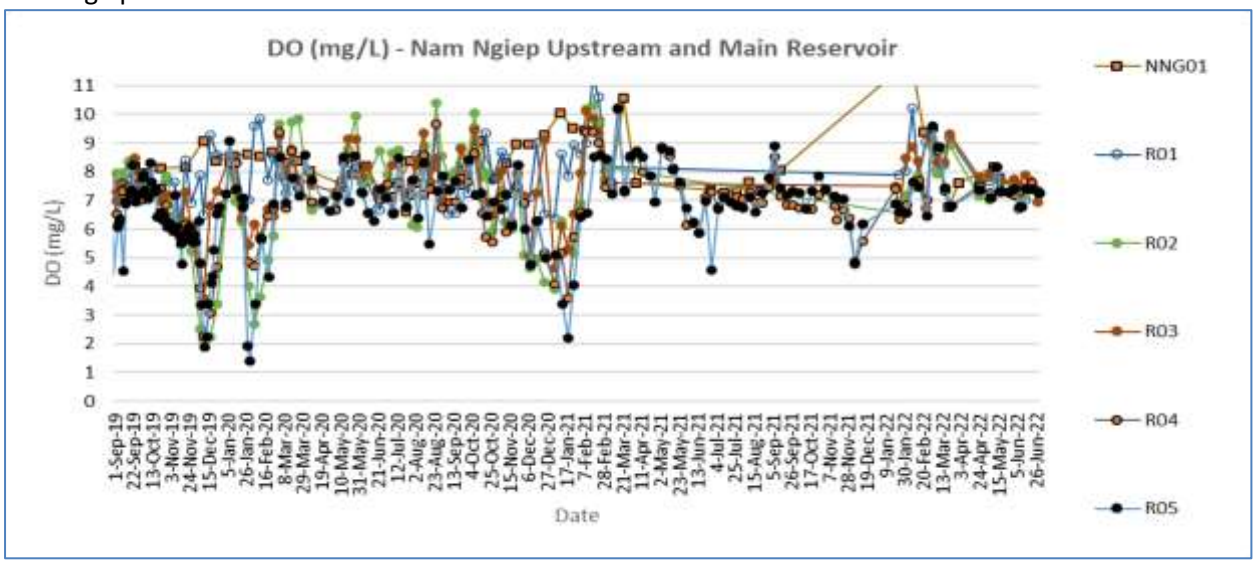
Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Monthly	TSS (mg/L), BOD_5 (mg/L), COD (mg/L), NH_3-N (mg/L), NO_3-N (mg/L), total coliform (MPN/100 mL), faecal coliform (MPN/100 mL), Hydrogen sulphide (mg/L), Phytoplankton biomass, TOC and TKN.	As per ESMMP-OP.

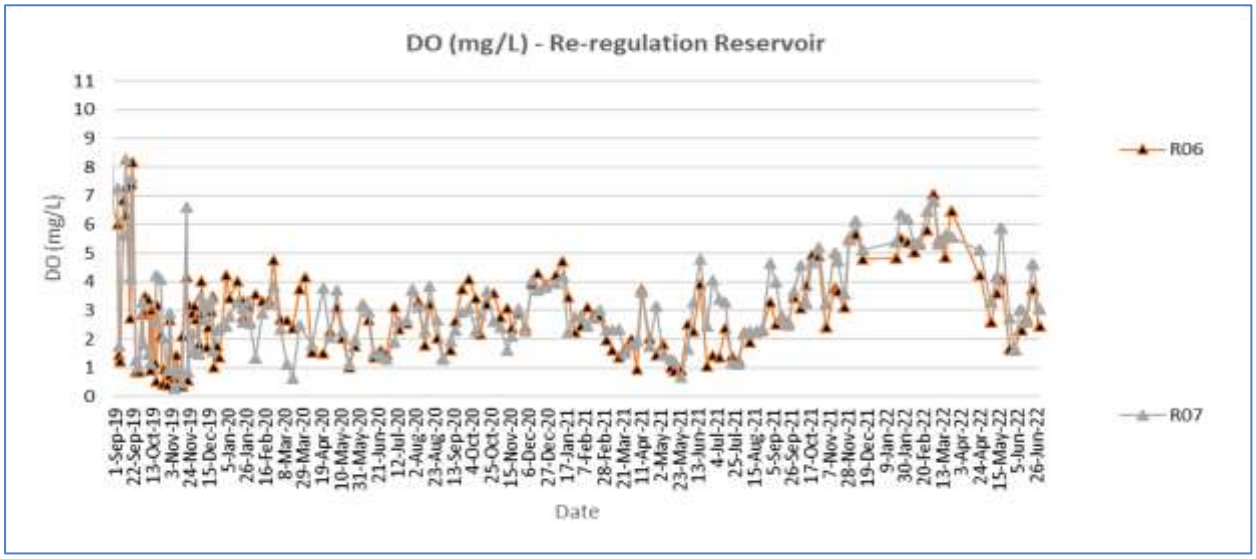
SURFACE WATER QUALITY MONITORING LOCATIONS

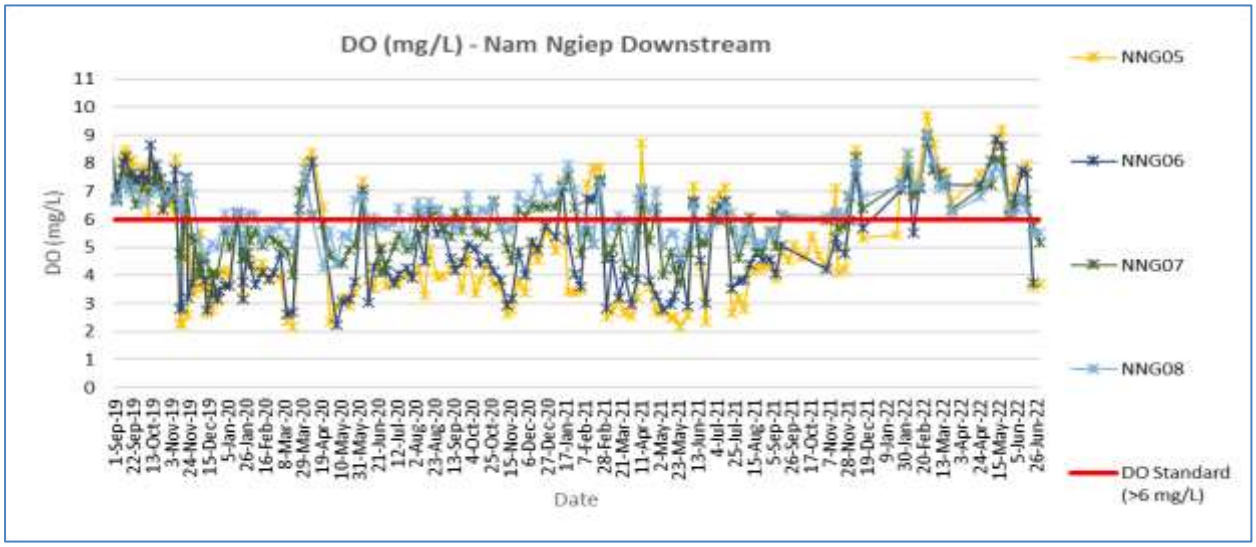


APPENDIX 4: KEY TRENDS OF WATER QUALITY MONITORING FROM JANUARY 2020 TO END OF JUNE 2022 (ONLY PARAMETERS THAT EXCEEDED THE STANDARDS)

