BAC KAN PROVINCIAL PEOPLE'S COMMITTEE

CONSTRUCTION AND INVESTMENT PROJECT MANAGEMENT UNIT OF BAC KAN

DAM REHABILITATION AND SAFETY IMPROVEMENT PROJECT (DRSIP- WB8)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

DAM REHABILITATION AND SAFETY IMPROVEMENT SUB-PROJECT (WB8), IN BAC KAN PROVINCE

March 2020

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REPRESENTATIVE OF OWNER

BAC KAN CONSTRUCTION AND INVESTMENT PMU

REPRESENTATIVE OF CONSULTANT

VIETNAM WATER, SANITATION AND ENVIRONMENT JSC.

March 2020

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ABBREVIATIONS

AHHs	Affected Households
BOD	Biochemical oxygen demand
CPMU	Central Project Management Unit (under MARD)
CSC	Construction supervision consultant
DARD	Department of Agriculture and Rural Development
DO	Dissolved Oxygen
DONRE	Department of Natural Resources and Environment
EM	Ethnic minority
ECOP	Environmental Codes of Practice
EIA	Environmental impact assessment
EMDP	Ethnic minority development plan
EMP	Environmental Management Plan
ES	Environmental staff
ESMF	Environmental and Social Management Framework
IPM	Integrated pest management
ESMP	Environmental and Social management plan
MARD	Ministry of Agriculture and Rural Development
OP	Operational policies (of the World Bank)
PPMU	Provincial Project Management Unit
QCVN	National Technical Regulations (Vietnam)
RAP	Resettlement action plan
RPF	Resettlement policy framework
TCVN	Vietnam standard
TOR	Terms of Reference
WB	World Bank

EXECUTIVE SUMMARY

Background

The "*Dam Rehabilitation and Safety Improvement Project*" loaned from WB by the Government of Vietnam to invest in dam safety improvement, and relevant structures over all the country in order to ensure safety for people and socio-economic infrastructures of the downstream communities according to Decree No.114/2018/NĐ-CP dated September 4th, 2018 about Dam and Reservoir Safety Management.

In Bac Kan province, the Dam Rehabilitation and Safety Improvement Sub-project (WB8) is funded by the WB for implementation of the reservoir safety program through repairing and upgrading prioritized dams, enhances management capacity, dam safety operation in order to protect the people and socio-economic infrastructure for the subproject area.

The Dam Rehabilitation and Safety Improvement Sub-project in Bac Kan includes 7 reservoirs located in 6 communes of 4 districts: Cho Don, Na Ri, Bach Thong and Cho Moi in Bac Kan province. These reservoirs have a capacity from 0.194 to 0.242 million cubic meters, with the height of the dam is from 7 to 20 m; time of operation is about 10 to 40 years. The works such as earth dam, spillway, and sluice are degraded seriously; the management road is small; no any monitoring and management devices. Since building, they are not invested in major maintenance, and have a risk of unsafety. In the context of limited local budgets, the use of ODA funding to implement the subproject on repairing and improving dam safety for the 7 above works is very necessary.

Description of the subproject

The sub-project is carried out based on the suggestion by MARD with the funding from the WB. The sub-project is conducted in 6 communes, including 7 reservoirs belonging to 04 districts are Cho Moi, Cho Don, Bach Thong, and Na Ri. The repairing and upgrading these reservoirs is to ensure water sources for irrigation, satisfying the water demand for 268.2 hectares of 2-crops of rice and about 27 hectares of farm-produce in 6 communes, including Yen Han, Thanh Mai in Cho Moi district, Nghia Ta in Cho Don district, Dong Xa in Na Ri district, and Sy Binh in Bach Thong district. The subproject owner is Bac Kan construction and investment PMU.

Specific targets:

- Restoration and ensuring safety for structures through repairing, upgrading reservoirs, dams that are degraded or short of discharged capacity
- Improving institutions and policies on management, monitoring safety for national-level dams, strengthening management and operation capacity, and information combination mechanism in the basin
- Ensuring irrigation capacity for crops; limit harmful impacts to the environment; the landscape of reservoir and downstream
- Ensuring dam safety and restoration of design function through repairing, upgrading and equipping forecast and operation devices
- Improving management and project execution capacity, management of environment and society
- Improving livelihood, improving the quality of life for people in the project area and speeding up socio-economic development by promoting investment effectiveness on rural infrastructure; approaching, applying advanced scientific technology into agricultural production, minimizing the loss of cultivated land, enhancing depth-

cultivation and diversification in agriculture; bringing stable job opportunities for people, contribute to sustainable poverty reduction, help people having a better approach to services such as health, education, market, cultural exchanges, beliefs, etc. It aims to reduce the cost for production, transportation and strengthening exchanges, trading farm-products and at the same time taking part in building the new rural program and the strategy of local socio-economic development

Building items:

a) Repairing, upgrading, reinforcing the dam crest, repairing the upstream and downstream slope, rebuilding the drainage system on the slope and treating seepage for the dam body;

b) Repairing, changing the sluice depending on the level of damages;

c) Solidification and renovation to raise flood discharged capacity, possibly expanding spillways and making spillways with open discharge gates or adding self-broken spillways;

d) Management road: depending on the actual status of each reservoir, building the structure of the asphalt road comply with the rural road standard;

e) Renovation of the management house: the IV-grade house with an electrical system, and domestic water supply for living and management purpose;

f) Monitoring devices: Building the system of hydrological columns to monitor the upstream and downstream water level of the reservoir;

Preparing the Environmental and Social Impact Assessment Report

The sub-project is designed and carried out to comply with the ESMF of the DRSIP project which was approved by the WB, and to ensure compliance with current regulations of Vietnam Laws. The target of the ESIA report is to determine the importance of environmental and social issues during decision issuance by the way evaluating clearly the consequences of society and the environment of the research proposed before executing activities of the sub-project. It should determine early and describe characteristics of negative and positive environmental social impacts to help community and authorities have an assessment of impact on the environment and society of the sub-project proposed, and conditions which are needed to apply in order to mitigate risk to those impacts. The activities during preparation, construction, and operation of the sub-project which is analyzed, evaluated and brought out solutions of prevention, mitigation maximum level of influence to the environment and living of local people. The result of screening 7/7 reservoirs showed that all of them satisfied the eligibility criteria, and was classified as Category B. The subproject triggered 04 safeguard policies, including OP/BP 4.01 (Environmental assessment), OP/BP 4.37 (Safety of Dams) OP/BP 4.10 (Indigenous Peoples) and OP/BP 4.12 (Involuntary Resettlement).

Environmental and Social impacts and mitigation: Impacts of the sub-project include long-term positive impacts during operation and temporary negative impacts during the pre-construction, construction and operation periods.

(i) Positive impacts: Repairing and upgrading work items in 7 reservoirs shall impact positively to change some meteorological conditions in the region, the stability of the reservoir surface shall change climate conditions of each area of reservoir bed. After finish, it will increase stability of water supplying for irrigation in downstream, warrantee safety in the flood season; ensuring the development conditions for lakeshore vegetation populations, making landscape around the reservoir and local traffic.