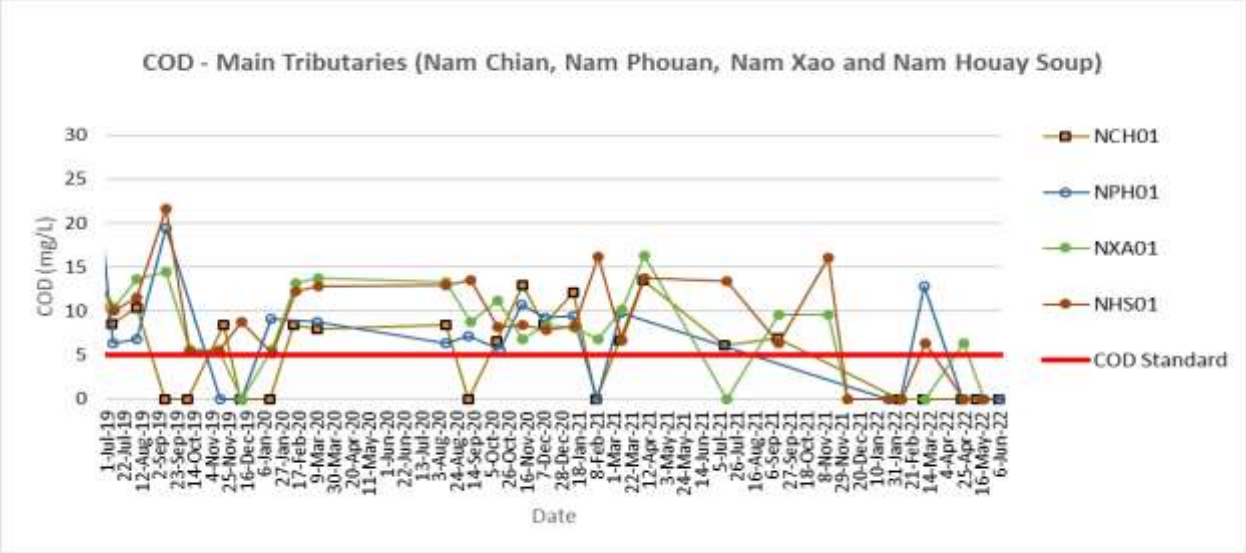
Nam Ngiep Surface Water

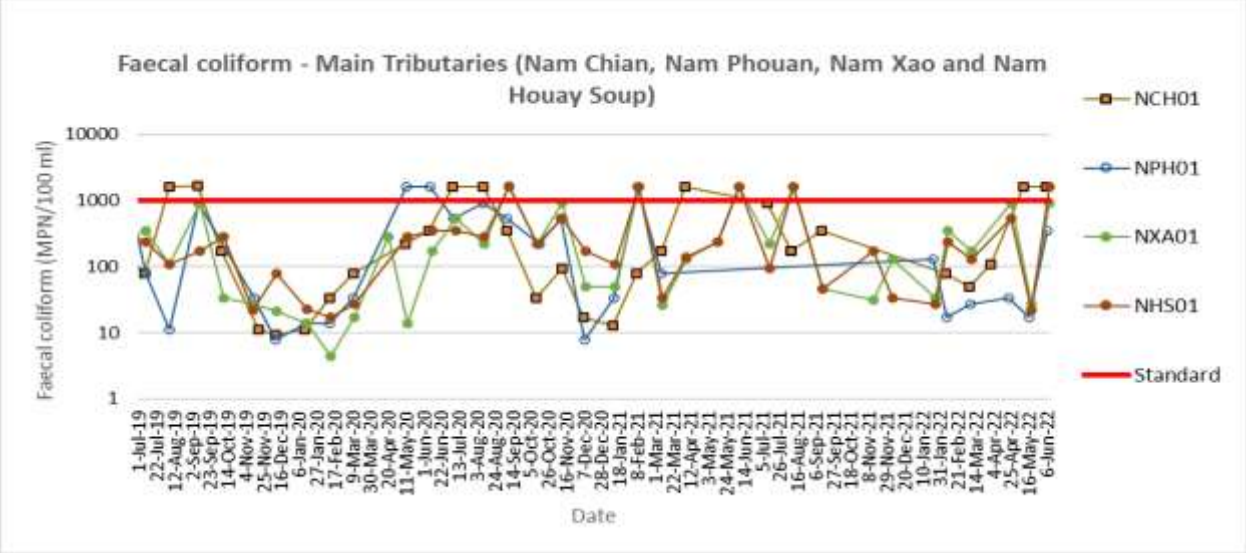




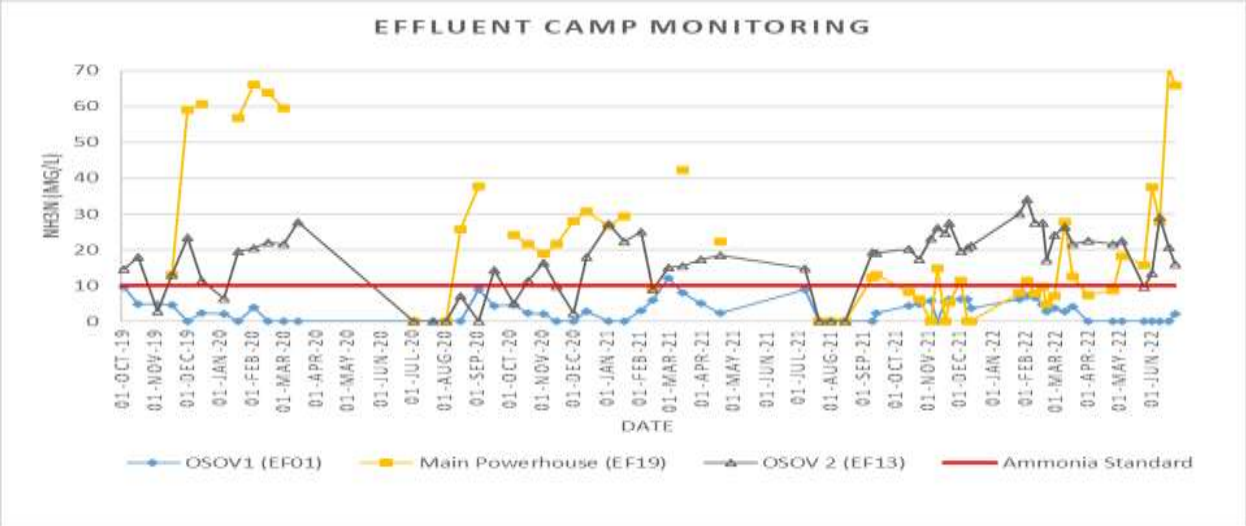


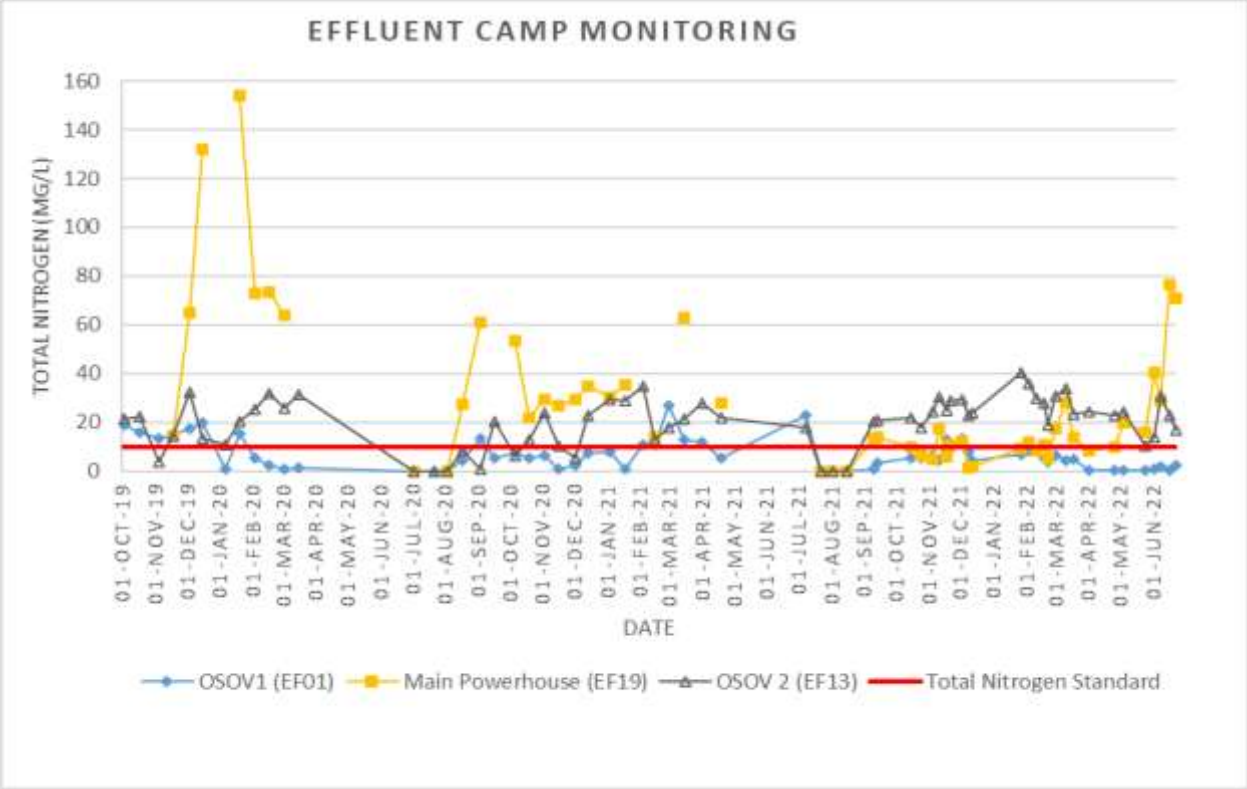
Key Water Quality Parameters for the Nam Ngiep Tributaries: Nam Chian, Nam Phouan, Nam Xao, Nam Houay Soup

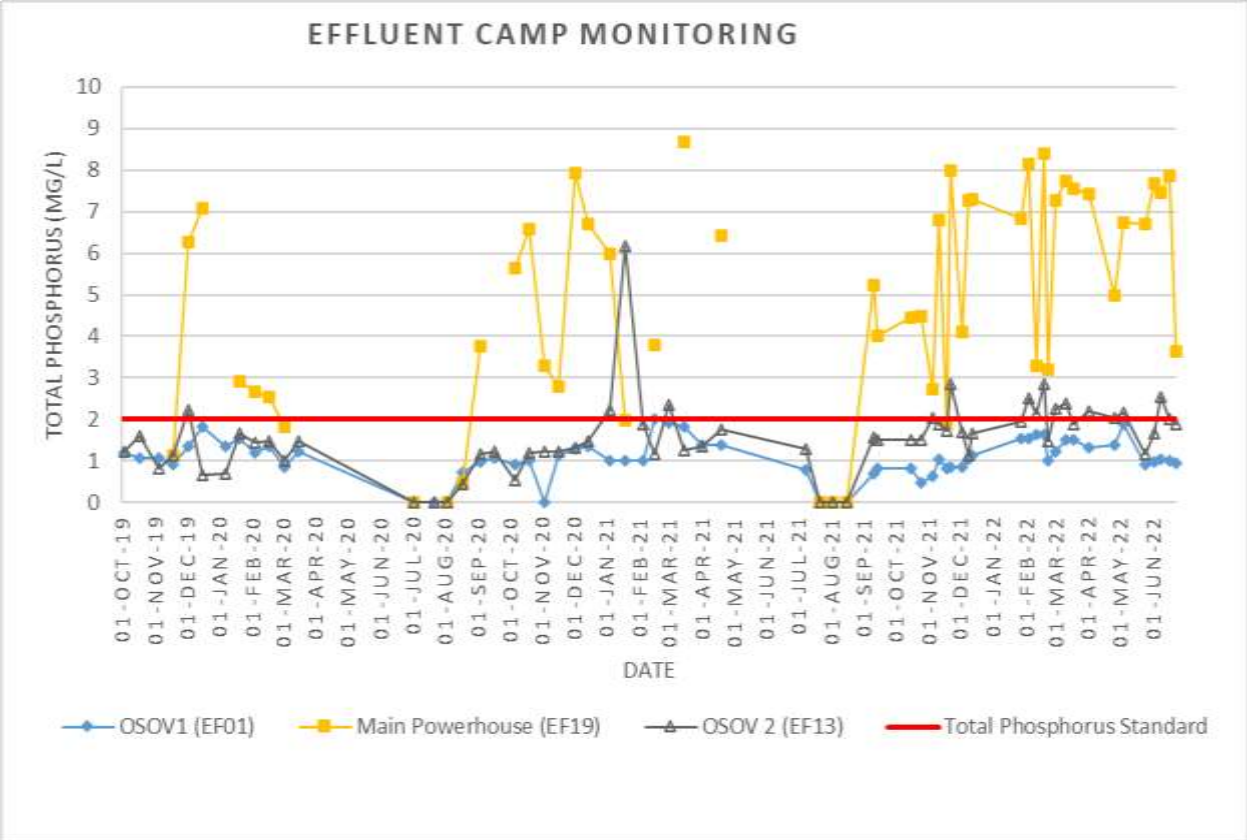


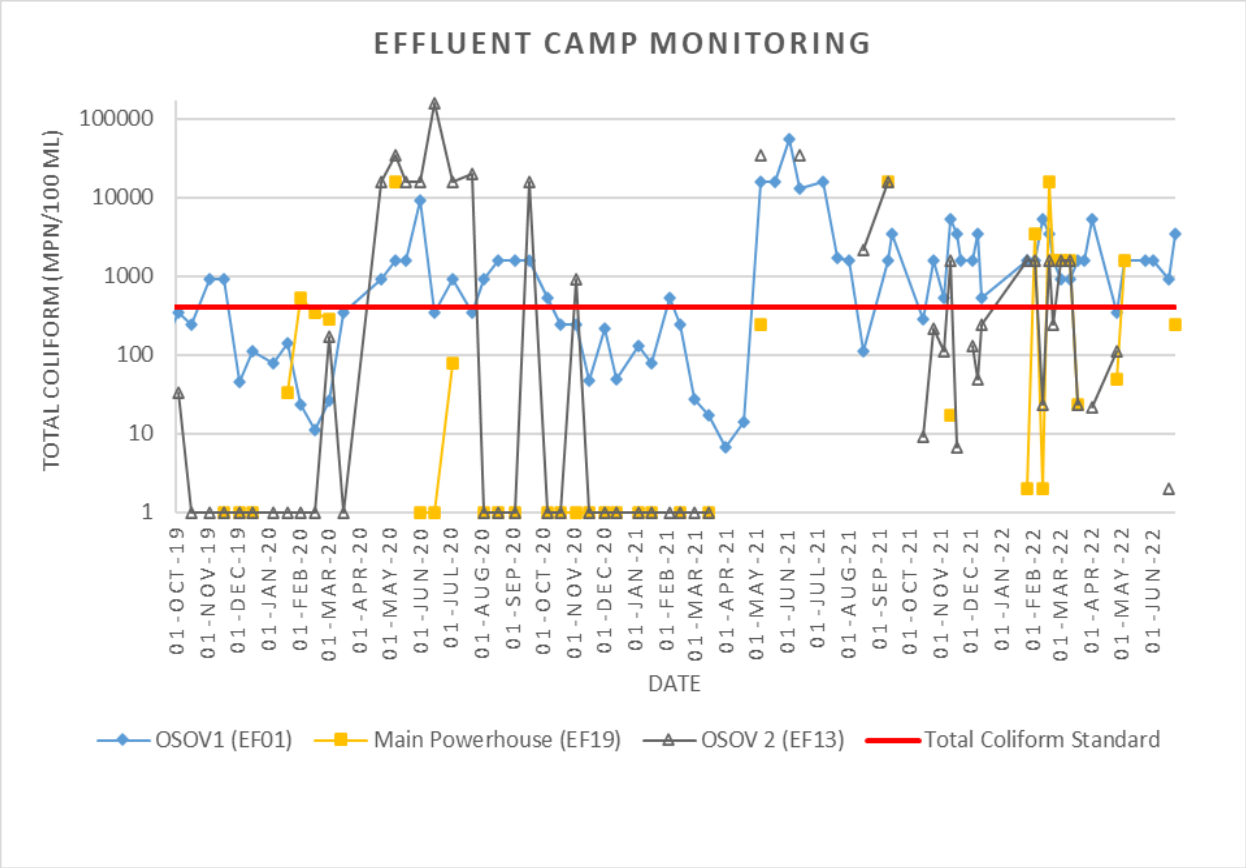


Camps' Effluent Water Quality Trends (Since October 2019 – June 2022)




EFFLUENT CAMP MONITORING
TOTAL NITROGEN (MG/L)
160
140
120
100
80
60
40
20
0
01-OCT-19
01-NOV-19
01-DEC-19
01-JAN-20
01-FEB-20
01-MAR-20
01-APR-20
01-MAY-20
01-JUN-20
01-JUL-20
01-AUG-20
01-SEP-20
01-OCT-20
01-NOV-20
01-DEC-20
01-JAN-21
01-FEB-21
01-MAR-21
01-APR-21
01-MAY-21
01-JUN-21
01-JUL-21
01-AUG-21
01-SEP-21
01-OCT-21
01-NOV-21
01-DEC-21
01-JAN-22
01-FEB-22
01-MAR-22
01-APR-22
01-MAY-22
01-JUN-22
DATE
OSOV1 (EF01)
Main Powerhouse (EF19)
OSOV 2 (EF13)
Total Nitrogen Standard


EFFLUENT CAMP MONITORING
TOTAL PHOSPHORUS (MG/L)
10
9
8
7
6
5
4
3
2
1
0
01-OCT-19
01-NOV-19
01-DEC-19
01-JAN-20
01-FEB-20
01-MAR-20
01-APR-20
01-MAY-20
01-JUN-20
01-JUL-20
01-AUG-20
01-SEP-20
01-OCT-20
01-NOV-20
01-DEC-20
01-JAN-21
01-FEB-21
01-MAR-21
01-APR-21
01-MAY-21
01-JUN-21
01-JUL-21
01-AUG-21
01-SEP-21
01-OCT-21
01-NOV-21
01-DEC-21
01-JAN-22
01-FEB-22
01-MAR-22
01-APR-22
01-MAY-22
01-JUN-22
DATE
OSOV1 (EF01)
Main Powerhouse (EF19)
OSOV 2 (EF13)
Total Phosphorus Standard


EFFLUENT CAMP MONITORING
TOTAL COLIFORM (MPN/100 ML)
100000
10000
1000
100
10
1
01-OCT-19
01-NOV-19
01-DEC-19
01-JAN-20
01-FEB-20
01-MAR-20
01-APR-20
01-MAY-20
01-JUN-20
01-JUL-20
01-AUG-20
01-SEP-20
01-OCT-20
01-NOV-20
01-DEC-20
01-JAN-21
01-FEB-21
01-MAR-21
01-APR-21
01-MAY-21
01-JUN-21
01-JUL-21
01-AUG-21
01-SEP-21
01-OCT-21
01-NOV-21
01-DEC-21
01-JAN-22
01-FEB-22
01-MAR-22
01-APR-22
01-MAY-22
01-JUN-22
DATE
OSOV1 (EF01)
Main Powerhouse (EF19)
OSOV 2 (EF13)
Total Coliform Standard

APPENDIX 5: WATER QUALITY MONITORING DATA
APPENDIX 5-1: SURFACE WATER QUALITY MONITORING – Q2 2022

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream				Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01		NPH 01		NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																		
1-Apr-22	pH	5.0 - 9.0	7.23												7.24					
23-Apr-22	pH	5.0 - 9.0		6.63	6.69	7.24											6.87			
24-Apr-22	pH	5.0 - 9.0					6.88	6.79	6.79	6.7										
25-Apr-22	pH	5.0 - 9.0									6.87	7	6.83	6.88					6.09	7.05
5-May-22	pH	5.0 - 9.0		7.01	7.07	7.26											7.15			
6-May-22	pH	5.0 - 9.0					7.82	7.73	7.37	7.45										
7-May-22	pH	5.0 - 9.0									7.43	7.55	7.6	7.66					7.58	7.61
10-May-22	pH	5.0 - 9.0	7.7												7.8					
12-May-22	pH	5.0 - 9.0						7.47	7.37	7.36										
13-May-22	pH	5.0 - 9.0									7.45	7.39	7.46	7.19					7.5	7.47
16-May-22	pH	5.0 - 9.0	6.65												6.6					
17-May-22	pH	5.0 - 9.0		6.89	6.72	6.83											7.05			
18-May-22	pH	5.0 - 9.0					6.92	6.86	6.78	6.84										
19-May-22	pH	5.0 - 9.0									6.92	6.94	6.88	6.98					6.94	6.85
27-May-22	pH	5.0 - 9.0					6.92	6.87	6.85	6.86										
28-May-22	pH	5.0 - 9.0									7.01	6.95	6.93	6.96					6.93	6.95
1-Jun-22	pH	5.0 - 9.0		7.44	7.49	7.81											7.4			
2-Jun-22	pH	5.0 - 9.0					6.98	6.9	7.05	6.99										
3-Jun-22	pH	5.0 - 9.0									6.92	6.89	6.74	6.77					6.88	6.83
6-Jun-22	pH	5.0 - 9.0	7.38												7.44					
7-Jun-22	pH	5.0 - 9.0		7.47	7.5	7.69											7.37			
8-Jun-22	pH	5.0 - 9.0					7.65	6.97	7.13	7.18										

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
10-Jun-22	pH	5.0 - 9.0									7.4	7.34	7.42	7.35			7.45	7.33
14-Jun-22	pH	5.0 - 9.0		7.23	7.53	7.01										6.98		
15-Jun-22	pH	5.0 - 9.0					6.9	6.89	7.04	7.03								
16-Jun-22	pH	5.0 - 9.0									7.07	7.2	7.09	7.08			7.12	7.07
20-Jun-22	pH	5.0 - 9.0	7.26												7.28			
21-Jun-22	pH	5.0 - 9.0		6.94	7.04	7.3										7.25		
22-Jun-22	pH	5.0 - 9.0					7.13	6.91	6.86	6.72								
23-Jun-22	pH	5.0 - 9.0									6.82	6.72	6.66	6.68			6.7	6.78
28-Jun-22	pH	5.0 - 9.0		7.12	7.35	7.75										7.12		
29-Jun-22	pH	5.0 - 9.0					7.71	7.32	7.06	6.92								
30-Jun-22	pH	5.0 - 9.0									6.95		6.9	6.88			6.93	6.92
1-Apr-22	Sat. DO (%)		92.9												88.7			
23-Apr-22	Sat. DO (%)			96.7	92.3	100										96.6		
24-Apr-22	Sat. DO (%)						97.3	94.5	55.3	66.9								
25-Apr-22	Sat. DO (%)										91.1	87.2	87.2	86.9			78.3	82.2
5-May-22	Sat. DO (%)			95.2	91.5	102.6										95.4		
6-May-22	Sat. DO (%)						93.7	90.9	31.3	42.4								
7-May-22	Sat. DO (%)										96.9	96.9	87.9	93.4			79.7	79.9
10-May-22	Sat. DO (%)		98.4												106.6			
12-May-22	Sat. DO (%)							105.8	42.8	50.3								
13-May-22	Sat. DO (%)										102.7	106	98.2	95.6			89.1	81.2
16-May-22	Sat. DO (%)		94.5												99.9			
17-May-22	Sat. DO (%)			91.5	94.4	99.2										97.2		
18-May-22	Sat. DO (%)						95.2	93.5	49.3	75								
19-May-22	Sat. DO (%)										112	104.9	100.8	99.2			84.2	92.4