(ii) Negative impacts during the pre-construction period

During implementation of the sub-project, it will cause land acquisition, assets, trees, and farm produce of 46 households, of which 41 households affected directly by land acquisition and 05 households affected indirectly. 3 of 46 households affected by residential land, one (01) household affected to the temporary fish looking-after hut. The result of the investigation showed that all 46 households affected are of ethnic minority. However, the level of effect is not significant, not affecting much to livelihood and income of households. Because of the works are repaired and improved based on the existing foundation, except for some operation roads and access road to the dam, which are built and expanded based on the existing earth roads. They cause some effects on farm production and some households.

According to the IOL for losses of the specific sub-project, the total area affected by the Sub-project due to land acquisition is 9,255m^2 of all kinds of 41 households. Of which is 200 m^2 of residential land, 1,113 m^2 of annual crops, 745 m^2 of perennial trees, 6,370 m^2 of cultivated forest, and 827 m^2 of aquaculture. In addition, during deploying of construction for work items of the sub-project, it also affected on trees of 5 households which cultivated in the safety corridor of the project and affected temporary on 37,132 m^2 of public land in 6 communes (which are bare land, unused) and affected temporary during construction of camp and building-material gathering yard…

(iii) Negative effects during the construction period

During the construction period, it also causes some potential impacts due to construction activities such as noise, and vibration. The amount of dust and exhaust fumes from the operation of vehicles during construction time affected water quality and land due to waste matter, land sliding and sedimentation; the social conflict between workers and local people; destroyed vegetation, traffic embroilment, risk of accidents, etc. For impacts due to interruption of water service during the construction period, like filling up the temporary dike during the construction of sluice, shall have to lead water in order to supply enough water for production in the downstream till people finish harvesting. Try to avoid making an influence on water supply for production in downstream. Through studying and assessment showed that, the impacts of the sub-project are not high due to the size of the structure is small, mobilization of the machine, a vehicle not much. These impacts just happen in the small space, just affects locally and intermittent, are evaluated at low and medium level.

(iv) *Negative effects during the operation* When the subProject put into operation, it will almost have positive impacts as mentioned above. The negative impacts may be the risks of breaking the dam, risk of drowning if not managed well. When the happening risk of breaking the dam, or emergency flood discharged, it will affect households in the downstream. Some households affected are 9 Households in The Khuoi Sung reservoir area, 5 Households in The Khuoi Dang reservoir area, 19 Households in the Khuoi Day reservoir area, 24 households in Coc Thong area, 10 Households in the Na Leng reservoir area, and 10 households in the Na Kieng reservoir area. There are no households are being affected in the May Day reservoir (according to the Dam Safety Report of the sub-project). In case of the absence of any timely response plan, it may cause damage to people and assets (rice, crops of people in the downstream). However, the level of risk is evaluated at a small level. In addition, compliance with the design also has limited these risks. For the operation of the reservoirs, each one has one to two operators and do not stay frequently in the reservoir area. Therefore, the generation of solid waste and wastewater is not very large. For people living around the reservoirs, and plus tourists, they can go to the lake area and playing activities will generate solid waste such as packaging, plastic, or people can litter into the lake, causing lost beauty and environmental sanitation. However, those activities do not happen frequently so this impact is negligible .

The mitigation measures will propose for negative impacts during preparation and construction. Impacts due to land acquisition will be minimized through the Resettlement Plan; the environmental impacts related during the construction phase will be minimized through the application of ECOP and site-specific mitigation measures.

During the design phase, design solutions have be selected optimally to avoid and minimize the negative impacts of land acquisition. However, the impacts caused by land acquisition and site clearance, especially housing impacts, cannot be avoided. Surveillance showed that, there are 3 households affected on structures: including one (01) household affected through loss of barn, one (01) households affected the leaf hut and one (01) household with an affected wall. According to regulations, compensation price for structures should follow in according with replacement cost including support cost for repairing affected households. Regarding interruption of water due to construction in case of emergency, thus Contractor, project Owner, and local authority will cooperate for an inventory of loss and planning the compensation, support for AHHs due to water interruption.

The mitigation proposed for negative impacts during operation

In the technical design stage, the integrated measures to minimize negative impacts during operation includes analyzing in detail meteorological and hydrological conditions and sedimentation rates before and after construction. The project is designed to ensure that the subproject will not adversely affect reservoir capacity, dam size, and ancillary facilities, as well as irrigation plans and living of local residents. PPMU monitors frequently in order to ensure losses for structures that will be repaired, rehabilitated according to the design approved, ensure safety during operation of the reservoir. Ensuring right as per the design is an important problem to excommunicate dam-broken trouble. The reservoir also should set some warning boards, simultaneously; have to monitor frequently in order to limit drowning for people.. When have to discharge flood in the emergency case, have to notify people living downstream at least 24 hours in advance, may have to evacuate people in the emergency case, so have a plan of flood-storm prevention and practice storm prevention frequently; prepare forces to proactively protect and repair dams. For households and tourists, we should propagandize awareness about preserving the common environment sanitation, put up a ban on littering, keep the sanitation for the lake area and conduct regular waste collection activities in the lake area

Institutional Arrangements: CPMU will recruit and hire ISC, project support Consultant to carry out the independent monitoring, support frequently on activities of the project. The Consultant will evaluate the safeguard policies compliance and the implementation of tools in construction, in which, having ESMP, ECOP, RPF/RAP, EMDP, and GAP. For the Sub-project, PPMU will be responsible for monitoring the implementation of ESMP and ensuring the Bidding and contractual Documents including the environmental covenants for which contractors must comply with during construction. The Contractors will carry out construction activities and comply with environmental provisions agreed in the Contract. The Contractor's ESMP is prepare by contractors, and reviewed and approved by PPMU and publicly disclosed to the local communities before the commencement of construction. The PPMU and ISC shall monitor compliance with the mitigation measures agreed with the Contractors. In addition, compliance of Contractors shall be monitored closely by Bac Kan DONRE, local authorities, and people.

Capacity building: The PPMU is the unit having enough experience in the construction field in general, and in irrigation and agriculture in particular. However, till to now, the PPMU has not carried out any projects funded by WB yet, so PPMU is not familiar with the Bank safeguard policy requirements. The PPMU has assigned staff who are in charge of environment safeguard implementation of the sub-project. However, these officers also

have not joined any training course about the safeguard policy of the WB conducted by the WB task team and CPMU. (Some people had joined the training course but now had changed work). Therefore, training and improving capacity through technical support activities of safeguard policy officers of the WB for the staff of PPMU and CPMU is necessary. The contents are necessary for training such as OP4.01 (Environment Assessment); General Guidelines for Environment, Health, and Safety (EHS) of IFC, OP 4.04 (Natural Habitats), OP 4.10 (Indigenous Peoples) and OP 4.12 (Involuntary Resettlement), etc. due to Experts of the WB guiding during the Sub-project implemenatation. Training, educating about ESP for CSC and EHS staff of the Contractors also shall be conducted frequently in order to update them on related safeguard policy requirements. . For PPMU, during the Sub-project implementation, they also receive support from ISC and Technical Support Consultant in the safeguard policy compliance from CPMU regarding managing risks on dam safety, and monitoring implementation of the ESMP.

Budget allocation for implementation of ESMP

It includes the cost for monitoring, carrying out of mitigations and capacity improvement. The cost for mitigations will be included in the construction cost.

Index	**Activities**	**Cost** *(VNĐ)*
1	Monitoring implementation of ESMP during the construction period and the first-year operation (details see in Annex 2)	329,500,000
2	Capacity building (details see in Annex 1)	320,000,000
	Total	**649,500,000**

Grievance redresses mechanism (GRM). The grievances related to the Sub-project will be redressed by negotiation aim to receive consensus with people. Related parties will negotiate the grievance in all 3 steps (people's committee at the commune, district, and provincial levels) before submit up to the Court according to regulations of the Law on complaints in 2011. PPMU will pay all administrative and legal expenses related to receiving complaints because this expense is included in the sub-project budget.

Public Consultation: The Subproject owner had coordinated with the Consultant carried out public consultations in the area of the subproject along with the participation of local authorities, the Fatherland Front Committee in localities, residential communities, and households affected by the project. Use of these methods and techniques will help strengthen the reliability and validity of feedback from sub-project stakeholders, especially is local people affected and ensure that: (i) AHHs shall inform enough information about the sub-project; and (ii) AHHs related to the freedom consultation, informed in advance and provided enough information during preparation and execution time. The meeting and direct consultations are conducted in the time as below: from 2 to 9th of July, 2018 had consulted in 3 communes, which are Dong Xa, Nghia Ta, and Yen Han; from 15th to 17th of February, 2019 had consulted in 04 communes are Liem Thuy, Yen Han, Thanh Mai, and Sy Binh. In July 2018, had submitted the first-time draft of SEIA report to consult from the local authorities in communes Dong Xa, Nghia Ta, and Yen Han; in February 2019, had sent the draft of SEIA report to consult from the local authorities in communes Liem Thuy, Yen Han, Thanh Mai, and Sy Binh. The number of people joining the community consultations in communes is approximate 20 to 40 people per each commune. The major comments of local people, as well as authorities, agree to support the implementation of the sub-project. Besides,

also some comments about policies of compensation and support for AHHs should do satisfactory; avoid making a negative impact on local infrastructure. Before construction, the Contractor has to prepare the construction schedule to let people know and arrange suitable crops, animals. It also is necessary to implement fully mitigations on environmental issues, at the same time, consider people's opinions during the implementation of the project, as shown in the ESIA report.

Information disclosure: In Compliance with the policies OP 4.01 and the policy of WB on access to information; since the first stage of the preparation of the subproject, information about content, the scope of the Sub-project, targets and potential environmental and social impacts, and mitigations, which popularized to local authorities and people. PPMU has carried out dissemination of information and community consultation with local people in July 2018 and in Feb 2019; sent the draft of SEIA Report in Vietnamese to communes, Fatherland Front Committee, Women's Union, Farmer union, Irrigation development One member Co., Ltd. The final draft will disclose in Sept 2019 via the website of the CPO and private website of WB by the English version before appraising the Sub-project. Simultaneously, the report also is sent to the district and commune people's committees in order to post up the notice public in the CPCs.

Conclusion: *The Dam Rehabilitation and Safety Improvement Sub-project* in Bac Kan has conducted with work items are not big, impacts occurring in the short term, scope and limitation just in the small region, not much significant so had brought out mitigations, which evaluated quite feasible, suitable to natural and socioeconomic conditions and conditions of management, operation in locals.

The environmental and social monitoring and management plan are set up to monitor the impacts, keeping management and local authorities regularly updated on the implementation process of the sub-projects construction items. The monitoring system prepared and approved by the WB will be applied in the sub-project implementation. The monitoring consultant will regularly check and report monthly for submission to the PPMU.

CHAPTER I. INTRODUCTION

Vietnam is one of the nations having a big network of dams and irrigation infrastructure. It includes over 7,000.0 dams of all kinds, in which over 750 large dams. (The dam is large if the height over 15m, or with the height from 5 to 15m but capacity over 3.0 million cubic meters); many small reservoirs (with the height less than 15m, and capacity less than 3.0 million cubic meters); in addition, estimates about 6.000 dams with earth-structure. In a total of 4 million hectares of agricultural area, has over 3.0 million hectares are irrigated by 6,648 reservoirs.

Many reservoirs with a medium and small size were built since the 1960s with limitations of technical survey, design, and construction. These factors along with the limitations of operation and maintenance make many dams degraded and the degree of safety is lower than the international standard. Besides it, increasing risks and unsafety by hydrological conditions due to climate change as well as the development of infrastructure and society fast in the upstream makes many reservoirs under risky status. It can list out such as foundation subsidence of main structures, seepage through the main dam body and/or the secondary dam, as well as surrounding the water intake structure; deformation of upstream/downstream slopes, the trouble of spillways…

Recognizing the importance of securing the basis for economic maintenance and growth, the Government of Vietnam had launched a dam safety program in 2003. Under which, the DRSIP had borrowed amount of money sources from the WB, will support the safety of dam structure and reservoirs, along with operational safety requirements to protect people at risk and socioeconomic infrastructure in the downstream, ensuring integrated basin development planning and strengthening institutional coordination, future development and safe operation of the reservoirs.

The MARD is responsible for implementing and managing the entire project. Provinces carrying out the repair and upgrading of dams under the Component 1 and MARD will coordinate activities with the MoIT and the MoNRE in Component 2. The CPO under MARD is responsible for the overall coordination and monitoring of the project. Implementation of repair and preparation work for the dam safety plan, including protection and commissioning, is concentrated to the provincial authorities. The PPCs and the DARD are the leading agencies at the provincial level. The PPMU is responsible for managing and monitoring the works with support from CPO.

The selection of rehabilitated dams in the project is based on prior unification criteria, calculating the probability and severity of incidents, risks to human and socioeconomic infrastructure. We consider economic benefits in the framework of poverty and inequality. Criteria for assessing dam safety risks include (i) probability of dam failure (structural risk based on height and capacity); (ii) the impact of the dam incident on people in the downstream; (iii) the impact of a dam failure on downstream infrastructure; (iv) poverty and impact contexts; (v) ethnic minority areas; and (vi) availability.

The project is implemented in 34 provinces in the North, Central, and Central Highlands. There are about 450 dams selected. The project components include:

- Component 1: Dam Safety Rehabilitation (*412 million USD, of which borrowed from IDA funding is 388.5 million USD*).
- Component 2: Dam Safety Management and Planning (*20 million USD, of which borrowed from IDA funding is 17 million USD*).

- Component 3: Project Management Support (*11 million USD, of which borrowed from IDA funding is 9.5 million USD*).

The second-year subprojects will support the repair and solidification of the related infrastructure and irrigation dams. About 90% of dams, which planned to repair, are earth structure, with a height of less than 15m, and less than 3 million m^3 volume of design. The project does not invest in completely changing of existing structures or building new, expanding main structures. The construction items of the project only focus on repairing and reshaping the structure of the main dam, the secondary dam, reinforcing the upstream slope with concrete or without-mortar stone. They also strengthen or expand the size of the spillway to increase discharge capacity, repair or renovate existing intake, replace hydraulic lifting systems at the inlets and overflow gates, drilling and grouting for waterproof the main dam body, and improve service roads.

The project implementation period is expected within 6 years, from July 8, 2016, to June 30, 2022. Regarding environmental protection, the ESMF of the project has been published since 2015. The Environmental and social impact assessment (ESIA) for the sub-projects in the next year will follow the project implementation schedule agreed between CPMU, PPMU, and WB.