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
27-May-22	Sat. DO (%)						95	94	19.6	32.9								
28-May-22	Sat. DO (%)										76.6	74.8	74.5	76			89.2	74.8
1-Jun-22	Sat. DO (%)			88.3	97.3	101										91.7		
2-Jun-22	Sat. DO (%)						93.8	95.2	19.7	19.7								
3-Jun-22	Sat. DO (%)										87.9	81.8	79.2	75.9			80	76.1
6-Jun-22	Sat. DO (%)		92.4												90.1			
7-Jun-22	Sat. DO (%)			81.2	92.6	100.7										89.1		
8-Jun-22	Sat. DO (%)						94.6	86.3	27.9	36.5								
10-Jun-22	Sat. DO (%)										92.1	94	83.6	84.6			79.6	81.2
14-Jun-22	Sat. DO (%)			87.2	96.6	105										91.7		
15-Jun-22	Sat. DO (%)						96.8	96.1	32.6	31.2								
16-Jun-22	Sat. DO (%)										96.1	92.5	81.2	77.1			79.6	78
20-Jun-22	Sat. DO (%)		90.4												92.9			
21-Jun-22	Sat. DO (%)			93.1	100.2	102.7										94.1		
22-Jun-22	Sat. DO (%)						102.3	97.2	46.6	61.8								
23-Jun-22	Sat. DO (%)										42.9	45.3	70.9	67.9			80.9	76.7
28-Jun-22	Sat. DO (%)			92.6	93.3	93.5										89.7		
29-Jun-22	Sat. DO (%)						97.1	95.9	29.7	37.5								
30-Jun-22	Sat. DO (%)										44.9		63.4	68.7			83.8	85.5
1-Apr-22	DO (mg/L)	>6.0	7.62												7.61			
23-Apr-22	DO (mg/L)	>6.0		7.64	7.15	7.81										7.95		
24-Apr-22	DO (mg/L)	>6.0					7.52	7.35	4.24	5.09								
25-Apr-22	DO (mg/L)	>6.0					7.52	7.35	4.24	5.09	7.6	7.22	7.08	6.79			6.02	6.63
5-May-22	DO (mg/L)	>6.0		7.68	7	7.89										7.09		
6-May-22	DO (mg/L)	>6.0					7.25	7.09	2.61	3.29								

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
7-May-22	DO (mg/L)	>6.0						7.09	2.61	3.29	8.1	8.09	7.24	7.61			6.16	6.35
10-May-22	DO (mg/L)	>6.0	8.16												8.76			
12-May-22	DO (mg/L)	>6.0						8.16	3.6	4.15								
13-May-22	DO (mg/L)	>6.0						8.16	3.6	4.15	8.63	8.87	8.13	7.87			7.06	6.62
16-May-22	DO (mg/L)	>6.0	7.79												8.36			
17-May-22	DO (mg/L)	>6.0		7.76	7.28	7.63										8.38		
18-May-22	DO (mg/L)	>6.0					7.38	7.29	4.08	5.89								
19-May-22	DO (mg/L)	>6.0						7.29	4.08	5.89	9.2	8.61	8.05	7.66			6.69	7.53
27-May-22	DO (mg/L)	>6.0					7.27	7.28	1.64	2.74								
28-May-22	DO (mg/L)	>6.0						7.28	1.64	2.74	6.34	6.14	6.12	6.25			6.78	6.11
1-Jun-22	DO (mg/L)	>6.0		7.43	7.44	7.73										7.75		
2-Jun-22	DO (mg/L)	>6.0					7.18	7.39	1.67	1.62								
3-Jun-22	DO (mg/L)	>6.0						7.39	1.67	1.62	7.38	6.77	6.45	6.15			6.36	6.24
6-Jun-22	DO (mg/L)	>6.0	7.44												7.34			
7-Jun-22	DO (mg/L)	>6.0		6.7	7.08	7.59										7.41		
8-Jun-22	DO (mg/L)	>6.0					7.29	6.78	2.31	3.01								
10-Jun-22	DO (mg/L)	>6.0						6.78	2.31	3.01	7.6	7.74	6.73	6.76			6.19	6.44
14-Jun-22	DO (mg/L)	>6.0		7.01	7.24	7.87										7.63		
15-Jun-22	DO (mg/L)	>6.0					7.4	7.4	2.74	2.6								
16-Jun-22	DO (mg/L)	>6.0						7.4	2.74	2.6	7.97	7.66	6.67	6.34			6.49	6.44
20-Jun-22	DO (mg/L)	>6.0	7.57												7.77			
21-Jun-22	DO (mg/L)	>6.0		7.5	7.61	7.68										7.68		
22-Jun-22	DO (mg/L)	>6.0					7.6	7.41	3.73	4.61								
23-Jun-22	DO (mg/L)	>6.0						7.41	3.73	4.61	3.57	3.72	5.77	5.5			6.42	6.13
28-Jun-22	DO (mg/L)	>6.0		7.37	6.94	6.94										7.09		

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
29-Jun-22	DO (mg/L)	>6.0					7.26	7.25	2.45	3.05								
30-Jun-22	DO (mg/L)	>6.0						7.25	2.45	3.05	3.7		5.15	5.53			6.48	7.17
1-Apr-22	Conductivity (µs/cm)		110												36			
23-Apr-22	Conductivity (µs/cm)			91	85	76										126		
24-Apr-22	Conductivity (µs/cm)						71	69	78	78								
25-Apr-22	Conductivity (µs/cm)										79	81	79	80			168	42
5-May-22	Conductivity (µs/cm)			91	88	76										97		
6-May-22	Conductivity (µs/cm)						72	70	79	80								
7-May-22	Conductivity (µs/cm)										80	80	78	79			147	60
10-May-22	Conductivity (µs/cm)		96												61			
12-May-22	Conductivity (µs/cm)							70	81	81								
13-May-22	Conductivity (µs/cm)										83	83	80	76			151	59
16-May-22	Conductivity (µs/cm)		99												38			
17-May-22	Conductivity (µs/cm)			92	88	74										141		
18-May-22	Conductivity (µs/cm)						71	69	83	78								
19-May-22	Conductivity (µs/cm)										81	83	81	73			130	36
27-May-22	Conductivity (µs/cm)						72	71	83	80								
28-May-22	Conductivity (µs/cm)										81	87	74	58			121	24
1-Jun-22	Conductivity (µs/cm)			89	79	73										90		
2-Jun-22	Conductivity (µs/cm)						71	70	81	81								
3-Jun-22	Conductivity (µs/cm)										77	87	70	60			106	20
6-Jun-22	Conductivity (µs/cm)		97												32			
7-Jun-22	Conductivity (µs/cm)			84	80	72										90		
8-Jun-22	Conductivity (µs/cm)						71	73	82	80								
10-Jun-22	Conductivity (µs/cm)										82	84	78	67			124	23

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
14-Jun-22	Conductivity (µs/cm)			83	80	73										84		
15-Jun-22	Conductivity (µs/cm)						70	73	85	82								
16-Jun-22	Conductivity (µs/cm)										82	84	63	57			113	19
20-Jun-22	Conductivity (µs/cm)		89												35			
21-Jun-22	Conductivity (µs/cm)			78	81	72										69		
22-Jun-22	Conductivity (µs/cm)						71	72	80	83								
23-Jun-22	Conductivity (µs/cm)										81	82	77	74			131	20
28-Jun-22	Conductivity (µs/cm)			81	77	73										76		
29-Jun-22	Conductivity (µs/cm)						70	71	80	79								
30-Jun-22	Conductivity (µs/cm)										81		77	70			122	12
1-Apr-22	Temperature (°C)		25.38												23.03			
23-Apr-22	Temperature (°C)			26.97	28.64	28.14										25.03		
24-Apr-22	Temperature (°C)						28.58	28.32	29.17	29.85								
25-Apr-22	Temperature (°C)										24.81	24.73	25.88	28.1			29.24	26.45
5-May-22	Temperature (°C)			26.28	28.95	28.96										24.41		
6-May-22	Temperature (°C)						28.6	28.08	24.26	27.4								
7-May-22	Temperature (°C)										24.4	24.42	25.29	25.62			28.75	27.18
10-May-22	Temperature (°C)		24.72												25.22			
12-May-22	Temperature (°C)							28.79	24.42	25.23								
13-May-22	Temperature (°C)										24.26	24.33	24.82	25.11			27.38	25.78
16-May-22	Temperature (°C)		25.04												24.22			
17-May-22	Temperature (°C)			23.53	28.75	29.08										22.64		
18-May-22	Temperature (°C)						28.58	28	24.8	27.53								
19-May-22	Temperature (°C)										25.43	25.58	26.84	28.61			27.31	25.71
27-May-22	Temperature (°C)						29.24	28.56	24.47	25.13								