In Bac Kan province, the dam rehabilitation and safety improvement sub-project are implemented to ensure reservoir safety through rehabilitation and safety improvement of 07 dams and solidifying related infrastructure works. It helps take initiative in irrigation water, strengthen the management and safe operation capacity of the dam to protect people as well as the socioeconomic infrastructure of the project area in 6 communes of Bach Thong, Na Ri, and Cho Moi and ChoDon districts.

1.1 Method of implementation

The ESIA is conducted in accordance with the WB safeguard policy requirements and Law on Environment Protection,. The purpose of ESIA is to determine the importance of environmental and social issues during making a decision by studying; evaluating clearly impacts on the environment and society. In addition, it finds out the solution for mitigation for negative impacts. It should determine early and describe characteristics of significant environmental social impacts to help local communities and authorities having an assessment of the impact on environment and society of the sub-project proposed, and conditions which are needed to apply in order to mitigate risk to those impacts.

1.1.1 Method of social impact assessment

The target of the SA report is conducted at the same time with the Environmental Assessment of the sub-project, with two goals. The first considers the potential impacts of the Sub-project, negative and positive, based on the activities execution plan of the sub-project. The second looks from design of methods for solving potential negative influences and suggests community development activities that concerned with development targets of the sub-project. Determining negative influences, conducting consultation with the locality, governmental organizations, relevant of the project will be conducted in order to affected people shall be compensated and supported satisfactory and timely, at least socioeconomic activities of them restoring back to the pre-execution status of the project. In addition, in the long term, it ensures their lives will not get worse, are considered because of the sub-project.

As part of the social assessment, are ethnic minorities (EM) living in the sub-project area, assessed and confirmed their presence in the sub-project area through screening on ethnic minorities (according to the OP 4.10 policy of the WB). Consultations are informed in advance in an appropriate manner to identify support to the community when sub-project

implementation. Ethnic screening is conducted in accordance with World Bank OP 4.10 guidelines and is conducted within the scope and area of social assessments corresponding to the scope of environmental assessment (according to OP 4.01).

A gender analysis was also conducted as part of the SA to describe the gender characteristics in the sub-project area. It allows gender integrating to promote gender equality and to improve gender equality. Further, it improves the development efficiency of the sub-project and the whole project. Depending on the scale of the potential project impacts identified, and the project development goals, GAPs, and gender action plan monitoring have been prepared.

To ensure that, all potential impacts can be identified during project preparation, the SAs are conducted through consultations with various parties involved in the sub-project. An important part of the concern is the household level, the potentially affected people by the project (both positive and negative). The evaluation techniques employed for this SA include 1) review of secondary data, 2) field observations; 3) focus group discussions/community meetings, 4) Detailed interviews, and 5) household surveys.

1.1.2 Methods of environmental impact assessment

In the process of research, survey and reporting ESIA, the consultant has used a combination of following research methods:.

(a) Rapid assessment method

Rapid assessment method issued by the World Health Organization (WHO) in 1993. The basis of rapid assessment methods are based on the nature of raw materials, technologies, laws of the processes in nature and level of experience to the pollution load.

In Vietnam, this method was introduced and applied in several ESIA studies; perform the relatively accurate calculation of pollution emissions in conditions of limited instrumentation, analysis. In this report, the pollution emission coefficients are taken according to guidelines of the World Bank EIA (Environmental Assessment Sourcebook, World Bank, Washington D.C. 8/1991).

(b) Construction methods of impact matrix

Preparing the correlation between the impact of project activities on each issue and each environmental component is expressed on the impact matrix. On that basis, it orients the content detailed impact study.

(c) Comparative method

Method of comparison was to assess the quality of the environment, the quality of the effluent, pollutant load ... because of comparison with the norms and standards related environment, the regulations of the MONRE, Ministry of Health as the research and experimentation related.

(d) Description of environmental systems

Identify the components of the project's environmental impact. Identify a full line of waste, the environmental issues involved in service work of detailed assessment.

(e) Method of enumeration

Used widespread (since the national environmental protection Agency established in some countries - NEPA) and bring many positive results due to the many advantages presented approach clear, supply acute during system analysis and system evaluation. It includes two main categories: Listing describes the environmental components needed

research along with information about the measurement, prediction, and assessment. Simply listing the components necessary to study the environment likely to be affected.

(f) Method of system analysis

This method does common applied in the environment. The advantage of this approach is a comprehensive assessment of the impact, does very useful in identifying the impact and waste sources. This method is applied based on the review of waste sources, sources of impact, subject to the impact, the components of the environment ... like the elements in a system that every intimate relationship with each other. Thereby we determine, analyze and assess the impact.

(g) Methods of public consultation

This method is used during interviews with local leaders and people to collect the necessary information for the ESIA of the project. It also introduces the potential benefits and negative impacts of the project on the environment and life. On that basis, it synthesizes feedback on the project and aspirations of the local people.

On the other hand, in each commune in sub-projects conducting engagement with the community and those affected directly or indirectly by the activities of the sub-projects to exchange, direct interviews with local officials and residents on the socio-economic development, farming traditions, and sanitation conditions.

(h) Methods of collection and analysis of information, data

This method aims to identify, evaluate natural and socioeconomic conditions in the project implementation area through the data and information gathered from various sources such as the Statistical Yearbook, socioeconomic situation report, the environmental status of the region and the work involved.

(i) Field survey method

Field surveys are required when conducting social-environmental impact assessments to determine the status of the project implementation area, nearby stakeholders, and surveys to select locations for taking a sample, survey the status of water supply, drainage, electricity...

The consulting agency has conducted topographic and geological surveys and collected hydro-meteorological documents to serve the design in accordance with the current standards of Vietnam. These survey results are used to assess the natural conditions of the sub-project area.

(j) Expert panel method

Base on the knowledge and experience of environmental impact assessment experts of the consultant and the other scientific research organizations.

(k) Methods of sampling and sample analysis in the laboratory

Sampling and analyzing environmental components (soil, water, air) will be conducted to determine and evaluate the status of environmental quality in the sub-project area.

After the field survey, a sampling and analysis program will be set up with the following main contents: sampling location, measurement and analysis parameters, personnel, necessary equipment and tools, execution time, sample preservation plan, analysis plan, etc.

For sub-project in Bac Kan, the consultant has cooperated with the Center for

Environmental Monitoring and Modeling Research (which certified by the MONRE to be eligible for environmental monitoring service activities, with the code No. VIMCERTS 198) organized monitoring, sampling, and analysis of air, water and soil samples in the area of seven reservoirs to assess the status of the quality of environmental components. The sampling, analysis, and preservation of samples all comply with the current QCVN.