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
28-May-22	Temperature (°C)										24.73	25.23	25.29	26.01			27.44	26.1
1-Jun-22	Temperature (°C)			24.18	29.5	29.36										23.9		
2-Jun-22	Temperature (°C)						29.31	28.33	24.49	25.12								
3-Jun-22	Temperature (°C)										24.32	25.28	25.97	26.05			27.05	25.57
6-Jun-22	Temperature (°C)		26.28												25.72			
7-Jun-22	Temperature (°C)			25.19	29.4	30.27										24.82		
8-Jun-22	Temperature (°C)						29.06	27.74	24.57	25.04								
10-Jun-22	Temperature (°C)										25.02	25.12	26.2	26.82			28.36	27.2
14-Jun-22	Temperature (°C)			26.1	30.08	30.31										24.69		
15-Jun-22	Temperature (°C)						29.36	28.83	24.58	25.06								
16-Jun-22	Temperature (°C)										24.87	24.99	25.29	25.2			26.74	25.17
20-Jun-22	Temperature (°C)		26.07												24.39			
21-Jun-22	Temperature (°C)			26.62	29.41	30.64										25.71		
22-Jun-22	Temperature (°C)						30.97	29.44	26.98	27								
23-Jun-22	Temperature (°C)										24.89	25.25	25.71	26.04			29.28	26.89
28-Jun-22	Temperature (°C)			27.06	30.97	31.2										27.45		
29-Jun-22	Temperature (°C)						30.58	29.97	25.22	25.97								
30-Jun-22	Temperature (°C)										25.22		25.9	26.42			28.61	24.3
1-Apr-22	Turbidity (NTU)		8.19												13			
23-Apr-22	Turbidity (NTU)			13	1.73	1.63										10.4		
24-Apr-22	Turbidity (NTU)						1.46	1.42	1.98	2.28								
25-Apr-22	Turbidity (NTU)										1.47	1.47	2.39	8.69			5.89	3.47
5-May-22	Turbidity (NTU)			18	1.75	1.2										4.69		
6-May-22	Turbidity (NTU)						1.33	1.09	0.93	2.76								
7-May-22	Turbidity (NTU)										1.9	2.4	4.54	5.3			4.22	3.43

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
10-May-22	Turbidity (NTU)		31.8												4.86			
12-May-22	Turbidity (NTU)								1.19	2.06								
13-May-22	Turbidity (NTU)										1.49	3.47	7.08	15.6			5.53	4.89
16-May-22	Turbidity (NTU)		114												18.1			
17-May-22	Turbidity (NTU)			257	3.4	1.94										71.4		
18-May-22	Turbidity (NTU)						1.75	1.31	1.47	2.75								
19-May-22	Turbidity (NTU)										1.41	4.81	6.39	5.42			12.4	3.94
27-May-22	Turbidity (NTU)						1.17	1.28	1.58	1.7								
28-May-22	Turbidity (NTU)										2.23	16	8.68	9.05			70.6	6.41
1-Jun-22	Turbidity (NTU)			39.4	2.59	1.37										12.7		
2-Jun-22	Turbidity (NTU)						1.43	1.31	1.55	1.58								
3-Jun-22	Turbidity (NTU)										2.42	15.1	19.2	14.7			37.7	5.44
6-Jun-22	Turbidity (NTU)		30.9												15.8			
7-Jun-22	Turbidity (NTU)			419	2.34	1.43										10.5		
8-Jun-22	Turbidity (NTU)						1.52	1.42	1.81	1.72								
10-Jun-22	Turbidity (NTU)										3.4	4.07	6.49	10.9			18.1	6.97
14-Jun-22	Turbidity (NTU)			40	1.18	1.35										8.92		
15-Jun-22	Turbidity (NTU)						1.48	1.08	1.47	1.79								
16-Jun-22	Turbidity (NTU)										2.67	4.45	19.3	12.7			51.8	5.62
20-Jun-22	Turbidity (NTU)		32												16.7			
21-Jun-22	Turbidity (NTU)			25.3	2.04	1.49										30.9		
22-Jun-22	Turbidity (NTU)						1.73	1.47	1.45	5.34								
23-Jun-22	Turbidity (NTU)										3.15	2.46	4.31	7.9			9.37	8.62
28-Jun-22	Turbidity (NTU)			23	4.68	1.1										10.6		
29-Jun-22	Turbidity (NTU)						1.92	1.23	1.55	1.66								

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
30-Jun-22	Turbidity (NTU)										2.22		5.78	9.13			16.7	1.8
1-Apr-22	TSS (mg/L)		6.43												7.4			
23-Apr-22	TSS (mg/L)			17.33		<5										9.14		
24-Apr-22	TSS (mg/L)						<5	<5	<5	<5								
25-Apr-22	TSS (mg/L)										<5	<5	<5	7.77			5.46	<5
10-May-22	TSS (mg/L)		32.2												<5			
17-May-22	TSS (mg/L)			257.6		<5										67.55		
18-May-22	TSS (mg/L)						<5	<5	<5	<5								
19-May-22	TSS (mg/L)										<5	<5	5.65	<5			5.37	<5
6-Jun-22	TSS (mg/L)		26.33												9.44			
7-Jun-22	TSS (mg/L)			304.12		<5										10		
8-Jun-22	TSS (mg/L)						<5	<5	<5	<5								
10-Jun-22	TSS (mg/L)										<5	<5	<5	5.8			5.6	<5
1-Apr-22	BOD_5 (mg/L)	<1.5	<1												<1			
23-Apr-22	BOD_5 (mg/L)	<1.5		<1		<1										<1		
24-Apr-22	BOD_5 (mg/L)	<1.5					<1	<1	<1	1.19								
25-Apr-22	BOD_5 (mg/L)	<1.5									<1	<1	<1	<1			<1	<1
10-May-22	BOD_5 (mg/L)	<1.5	<1												<1			
17-May-22	BOD_5 (mg/L)	<1.5		<1		<1										<1		
18-May-22	BOD_5 (mg/L)	<1.5					<1	<1	<1	<1								
19-May-22	BOD_5 (mg/L)	<1.5									<1	<1	<1	<1			<1	<1
6-Jun-22	BOD_5 (mg/L)	<1.5	<1												<1			
7-Jun-22	BOD_5 (mg/L)	<1.5		<1		<1										<1		
8-Jun-22	BOD_5 (mg/L)	<1.5					<1	<1	<1	<1								
10-Jun-22	BOD_5 (mg/L)	<1.5									<1	<1	<1	<1			<1	<1

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
22-Apr-22	COD (mg/L)	<5.0	<5												<5			
23-Apr-22	COD (mg/L)	<5.0														<5		
24-Apr-22	COD (mg/L)	<5.0							<5	<5								
25-Apr-22	COD (mg/L)	<5.0									<5	<5	<5	<5			6.4	<5
10-May-22	COD (mg/L)	<5.0	<5												<5			
17-May-22	COD (mg/L)	<5.0														<5		
18-May-22	COD (mg/L)	<5.0							<5	<5								
19-May-22	COD (mg/L)	<5.0									<5	<5	<5	<5			<5	<5
6-Jun-22	COD (mg/L)	<5.0	<5												<5			
7-Jun-22	COD (mg/L)	<5.0														<5		
8-Jun-22	COD (mg/L)	<5.0							<5	<5								
10-Jun-22	COD (mg/L)	<5.0									<5	<5	<5	<5				
22-Apr-22	NH_3-N (mg/L)	<0.2	<0.2												<0.2			
23-Apr-22	NH_3-N (mg/L)	<0.2		<0.2		<0.2										<0.2		
24-Apr-22	NH_3-N (mg/L)	<0.2					<0.2	<0.2										
10-May-22	NH_3-N (mg/L)	<0.2	<0.2												<0.2			
17-May-22	NH_3-N (mg/L)	<0.2		<0.2		<0.2										<0.2		
18-May-22	NH_3-N (mg/L)	<0.2					<0.2	<0.2										
6-Jun-22	NH_3-N (mg/L)	<0.2	<0.2												<0.2			
7-Jun-22	NH_3-N (mg/L)	<0.2		<0.2		<0.2										<0.2		
8-Jun-22	NH_3-N (mg/L)	<0.2					<0.2	<0.2								<0.2		
22-Apr-22	NO_3-N (mg/L)	<5.0	0.09												0.17			
23-Apr-22	NO_3-N (mg/L)	<5.0		0.15		0.06										0.16		
24-Apr-22	NO_3-N (mg/L)	<5.0					0.05	0.06										
10-May-22	NO_3-N (mg/L)	<5.0	0.05												0.05			

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
17-May-22	NO_3-N (mg/L)	<5.0		<0.02		0.06										0.08		
18-May-22	NO_3-N (mg/L)	<5.0					0.07	0.07										
6-Jun-22	NO_3-N (mg/L)	<5.0	0.07												0.08			
7-Jun-22	NO_3-N (mg/L)	<5.0		0.18		0.08										0.08		
8-Jun-22	NO_3-N (mg/L)	<5.0					0.08	0.09										
1-Apr-22	Faecal coliform (MPN/100 mL)	<1,000	540												110			
23-Apr-22	Faecal coliform (MPN/100 mL)	<1,000														33		
24-Apr-22	Faecal coliform (MPN/100 mL)	<1,000							14	27								
25-Apr-22	Faecal coliform (MPN/100 mL)	<1,000									14	170	170	920			920	540
10-May-22	Faecal coliform (MPN/100 mL)	<1,000	1,600												1,600			
17-May-22	Faecal coliform (MPN/100 mL)	<1,000														17		
18-May-22	Faecal coliform (MPN/100 mL)	<1,000							14	9								
19-May-22	Faecal coliform (MPN/100 mL)	<1,000									27	26	22	79			27	22
6-Jun-22	Faecal coliform (MPN/100 mL)	<1,000	1,600												1,600			
7-Jun-22	Faecal coliform (MPN/100 mL)	<1,000														350		
8-Jun-22	Faecal coliform (MPN/100 mL)	<1,000							70	49								
10-Jun-22	Faecal coliform (MPN/100 mL)	<1,000									33	23	23	70			920	1,600
1-Apr-22	Total Coliform (MPN/100 mL)	<5,000	1,600												1,600			
23-Apr-22	Total Coliform (MPN/100 mL)	<5,000														27		
24-Apr-22	Total Coliform (MPN/100 mL)	<5,000							14	11								
25-Apr-22	Total Coliform (MPN/100 mL)	<5,000									7	14	26	540			70	49
10-May-22	Total Coliform (MPN/100 mL)	<5,000	1,600												1,600			
17-May-22	Total Coliform (MPN/100 mL)	<5,000														70		
18-May-22	Total Coliform (MPN/100 mL)	<5,000							130	22								
19-May-22	Total Coliform (MPN/100 mL)	<5,000									170	70	79	110			79	79