1.2 Implementation organization of the ESIA Report

Project owner

Bac Kan Construction and Investment Project Management Unit

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Consultant preparing the Report

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Table 1. List of Experts preparing the report

No.	Name	Speciality	In charge of
1	Nguyen Le Phu	Expert on Environment	**Team leader** The Report preparation
2	Trinh Anh Duc	Expert on Hydrology	Field survey; environmental impact assessment, mitigation measures, community consultation
3	Le Hung Anh	Expert on Eco-environment	Field survey; environmental impact assessment, biodiversity
4	Phan Thi Tram	Expert on Environment	Field survey; environmental impact assessment, mitigation measures
5	Tran Huu Tinh	Expert on Irrigation	Field survey; environmental impact assessment,
6	Bui Thai Bach Duong	Expert on Environment	Field survey; environmental impact assessment, community consultation, environmental management plan
7	Dang Thi Hoa	Expert on Society	**Deputy team leader** will be responsible for social issues for the consulting team.
8	Do Minh Khue	Expert on Society	Conducting social surveys, community consultations
9	Pham Quang Hoc	Expert on Ethnic Minority	Implementation of Ethnic Minority Report, community consultation
10	Dao Thanh Thai	Expert on Gender	Conduct social surveys, gender, community consultations

No.	Name	Speciality	In charge of
11	Quang Thu Nguyet	Expert on Resettlement	Implementation of Resettlement report

CHAPTER II. DESCRIPTION OF THE SUB-PROJECT

The DRSIP sub-project in Bac Kan will be implemented in 6 communes in Na Ri district, Bach Thong, Cho Moi, and Cho Don. About the status of infrastructure in 7 reservoirs, mostly built over 10 years ago, the quality of structures has degraded, some dam slope are seepage and erode, the drain sluice, the intake, overflow spillway is cracked; management road has not been solidified, damaged should be repaired and upgraded to ensure the safety and operation of the reservoir.

2.1 The objective of the sub-project

1) To restore and ensure work safety through repair and upgrade reservoirs and dams have been degraded or short of flood discharge capacity.
2) Improve the institutional and policy management, monitor the national level dam safety, strengthening the management, operation and coordination mechanisms and information on the basin
3) Ensuring the capacity to serve stable irrigation for crops; Limiting negative impacts on the environment, the landscape of reservoir and downstream areas.
4) Ensure the capacity for irrigation for crops stable; Limit the negative impact on the environment, landscape and lake area downstream.
5) Ensure the safety of dam stabilization and restoration of design functions through repairing, upgrading and equipping forecasting and operating equipment.
6) Improve the capacity of project management and implementation, environmental and social management.
7) Improve the capacity of project management and implementation, environmental and social management.
8) Improve livelihoods, the quality of life for people in the project area and promote socioeconomic development by promoting the efficiency of rural infrastructure investments. At the same time, approach and apply scientific and technical advances in agricultural production, minimize the loss of cultivated land, improve intensive farming and diversify in agriculture. In addition, it provides stable employment opportunities for people, contributes to sustainable poverty reduction, helps people to access services better such as health care, education, markets, cultural exchanges, and faith. It is also to reduce production costs, transportation costs, and enhance the exchange and trade of agricultural products and at the same time contribute actively to the development of a new rural program and strategy for socio-economic development in local.

2.2 The geographical location of the sub-project

Repairing and renovating headworks of 7 reservoirs is in Bac Kan province in the following locations:

Table 2. Location of 7 reservoirs belonging to the sub-project

Index	**Name of the reservoir**	**Grade of work**	**Location**	**Height of dam Hmax (m)**	**Working capacity (10^3 m3)**	**Coordinate of the reservoir** (Meridian106°30'. projection zone 3°)

						X(m)	Y(m)
1	May Day	III	Dong Xa commune, Na Ri district	17	102	2437561.72	453719,97
2	Coc Thong	III	Liem Thuy, Na Ri	27	234.41	2420796.90	429385,81
3	Na Kien	IV	Nghia Ta, Cho Don	3 earth dams. with the height of 8.37; 6.29; and 6.82	206.00	2441629.74	399289,43
4	Khuoi Day	III	Yen Han, Cho Moi	20.4	193.99	2426531.41	441090,51
5	Khuoi Sung	III	Yen Han, Cho Moi	17.3	211.70	2426588.38	442324,62
6	Khuoi Dang	III	Thanh Mai, Cho Moi	21.5	242.00	2436419.63	423232,25
7	Na Leng	III	Sy Binh, Bach Thong	13	115.4	2465044.11	439889,40

Table 3. Actual status of management and use of land in the project area

Index	Name of the reservoir	Year of building	basin (km^2)	Irrigation area (ha)	Classification of dam	Management company
1	May Day	2008	0.85	20	Large dam	Bac Kan Irrigation Development Management One-Member Limited Company
2	Coc Thong	2009	1.5	46.2	Large dam	
3	Na Kien	1976	0.8	52	Small dam	
4	Khuoi Sung	2009	1.2	40	Large dam	
5	Khuoi Day	2006	1.1	40	Large dam	
6	Khuoi Dang	2006	1.6	45	Large dam	
7	Na Leng	2007	0.75	25	Small dam	

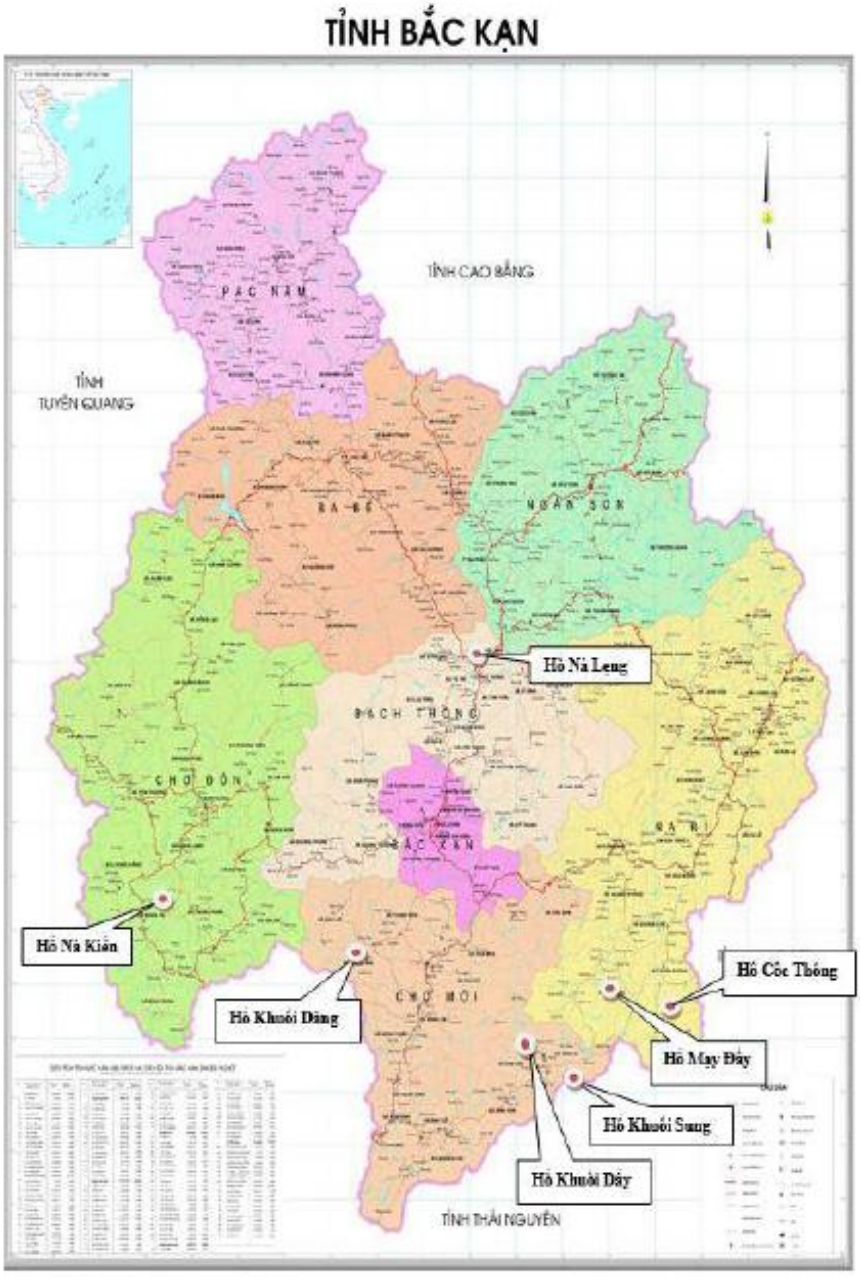


Figure 1: The map of 7 reservoirs belonging to the project

Figure 2: The diagram of works belonging to The May Day reservoir - Dong Xa commune

Figure 3: The diagram of works belonging to The Coc Thong reservoir - Liem Thuy commune

Figure 4: The diagram of works belonging to the Na Kien reservoir - Nghia Ta commune

Figure 5: The diagram of works belonging to the Khuoi Sung reservoir - Yen Han commune

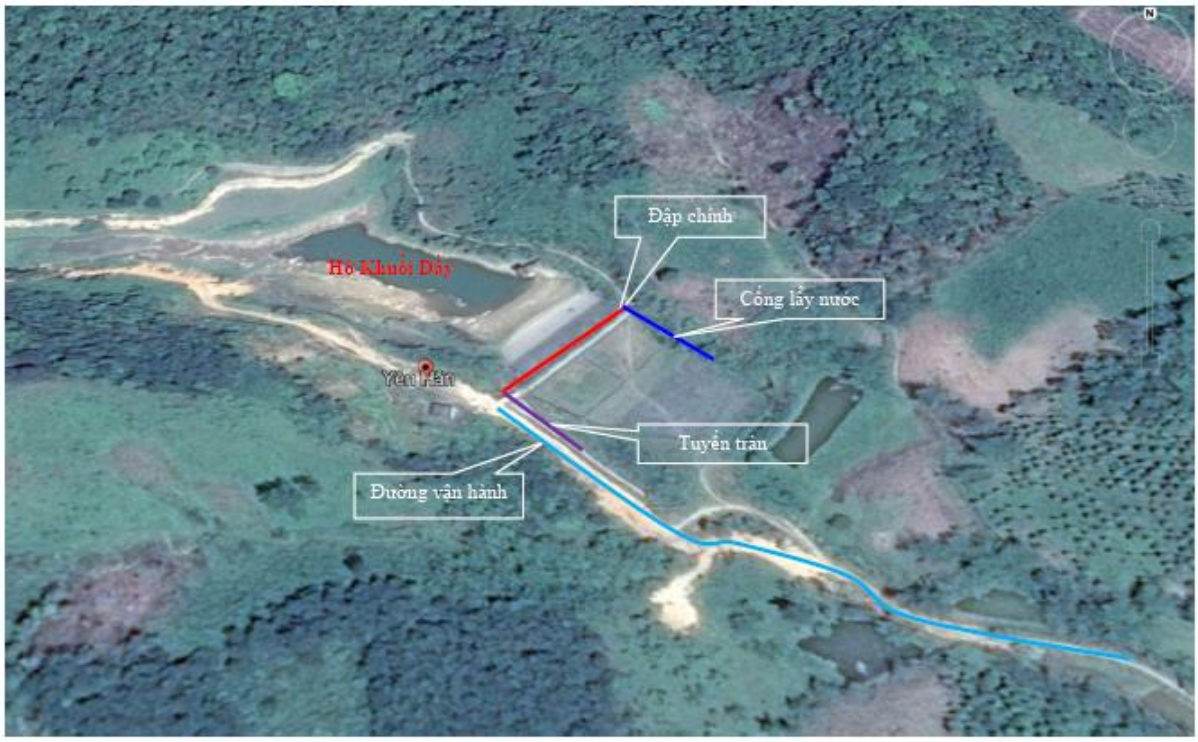


Figure 6: The diagram of works belonging to The Khuoi Day reservoir - Yen Han commune

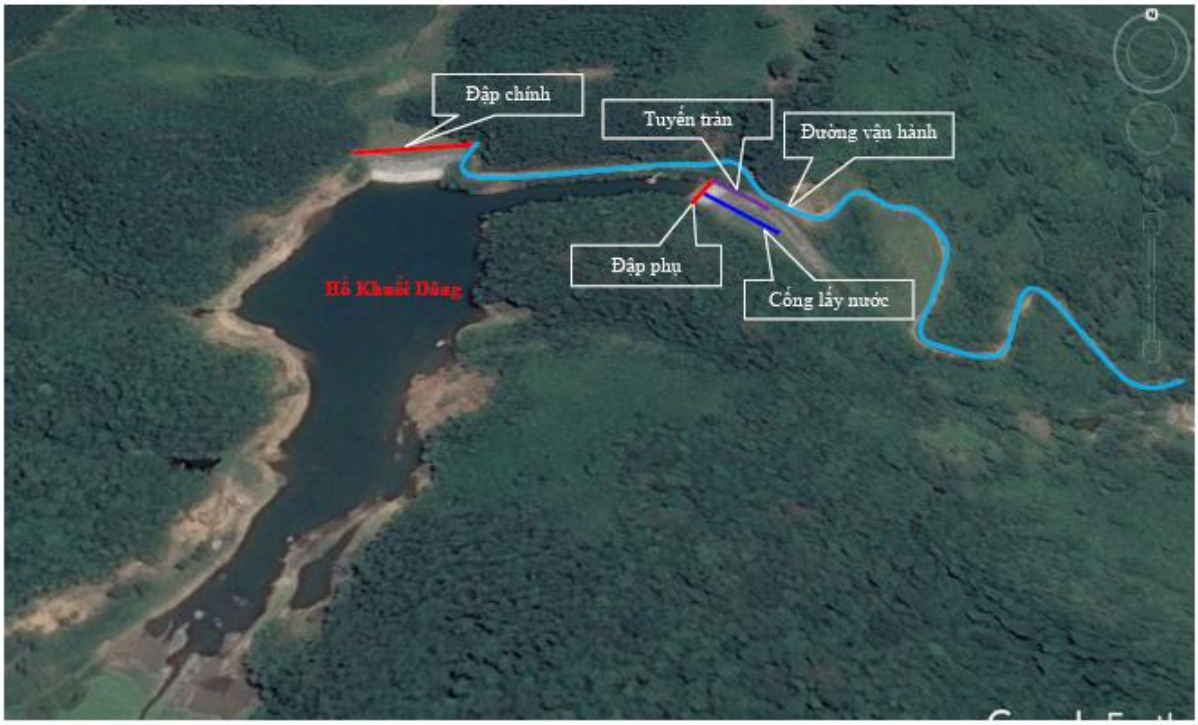


Figure 7: The diagram of works belonging to The Khuoi Dang reservoir - Thanh Mai commune

Figure 8: The diagram of works belonging to The Na Leng reservoir - Sy Binh commune

2.3 Status of works and construction items

Table 4. Summary of status of reservoirs and construction items of the sub-project