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
6-Jun-22	Total Coliform (MPN/100 mL)	<5,000	1,600												1,600			
7-Jun-22	Total Coliform (MPN/100 mL)	<5,000														920		
8-Jun-22	Total Coliform (MPN/100 mL)	<5,000							1,600	350								
10-Jun-22	Total Coliform (MPN/100 mL)	<5,000									220	920	540	540			1,600	1,600
22-Apr-22	TKN		<1.5												<1.5			
23-Apr-22	TKN			<1.5		<1.5										<1.5		
24-Apr-22	TKN						<1.5	5										
10-May-22	TKN		<1.5												<1.5			
17-May-22	TKN			<1.5		<1.5												
18-May-22	TKN						<1.5	<1.5								<1.5		
6-Jun-22	TKN		<1.5												<1.5			
7-Jun-22	TKN			<1.5		<1.5										<1.5		
8-Jun-22	TKN						<1.5	<1.5										
23-Apr-22	Secchi Disk (m)				2	3.75												
24-Apr-22	Secchi Disk (m)						4	4.2	3.25	2								
22-Apr-22	TOC (mg/L)		1.46												2.5			
23-Apr-22	TOC (mg/L)															1.71		
24-Apr-22	TOC (mg/L)								1.87	1.82								
25-Apr-22	TOC (mg/L)										1.58	1.52	1.67	1.82			3.36	6.57
10-May-22	TOC (mg/L)		1.99												1.53			
17-May-22	TOC (mg/L)															2.38		
18-May-22	TOC (mg/L)								1.65	2.21								
19-May-22	TOC (mg/L)										1.85	1.77	2.6	3.3			4.79	11.1
6-Jun-22	TOC (mg/L)		1.47												1.86			
7-Jun-22	TOC (mg/L)															1.01		

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
8-Jun-22	TOC (mg/L)								1.79	1.64								
10-Jun-22	TOC (mg/L)										1.58	1.62	1.77	1.99				
23-Apr-22	Phytoplankton Biomass (g dry wt/m³)			16.6		2.4												
24-Apr-22	Phytoplankton Biomass (g dry wt/m³)						0.4	0.8										
17-May-22	Phytoplankton Biomass (g dry wt/m³)			182		1.8												
18-May-22	Phytoplankton Biomass (g dry wt/m³)						0.6	0.8										
7-Jun-22	Phytoplankton Biomass (g dry wt/m³)			273		0.4												
8-Jun-22	Phytoplankton Biomass (g dry wt/m³)						0.8	1.4										
22-Apr-22	Total Phosphorus (mg/L)		0.02												0.02			
23-Apr-22	Total Phosphorus (mg/L)			0.03		0.02										0.03		
24-Apr-22	Total Phosphorus (mg/L)						0.02	0.03										
10-May-22	Total Phosphorus (mg/L)		0.04												0.01			
17-May-22	Total Phosphorus (mg/L)			0.2		0.02										0.14		
18-May-22	Total Phosphorus (mg/L)						0.01	0.02										
6-Jun-22	Total Phosphorus (mg/L)		0.08												0.06			
7-Jun-22	Total Phosphorus (mg/L)			0.25		0.05										0.05		
8-Jun-22	Total Phosphorus (mg/L)						0.08	0.05										
22-Apr-22	Total Dissolved Phosphorus (mg/L)		0.01												0.01			
23-Apr-22	Total Dissolved Phosphorus (mg/L)			0.02		0.01										0.02		

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
24-Apr-22	Total Dissolved Phosphorus (mg/L)						0.01	0.03										
10-May-22	Total Dissolved Phosphorus (mg/L)		0.02												<0.01			
17-May-22	Total Dissolved Phosphorus (mg/L)			0.13		0.01										0.08		
18-May-22	Total Dissolved Phosphorus (mg/L)						<0.01	0.01										
6-Jun-22	Total Dissolved Phosphorus (mg/L)		0.05												0.04			
7-Jun-22	Total Dissolved Phosphorus (mg/L)			0.16		0.03										0.03		
8-Jun-22	Total Dissolved Phosphorus (mg/L)						0.03	0.03										
23-Apr-22	Hydrogen Sulfide (mg/L)			<0.02		<0.02												
24-Apr-22	Hydrogen Sulfide (mg/L)						<0.02	<0.02										
17-May-22	Hydrogen Sulfide (mg/L)			<0.02		<0.02												
18-May-22	Hydrogen Sulfide (mg/L)						<0.02	<0.02										
23-Apr-22	Turbidity (NTU)-bottom					2.01												
24-Apr-22	Turbidity (NTU)-bottom						0.46	0.44										
17-May-22	Turbidity (NTU)-bottom					1.94												
18-May-22	Turbidity (NTU)-bottom						1.75	1.31										
7-Jun-22	Turbidity (NTU)-bottom					1.58												
8-Jun-22	Turbidity (NTU)-bottom						1.68	1.94										
23-Apr-22	TSS (mg/L)-bottom					<5												
24-Apr-22	TSS (mg/L)-bottom						<5	5										
17-May-22	TSS (mg/L)-bottom					<5												
18-May-22	TSS (mg/L)-bottom						<5	<5										

		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						Within / Re-regulation Reservoir	Downstream			Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
7-Jun-22	TSS (mg/L)-bottom					<5												
8-Jun-22	TSS (mg/L)-bottom						<5	<5										
23-Apr-22	BOD_5 (mg/L)-bottom					<1												
24-Apr-22	BOD_5 (mg/L)-bottom						7.71	7.32										
17-May-22	BOD_5 (mg/L)-bottom					<1												
18-May-22	BOD_5 (mg/L)-bottom						<1	<1										
7-Jun-22	BOD_5 (mg/L)-bottom					<1												
8-Jun-22	BOD_5 (mg/L)-bottom						4.64	5.46										
23-Apr-22	NH_3-N (mg/L)-bottom					<0.2												
24-Apr-22	NH_3-N (mg/L)-bottom						0.2	<0.2										
17-May-22	NH_3-N (mg/L)-bottom					0.4												
18-May-22	NH_3-N (mg/L)-bottom						0.3	<0.2										
7-Jun-22	NH_3-N (mg/L)-bottom					<0.2												
8-Jun-22	NH_3-N (mg/L)-bottom						0.3	<0.2										
23-Apr-22	NO_3-N (mg/L)-bottom					0.18												
24-Apr-22	NO_3-N (mg/L)-bottom						0.11	0.14										
17-May-22	NO_3-N (mg/L)-bottom					0.08												
18-May-22	NO_3-N (mg/L)-bottom						0.06	0.07										
7-Jun-22	NO_3-N (mg/L)-bottom					0.14												
8-Jun-22	NO_3-N (mg/L)-bottom						0.1	0.16										
23-Apr-22	TKN-bottom					<1.5												
24-Apr-22	TKN-bottom						<1.5	<1.5										
17-May-22	TKN-bottom					<1.5												
18-May-22	TKN-bottom						<1.5	<1.5										
7-Jun-22	TKN-bottom					<1.5												

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
8-Jun-22	TKN-bottom						<1.5	<1.5										
23-Apr-22	Total Dissolved Phosphorus (mg/L)-bottom					0.02												
24-Apr-22	Total Dissolved Phosphorus (mg/L)-bottom						0.01	0.01										
17-May-22	Total Dissolved Phosphorus (mg/L)-bottom					0.01												
18-May-22	Total Dissolved Phosphorus (mg/L)-bottom						0.02	0.02										
7-Jun-22	Total Dissolved Phosphorus (mg/L)-bottom					0.03												
8-Jun-22	Total Dissolved Phosphorus (mg/L)-bottom						0.04	0.04										
23-Apr-22	Total Phosphorus (mg/L)-bottom					0.02												
24-Apr-22	Total Phosphorus (mg/L)-bottom						0.02	0.01										
17-May-22	Total Phosphorus (mg/L)-bottom					0.02												
18-May-22	Total Phosphorus (mg/L)-bottom						0.03	0.03										
7-Jun-22	Total Phosphorus (mg/L)-bottom					0.05												
8-Jun-22	Total Phosphorus (mg/L)-bottom						0.08	0.05										
23-Apr-22	Hydrogen Sulfide (mg/L)-bottom					<0.02												
24-Apr-22	Hydrogen Sulfide (mg/L)-bottom						<0.02	<0.02										
17-May-22	Hydrogen Sulfide (mg/L)-bottom					<0.02												
18-May-22	Hydrogen Sulfide (mg/L)-bottom						<0.02	<0.02										
7-Jun-22	Hydrogen Sulfide (mg/L)-bottom					<0.02												
8-Jun-22	Hydrogen Sulfide (mg/L)-bottom						<0.02	<0.02										
23-Apr-22	Phytoplankton Biomass (g dry wt/m^3)-bottom					1.2												

		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						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream				Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01		NPH 01		NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																		
24-Apr-22	Phytoplankton Biomass (g dry wt/m³)-bottom						5.2	3.2												
17-May-22	Phytoplankton Biomass (g dry wt/m³)-bottom					4.4														
18-May-22	Phytoplankton Biomass (g dry wt/m³)-bottom						2.8	2												
7-Jun-22	Phytoplankton Biomass (g dry wt/m³)-bottom					3.4														
8-Jun-22	Phytoplankton Biomass (g dry wt/m³)-bottom						16	1.2												