Location	Actual status	Construction items	Pictures of current
1) The May Day reservoir in Dong Xa, Na Ri district	- The dam is designed to be a homogeneous earth dam, 80 m in length, the largest dam height Hmax = 17.0 m; the upstream roof is reinforced with concrete poured in place into sheets (length x width) = (2.5x1.5) m; Downstream slope is planted with grass, without surface drainage ditches; There is no pile of water to drain. After many years of managing and exploiting, the main dam route has now revealed its deterioration and degradation. - Seepage flow has occurred in the left shoulder downstream of the dam when the lake water level was high; the downstream dam toe from the outlet to get water to the left shoulder is swampy, the groundwater rises, easily causing unsafe foot dam. - The flood spillway is located in the body of the dam with the wing-wall is a rock masonry structure, now cracked. The contiguous section between the spillway wall and the earth dam body has appeared to adjacent the gap and appears water penetration through these slots when the water level of the lake will rise and cause unsafe for dam toe. - The upstream roof is reinforced with reinforced concrete, poured in place, divided into sheets (height x length x width) = (0.10x5.0x5.0) m. In basically it is possible to take advantage of, but the contiguous locations between the concrete slabs poured in the grass where the grass needs to be	- The dam crest has to elevate up, perfect the crest level of the dam. Have to harden the dam crest by the grade-250 concrete structure. Make a wave wall upstream of the dam's face with the grade-250 reinforced concrete structure. Make the curb on the downstream side of the dam's crest with the concrete structure grade-250. - Upstream dam: Currently reinforced with reinforced concrete poured in place, still under good condition, should remain the current roof, not repaired. - The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, grade 200 concrete structures. Make the trapezoidal-section drainage ditches on both shoulders of the embankment with grade 200 concrete structures. Renew the	 

Location	Actual status	Construction items	Pictures of current
	removed. - The dam's face has been reinforced with concrete. However, there are cracks on both sides of the upper and lower sides, many of the sides of the dam have subsided, need to be completed to ensure the favorable conditions for the operation and management of the lake. - The downstream slope of the dam is planted with grass, but the grass is free and sparse, the trees are small and weak, the downstream slope does not have drainage ditches on the surface, there is no without-mortar stone to drain the saturated road. Whenever the water level rises, there is a phenomenon of wetting the downstream roof. Over time and in each rainy season, the downstream roof is eroded causing many holes, holes, deep holes on the surface, the land on the downstream roof is always in a humid condition, easily causing instability for banging. - The overflow located in the dam body, perpendicular to the dam and the dam shifted toward description. The form of the spillway is straight free-flowing, broad-crested weir; water aperture of B = 4.0 m wide (length of overflow threshold σ = 5.0 m), a width of the chute Bdoc = 4.0 m; with absorption basin. The structure of the spillway threshold is concrete, with the ashlar-stone wall; the absorption basin with the reinforced concrete structure of the upper layer, the lower layer is ashlar stone.	drainage system for the slope by pouring snecked rubble on the slope-surface and trapezoidal-section stone block in the toe of the dam. - Installation of equipment for water-level monitoring, displacement monitoring and saturation monitoring for dams. - Doing waterproof for the dam body and base with the form of grouting, seepage stop (traditional jet grouting). The liquid is clay - cement. The number of borehole lines is 03 rows, with the distance between the rows is every 1.50m, the distance between holes on a row is 03m / hole; boreholes on the two lines are staggered. - Destroying the old degraded spillway, renewing the spillway with the grade 300 reinforced concrete structure, the overflow is the free spillway - The water intake: Supplementing the valve house upstream of the drain and operating with DN300 “pyramid” valve; adding the valve houses in downstream operate by disc valve DN300; replace new the	

Location	Actual status	Construction items	Pictures of current
	- At present, many positions have been peeling in the overflow area, the pitch is on the slope, the bottom slopes and the foot of the wall; overflowing pitches appear horizontally, so there is a potential risk of fear when trying to rain. - The surface of the overflow threshold has been peeled off when the lake water level rises, the seepage flows from the body of the overflow threshold, directly threatening the work stability. The Mining Management Unit has strengthened and repaired a part of the spillway, but there is still a risk of unsafe work. - The water sluice is located on the main dam and is located to the left of the dam. The form of the sluice is a circle, made of DN300 diameter cast iron pipe placed on a concrete pedestal. It is controlled by downstream disc valves, without valve houses in upstream and downstream. - The outlet of the drain is a DN250 steel pipe, connected directly to the back drain, a disc valve with a diameter of DN300. The steel pipe is about 250 m long, going along the stream to the regulating house. There are three valves regulating water to discharge three concrete canal routes of three irrigation areas. At present, the disc valves' position of the intake drain is broken, so the water is always fertile at this location. On the other hand, the pipeline connecting behind the valve is a steel pipe also connected by a rubber washer flange. Due to long days and no support system, the protective layer has rusted and many cracks of	steel pipe section which connected after the downstream control valve to the water-regulating house by the new DN250 diameter cast-steel pipe, 5 mm thick and 201 m long. The sewer lines in the old dam body. - Break down the old drain; rebuild the drain system to collect water. The circular culvert is made of cast iron pipe, placed on the reinforced concrete pedestal, regulated by a downstream valve. The type of sluice is pressured-flow. Build the valve houses in the downstream. - Upgrading the road to manage roads from the dirt roads to cement concrete roads, with a width of the roadbed Bn = 4.0 m; width of the road surface Bm = 3.0 m, the total length L = 769.46 m. The pavement structure by concrete grade 250 is 16 cm thick.	

Location	Actual status	Construction items	Pictures of current
	steel pipes have appeared. Water leakage has also occurred in cracks and connections of steel pipes. On the other hand, because the lake has quite a high water column, closing, and opening to get water by a valve downstream is very difficult. At the same time, it makes the valve easy to get stuck and broken gaskets, losing the ability to keep watertight. - The management road is about 800 m long, which is a rural road for people's livelihood and reservoir operation management. Now it is still a dirt road, many small and very steep sections, often damaged by floods and floods, making it difficult for lake management in the rainy season and the movement of people living in the area. - Due to small works, so the proposal does not build a management house.		
2) The Coc Thong reservoir in Liem Thuy, Na Ri district	- Dam: designed being a homogeneous earth dam, with a length of 103.59 m, the largest dam height Hmax = 20.7 m; The upstream slope is reinforced with paving stone; The downstream slope was planted with grass, with drainage ditches on both sides of the dam shoulder; the drainage block at the dam downstream is rock prismatic. Over many years of management and exploitation, up to now, the main dam has exposed the damaged and degraded: - Along the downstream slope of the dam is about 1m below the berm, strong seepage flow occurred, water permeating the entire dam slope below the	- The dam crest has to elevate up, perfect the top of the dam. Have to harden the dam crest by the grade-250 concrete structure. Make the upstream wave retaining wall with reinforced concrete structure grade 250. Make the curb on the downstream side by the concrete structure of grade 250. - The upstream dam slope: Currently reinforced with ashlar, it is still good, keeps the current slope without repair.	