APPENDIX 5-2: EFFLUENT CAMP MONITORING RESULTS – Q2 2022

		Site Name (Code)	OSOV1 (EF01)	OSOV2 (EF13)	Main Powerhouse (EF19)
Date	**Parameter (Unit)**	**Guideline in the CA**			
02-Apr-22	pH	6.0 - 9.0	7.29	7.68	7.83
26-Apr-22	pH	6.0 - 9.0	6.5	6.97	7.22
04-May-22	pH	6.0 - 9.0	7.07	7.32	7.37
25-May-22	pH	6.0 - 9.0	7.37	7.74	7.84
02-Jun-22	pH	6.0 - 9.0	6.65	7.59	7.56
09-Jun-22	pH	6.0 - 9.0	7.17	7.65	7.76
17-Jun-22	pH	6.0 - 9.0	7.11	7.36	7.56
23-Jun-22	pH	6.0 - 9.0	7.06	7.49	7.76
02-Apr-22	Sat. DO (%)	-	72.9	73.4	75.3
26-Apr-22	Sat. DO (%)	-	82.5	19.2	54.6
04-May-22	Sat. DO (%)	-	89.9	62.2	53.4
25-May-22	Sat. DO (%)	-	72.5	82.7	69
02-Jun-22	Sat. DO (%)	-	69.9	80.3	61.5
09-Jun-22	Sat. DO (%)	-	53.1	90.5	57.6
17-Jun-22	Sat. DO (%)	-	69.8	80.6	33.8
23-Jun-22	Sat. DO (%)	-	68.1	72.9	33.1
02-Apr-22	DO (mg/L)	-	5.81	5.81	5.85
26-Apr-22	DO (mg/L)	-	6.35	1.56	4.3
04-May-22	DO (mg/L)	-	7.1	4.91	4.06
25-May-22	DO (mg/L)	-	5.72	6.52	5.35
02-Jun-22	DO (mg/L)	-	5.44	6.22	4.66
09-Jun-22	DO (mg/L)	-	4.14	6.99	4.38
17-Jun-22	DO (mg/L)	-	5.53	6.3	2.62
23-Jun-22	DO (mg/L)	-	5.35	5.71	2.51
02-Apr-22	Conductivity (µs/cm)	-	320	533	879
26-Apr-22	Conductivity (µs/cm)	-	382	525	882
04-May-22	Conductivity (µs/cm)	-	352	567	1067
25-May-22	Conductivity (µs/cm)	-	262	574	977
02-Jun-22	Conductivity (µs/cm)	-	287	536	1172
09-Jun-22	Conductivity (µs/cm)	-	301	590	1208
17-Jun-22	Conductivity (µs/cm)	-	284	554	1365
23-Jun-22	Conductivity (µs/cm)	-	263	567	1520
02-Apr-22	Temperature (°C)	-	26.89	27.15	28.27
26-Apr-22	Temperature (°C)	-	28.89	26.21	27.5
04-May-22	Temperature (°C)	-	27.41	27.42	29.78
25-May-22	Temperature (°C)	-	27.47	27.53	28.3
02-Jun-22	Temperature (°C)	-	28.12	28.51	29.52
09-Jun-22	Temperature (°C)	-	28.01	28.65	29.18

		Site Name (Code)	OSOV1 (EF01)	OSOV2 (EF13)	Main Powerhouse (EF19)
Date	**Parameter (Unit)**	**Guideline in the CA**			
17-Jun-22	Temperature (°C)	-	27.15	28.04	28.19
23-Jun-22	Temperature (°C)	-	27.63	27.28	29.31
02-Apr-22	Turbidity (NTU)	-	0.65	12	8.81
26-Apr-22	Turbidity (NTU)	-	0.07	8.98	3.2
04-May-22	Turbidity (NTU)	-	0.39	5.45	6.85
25-May-22	Turbidity (NTU)	-	0.4	6.93	10.3
02-Jun-22	Turbidity (NTU)	-	1.01	10.7	15.6
09-Jun-22	Turbidity (NTU)	-	1.45	8	15
17-Jun-22	Turbidity (NTU)	-	0.53	8.62	18.8
23-Jun-22	Turbidity (NTU)	-	1.14	13.3	27.3
02-Apr-22	TSS (mg/L)	<50	0.6	18.93	9.47
26-Apr-22	TSS (mg/L)	<50	0.1	9	1.31
04-May-22	TSS (mg/L)	<50	<5	5.31	8.33
25-May-22	TSS (mg/L)	<50	<5	<5	10
02-Jun-22	TSS (mg/L)	<50	<5	10.2	18.2
09-Jun-22	TSS (mg/L)	<50			
17-Jun-22	TSS (mg/L)	<50	<5	10.2	17.36
23-Jun-22	TSS (mg/L)	<50	<5	9.55	23.92
02-Apr-22	BOD5 (mg/L)	<30	<6	7.26	7.62
26-Apr-22	BOD5 (mg/L)	<30	<6	15.6	<6
04-May-22	BOD5 (mg/L)	<30	<6	<6	19.2
25-May-22	BOD5 (mg/L)	<30	<6	<6	<6
02-Jun-22	BOD5 (mg/L)	<30	<6	<6	<6
09-Jun-22	BOD5 (mg/L)	<30			
17-Jun-22	BOD5 (mg/L)	<30	<6	<6	<6
23-Jun-22	BOD5 (mg/L)	<30	<6	12.39	22.56
02-Apr-22	COD (mg/L)	<125	<25	41	48.4
26-Apr-22	COD (mg/L)	<125	<25	33	<25
04-May-22	COD (mg/L)	<125	<25	26.3	33
25-May-22	COD (mg/L)	<125	<25	<25	39.4
02-Jun-22	COD (mg/L)	<125	<25	33.5	60
09-Jun-22	COD (mg/L)	<125			
17-Jun-22	COD (mg/L)	<125	<25	34.5	64.5
23-Jun-22	COD (mg/L)	<125			
02-Apr-22	NH3-N (mg/L)	<10.0	<2	22.5	7.3
26-Apr-22	NH3-N (mg/L)	<10.0	<2	21.5	8.6
04-May-22	NH3-N (mg/L)	<10.0	<2	22.6	18.3
25-May-22	NH3-N (mg/L)	<10.0	<2	9.7	15.8
02-Jun-22	NH3-N (mg/L)	<10.0	<2	13.5	37.5

		Site Name (Code)	OSOV1 (EF01)	OSOV2 (EF13)	Main Powerhouse (EF19)
Date	**Parameter (Unit)**	**Guideline in the CA**			
09-Jun-22	NH3-N (mg/L)	<10.0	<2	29.1	27.8
17-Jun-22	NH3-N (mg/L)	<10.0	<2	20.8	70.8
23-Jun-22	NH3-N (mg/L)	<10.0	2.1	15.9	65.8
02-Apr-22	Total Nitrogen (mg/L)	<10	0.5	24.3	8.38
26-Apr-22	Total Nitrogen (mg/L)	<10	0.52	23	9.86
04-May-22	Total Nitrogen (mg/L)	<10	0.51	24.3	19.8
25-May-22	Total Nitrogen (mg/L)	<10	0.52	10.5	16.1
02-Jun-22	Total Nitrogen (mg/L)	<10	1.01	14	40.2
09-Jun-22	Total Nitrogen (mg/L)	<10	1.92	31.1	28.8
17-Jun-22	Total Nitrogen (mg/L)	<10	0.43	22.7	76.4
23-Jun-22	Total Nitrogen (mg/L)	<10	2.3	16.9	71.1
02-Apr-22	Total Phosphorus (mg/L)	<2	1.33	2.2	7.43
26-Apr-22	Total Phosphorus (mg/L)	<2	1.39	2.05	4.97
04-May-22	Total Phosphorus (mg/L)	<2	1.9	2.17	6.75
25-May-22	Total Phosphorus (mg/L)	<2	0.92	1.18	6.72
02-Jun-22	Total Phosphorus (mg/L)	<2	0.97	1.68	7.66
09-Jun-22	Total Phosphorus (mg/L)	<2	1.03	2.54	7.46
17-Jun-22	Total Phosphorus (mg/L)	<2	1.01	2	7.86
23-Jun-22	Total Phosphorus (mg/L)	<2	0.96	1.9	3.64
02-Apr-22	Oil & Grease (mg/)	<10.0	<1	<1	1.2
04-May-22	Oil & Grease (mg/)	<10.0	<1	<1	<1
02-Jun-22	Oil & Grease (mg/)	<10.0	<1	1.3	1.2
02-Apr-22	Total coliform (MPN/100mL)	<400	5400	22	0
26-Apr-22	Total coliform (MPN/100mL)	<400	350	110	49
04-May-22	Total coliform (MPN/100mL)	<400	1600	0	1600
25-May-22	Total coliform (MPN/100mL)	<400	1600	0	0
02-Jun-22	Total coliform (MPN/100mL)	<400	1600	0	0
17-Jun-22	Total coliform (MPN/100mL)	<400	920	2	0
23-Jun-22	Total coliform (MPN/100mL)	<400	3500	0	240
02-Apr-22	Fecal Coliform (MPN/100mL)	<400	1600	0	0
26-Apr-22	Fecal Coliform (MPN/100mL)	<400	350	110	49
04-May-22	Fecal Coliform (MPN/100mL)	<400	540	0	1600
25-May-22	Fecal Coliform (MPN/100mL)	<400	1600	0	0
02-Jun-22	Fecal Coliform (MPN/100mL)	<400	1600	0	0
17-Jun-22	Fecal Coliform (MPN/100mL)	<400	130	0	0
23-Jun-22	Fecal Coliform (MPN/100mL)	<400	3500	0	240
02-Apr-22	Residual Chlorine (mg/L)	<0.2		0.77	0.49
26-Apr-22	Residual Chlorine (mg/L)	<0.2		0.5	0.07
04-May-22	Residual Chlorine (mg/L)	<0.2		0.82	0.06

		Site Name (Code)	OSOV1 (EF01)	OSOV2 (EF13)	Main Powerhouse (EF19)
Date	**Parameter (Unit)**	**Guideline in the CA**			
25-May-22	Residual Chlorine (mg/L)	<0.2		1.98	1.33
02-Jun-22	Residual Chlorine (mg/L)	<0.2		0.24	0.67
09-Jun-22	Residual Chlorine (mg/L)	<0.2		0.39	0.33
17-Jun-22	Residual Chlorine (mg/L)	<0.2		0.18	0.2
23-Jun-22	Residual Chlorine (mg/L)	<0.2		0.23	0.11

APPENDIX 5-3: COMMUNITY GROUNDWATER QUALITY MONITORING RESULTS – Q2 2022

		Site Name	Phouhomxay Village		Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
Month Year	Parameter (Unit)	Station	GPHX 01	GPHX 02	GSXN01	GNPA0 1	GTHN01	GPOU 01	GPOU 02
		Guideline							
01-Apr-22	pH	6.5 - 9.2						6.64	7.28
26-Apr-22	pH	6.5 - 9.2	6.93	6.95	7	6.84	6.73		
09-May-22	pH	6.5 - 9.2	7.59	7.55	7.6	7.29	7.06		
10-May-22	pH	6.5 - 9.2						7.15	7.12
06-Jun-22	pH	6.5 - 9.2						6.84	7.26
13-Jun-22	pH	6.5 - 9.2			6.88	6.89	6.93		
01-Apr-22	Sat. DO (%)							73.2	82.7
26-Apr-22	Sat. DO (%)				70.9	82.7	52.3		
09-May-22	Sat. DO (%)		39.7	53.1	54.7	89.3	47		
10-May-22	Sat. DO (%)							78.6	81.2
06-Jun-22	Sat. DO (%)							74.8	75.6
13-Jun-22	Sat. DO (%)				69	90.3	62		
01-Apr-22	DO (mg/l)							5.97	6.75
26-Apr-22	DO (mg/l)		1.83	2	5.26	6.38	3.99		
09-May-22	DO (mg/l)		3.1	4.24	4.4	7.04	3.61		
10-May-22	DO (mg/l)							6.28	6.55
06-Jun-22	DO (mg/l)							5.74	6.08
13-Jun-22	DO (mg/l)				5.25	7.04	4.75		
01-Apr-22	Conductivity (µS/cm)							21	314
26-Apr-22	Conductivity (µS/cm)		417	452	385	405	403		
09-May-22	Conductivity (µS/cm)		421	430	377	404	396		
10-May-22	Conductivity (µS/cm)							23	337
06-Jun-22	Conductivity (µS/cm)							19	414
13-Jun-22	Conductivity (µS/cm)				360	392	381		
01-Apr-22	Temperature (°C)							26.19	25.64
26-Apr-22	Temperature (°C)		26.22	25.83	30.13	28.78	29.41		
09-May-22	Temperature (°C)		28.17	27.8	27.87	27.49	29.06		
10-May-22	Temperature (°C)							26.85	26.22
06-Jun-22	Temperature (°C)							29.04	26.4
13-Jun-22	Temperature (°C)				29.71	28.19	29.39		
01-Apr-22	Turbidity (NTU)	<20						1.29	0.71
26-Apr-22	Turbidity (NTU)	<20	1.25	2.91	1.04	0.37	1.05		
09-May-22	Turbidity (NTU)	<20	2.69	2.77	0.47	0.17	1.61		
10-May-22	Turbidity (NTU)	<20						2.31	2.17
06-Jun-22	Turbidity (NTU)	<20						1.89	0.42
13-Jun-22	Turbidity (NTU)	<20			1.18	1.31	1.51		
01-Apr-22	Fecal coliform (MPN/100ml)	0						0	0

		Site Name	Phouhomxay Village		Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
Month Year	Parameter (Unit)	Station	GPHX 01	GPHX 02	GSXN01	GNPA0 1	GTHN01	GPOU 01	GPOU 02
		Guideline							
26-Apr-22	Fecal coliform (MPN/100ml)	0	0	0	0	4.5	11		
09-May-22	Fecal coliform (MPN/100ml)	0	0	0	4.5	22	240		
10-May-22	Fecal coliform (MPN/100ml)	0						12	4.5
06-Jun-22	Fecal coliform (MPN/100ml)	0						0	49
13-Jun-22	Fecal coliform (MPN/100ml)	0			0	2	130		
01-Apr-22	E.coli Bacteria (MPN/100ml)	0						0	0
26-Apr-22	E.coli Bacteria (MPN/100ml)	0	0	0	0	4.5	7.8		
09-May-22	E.coli Bacteria (MPN/100ml)	0	0	0	4.5	22	240		
10-May-22	E.coli Bacteria (MPN/100ml)	0						12	4.5
06-Jun-22	E.coli Bacteria (MPN/100ml)	0						0	49
13-Jun-22	E.coli Bacteria (MPN/100ml)	0			0	2	130		

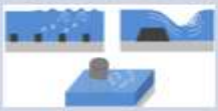
APPENDIX 5-4: GRAVITY FED WATER SUPPLY QUALITY MONITORING RESULTS – Q2 2022

		Site Name	Thaheua Village	Hat Gniun Village	Phouhomxay Village	
		Station	WTHH02	WHGN02	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline				
26-Apr-22	pH	6.5 - 8.5	7.03	7.17	7.1	7.06
09-May-22	pH	6.5 - 8.5	7.65	7.69	7.72	7.73
13-Jun-22	pH	6.5 - 8.5	7.54	7.55		
24-Jun-22	pH				7.1	6.88
26-Apr-22	Sat. DO (%)		88.5	85.2	65.7	70
09-May-22	Sat. DO (%)		93.5	94	90.8	77.4
13-Jun-22	Sat. DO (%)		91.8	93.8		
24-Jun-22	Sat. DO (%)				80.8	77.7
26-Apr-22	DO (mg/L)		6.9	6.62	5.32	6.47
09-May-22	DO (mg/L)		7.26	7.38	7.11	5.87
13-Jun-22	DO (mg/L)		7.21	7.32		
24-Jun-22	DO (mg/L)				6.27	6.18
26-Apr-22	Conductivity (µS/cm)	<1,000	76	127	108	96
09-May-22	Conductivity (µS/cm)	<1,000	82	129	130	128
13-Jun-22	Conductivity (µS/cm)	<1,000	70	111		
24-Jun-22	Conductivity (µS/cm)	<1,000			11	10
26-Apr-22	Temperature (°C)	<35	28.29	28.48	26.52	28.3
09-May-22	Temperature (°C)	<35	28.36	27.76	27.88	29.13
13-Jun-22	Temperature (°C)	<35	27.87	28.14		
24-Jun-22	Temperature (°C)	<35			28.52	27.62
26-Apr-22	Turbidity (NTU)	<10	1.48	1.17	0.65	0.73
09-May-22	Turbidity (NTU)	<10	1.08	1.21	1.76	1.25
13-Jun-22	Turbidity (NTU)	<10	4.16	6.97		
24-Jun-22	Turbidity (NTU)	<10			1.41	1.72
26-Apr-22	Faecal Coliform (MPN/100 mL)	0	79	79	26	9.3
09-May-22	Faecal Coliform (MPN/100 mL)	0	7	70	70	49
13-Jun-22	Faecal Coliform (MPN/100 mL)	0	13	130		
24-Jun-22	Faecal Coliform (MPN/100 mL)	0			0	2
26-Apr-22	E.coli Bacteria (MPN/100 mL)	0	49	49	22	6.8
09-May-22	E.coli Bacteria (MPN/100 mL)	0	7	49	70	49
13-Jun-22	E.coli Bacteria (MPN/100 mL)	0	13	130		
24-Jun-22	E.coli Bacteria (MPN/100 mL)	0			0	2

APPENDIX 5-5: LANDFILL LEACHATE QUALITY MONITORING RESULTS – Q2 2022

		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							
4-May-22	pH	6.0-9.0				8.32		8.64	
2-Jun-22	pH	6.0-9.0				8.18		7.87	
4-May-22	Sat. DO (%)					128.1		208.1	
2-Jun-22	Sat. DO (%)					113.2		122.6	
4-May-22	DO (mg/L)					9.14		14.74	
2-Jun-22	DO (mg/L)					7.84		8.84	
4-May-22	Conductivity (µS/cm)					120		192	
2-Jun-22	Conductivity (µS/cm)					81		185	
4-May-22	Temperature (°C)					33.28		33.8	
2-Jun-22	Temperature (°C)					35.33		32.72	
4-May-22	Turbidity (NTU)					15.3		32.6	
2-Jun-22	Turbidity (NTU)					49.4		5.8	
4-May-22	COD (mg/L)	<125				54.4		55.2	
2-Jun-22	COD (mg/L)	<125				56.4		<25	
4-May-22	Faecal Coliform (MPN/100mL)	<400				23		13	
2-Jun-22	Faecal Coliform (MPN/100mL)	<400				49		140	
4-May-22	Total Coliform (MPN/100mL)	<400				350		79	
2-Jun-22	Total Coliform (MPN/100mL)	<400				49		140	
4-May-22	Total Nitrogen (mg/L)	<10				1.1		0.52	
2-Jun-22	Total Nitrogen (mg/L)	<10				0.4		4.26	
4-May-22	Lead (mg/L)	<0.2				<0.01		<0.01	
2-Jun-22	Lead (mg/L)	<0.2				<0.01		<0.01	
4-May-22	Copper (mg/L)					<0.006		<0.006	
2-Jun-22	Copper (mg/L)					<0.006		<0.006	
4-May-22	Iron (mg/L)					0.399		1.1	
2-Jun-22	Iron (mg/L)					0.602		0.452	
4-May-22	Ammonia nitrogen (mg/L)	<10				<2		<2	
2-Jun-22	Ammonia nitrogen (mg/L)	<10				<2		3.10	
4-May-22	Oil & Grease (mg/L)	<10				<1		<1	
2-Jun-22	Oil & Grease (mg/L)	<10				<1		<1	

APPENDIX 5-6: SUMMARY PRELIMINARY STUDY RESULT OF POSSIBLE PROTOTYPE OF HYDRAULIC

	Drop Type	River Channel Structure	Tailrace Outlet Structure	Pump up and Drop	Combination Discharge
Feature	 NT2	On riverbed  	 NT2 		 Re-regulation gate discharge
Function	Air supplied during dropping	Air supplied caused by turbulence up to the structure on river bed	Air supplied by hitting water to obstruction with high velocity at tailrace outlet	Pump up water and drop	Combined with high DO through gate discharge and turbine discharge
Aerator Performance	Middle-High	Low	Middle	High	Middle (Depending on MPH discharge)
Construction Cost	0.5 MUSD	0.03 MUSD	0.1 MUSD	5 MUSD + Operation cost	None
Adverse Impact on Generation	-0.4 MUSD/year x 26 years = -10.4 MUSD	-0.05 MUSD/year x 26 years = -1.3 MUSD	-0.5 MUSD/year x 26 years = -13.0 MUSD	None	-2.7 MUSD/year x 26 years = -70.2 MUSD