Location	Actual status	Construction items	Pictures of current
	berm makes the embankment here pasty and muddy, the level of permeability increases gradually by the time. - The dam surface has been reinforced with gravel, and there have appeared many subsidence areas that need to be improved; berms on both sides of the upstream and downstream by masonry have cracked. The surface of the dam is degraded and needs to be refurbished to ensure it is convenient for lake operation and management. - The downstream slope is planted with grass. However, plants grow freely and are weak small plants. The drainage blocks in the downstream slope, the surface is covered by sandy soil and many locations are skewed, reducing the function of drainage. Therefore, whenever the water level rises, the permeability flow does not collect to the rock pile but rises to the surface of the dam slope, making wet the entire downstream slope from the dam muscle to the top of the rock pile. Over time, rainwater and currents erode the downstream slope, resulting in many deep pits on the surface. The downstream slope is always in a humid state, causing instability for the dam. - The spillway on the right shoulder of the earth dam: with form of vertical overflow, free spillway, broad-crested weir; width of overflow B = 5.5 m (length of over-fall aperture b = 5.0 m), the width of slope Bdoc = 4.5 m; the form of a dispersion of energy is dissipation-tank type. The structure of the threshold is concrete, masonry sidewalls; the	- The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, grade 200 concrete structures. Make the trapezoidal-section drainage ditches on both shoulders of the embankment with grade 200 concrete structures. Repair the drainage prism. - Installing equipment for water-level monitoring, displacement monitoring and saturation monitoring for dams. - Doing waterproof for the dam body and base with the form of grouting (traditional jet-grouting). The liquid is clay - cement. The number of borehole lines is 02 rows, with the distance between the rows is every 2.0 m, the distance between holes on a row is 03 m / hole; boreholes on the two lines are staggered. - The current state of the spillway is good, just need to repair the entrance and overflow threshold	 

Location	Actual status	Construction items	Pictures of current
	structure of the energy dissipation tank is a reinforced concrete of the upper layer and lower layer by masonry stone. - In basically, the spillway is still good, but there have been many locations that were peeled off in the overflow area, such as the platform on the chute, the base of the slope and the toe of the wall. On the other hand, along the chute, was covered with overgrown vegetation over the spill walls and spilled rock on the chute, reducing discharge capacity. - The sluice is located on the main dam and to the left of the dam. The form of the sewer is a circular sluice made of DN400 diameter cast-iron pipe, placed on a concrete pedestal, controlled by a "chop" valve in upstream, and control valves are located in the valve house. - At present, the sewer is still in good working condition. - The management road is about 148.80 m long, managing and operating the reservoir, but at present, it is still an earth road. Many small and very steep sections are frequently damaged by floods, making it difficult to manage the lake during the rainy season and to travel of people living in the area. - Due to small works, so the proposal does not build a management house.	with the structure of paving stone and grade-100 mortar and grade-300 reinforced concrete. Make bridges over the spill with the reinforced concrete structure of grade-300. - The water intake: the old drain is the cast-iron pipe of DN400 diameter, operated by disc valve in the downstream, still in good condition and should keep intact. - Upgrading of the management road from dirt roads to cement concrete roads, with a width of Bn = 4.0 m; width of the road surface Bm = 3.0 m, the total length L = 148.80 m. The structure of the road surface is grade 250 concrete, 16 cm thick.	
3) Na Kien reservoir in	- The situation of earth dam: The lake has 3 main dams and 5 sub-dams, of 5 auxiliary dams there are	- The dam crest has to elevate up, perfect the top of the dam. Have to	

Location	Actual status	Construction items	Pictures of current
Nghia Ta, Cho Don district	3 inter-reservoir auxiliary dams and 2 other dams. Currently, the width of the dam faces is from 3.0 to 4.0 m. Through a field survey on 10/5/2018 of the dams, shows: the slope of the upstream and downstream is soil, has no paving stone. Upstream and downstream roofs do not have drainage equipment; there has been erosion phenomenon into trenches, seepage in the dam body and around the sluice gate. Therefore, it is necessary to have a timely solution to handle the above infiltration phenomenon to ensure that the lake always has enough water as designed. - The situation of flood overflow: Located on the left shoulder of sub-dam No. 5, the form of the spillway is a broad-crested weir, the spillway threshold is the natural soil, because the annual floods have eroded, so the shape of the current spillway no more. Now it was just a saddle-shaped isthmus. The elevation of the spillway threshold is at 85.10 m. - The situation of the water intake under the dam body: There are 3 drains under the three main dam bodies. The current form of the water intake is ladder-step, made of stone. Over many years of operation, the sewer has been degraded, the caps for watertight have been broken, leaking water has lost a lot, thus affecting the water storage of the reservoir; the operation of the drain operation is very difficult. - The current situation of construction roads and operation management: Currently, there are soil	harden the dam crest by the grade-250 concrete structure. Make the upstream wave retaining wall with reinforced concrete structure grade 250. Make the curb on the downstream side by the concrete structure of grade 250. - The upstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by rock putting into the concrete structure. - The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, grade 200 concrete structures. Make the trapezoidal-section drainage ditches on both shoulders of the embankment with grade 200 concrete structures. Renew the drainage devices by the drainage prism. - Renew the flood overflow on the main dam No.3, spillway structure	

Location	Actual status	Construction items	Pictures of current
	roads, some very narrow sections with a width of about 2 m; after many years of use due to rain, the road surface has been strongly eroded, convex and concave, and traveling is very difficult, affecting the operation management and rescue when an incident occurs. - Due to small works, so the proposal does not build a management house.	with reinforced concrete M300. The form of overflow is free spillway. - Renew 03 culverts to get water at the main dams No. 1, 2 and 3. It is a circular sewer structure with a nodular cast iron pipe, placed on the reinforced concrete pedestal, regulated by a valve downstream. The form is pressure-flow. Have to construct valve houses downstream. - Upgrade 1,545.6 m of the operation management road. Width of surface B surface = 3.0 m, width of platform B = 4.0 m. Pavement structure is made of #250 concrete, 16 cm thick.	
4) The Khuoi Sung reservoir in Yen Han commune, Cho Moi district	- The earth dam has a width of 4.0 m. The dam's upstream slope is reinforced by paving stone; downstream planted grass. The downstream drainage equipment is rock drainage prismatic. There was a phenomenon of infiltration from the dam body to the downstream slope; the infiltration position is located on the top of the drainage prismatic, on the right bank, near the overflow. Permeate from the dam body and around the spillway. Therefore, it is necessary to have a solution timely to solve the above seepage phenomenon to ensure that the lake always has	- The dam crest has to elevate up, perfect the top of the dam. Have to harden the dam crest by the grade-250 concrete structure. Make the upstream wave retaining wall with the reinforced concrete structure grade-250. Make the curb on the downstream side by the concrete structure of grade 250. - The upstream slope: reinforcing the slope by without-mortar paving rock, still under good condition, so	

Location	Actual status	Construction items	Pictures of current
	enough water according to the design. - The existing earth dam with upstream-slope factor m = 3.0-3.5, has been reinforced with without-mortar paving stone, which is quite good. The downstream slope has inclined-factor of m = 2.25-2.5, the downstream slope has many stone-drainage prismatic; trees grow much, greatly affecting the drainage of dam body; the downstream slope has much permeable water, cause eroding downstream slope above the drainage prismatic. - The upstream and downstream slope is quite stable. For the upstream slope, has reinforced, solidified by without-mortar paving stone, still good, not peeled. The downstream slope is drained by rock prismatic. On this slope, vegetation grew much covered the prismatic. There also has the phenomenon of seepage through the dam body to the downstream, make a sagging downstream slope, which can be unsafe. - The overflow: spillway on the right shoulder of the dam, the width of spillway: B spillway 7.2 m, elevation threshold at 383.9 m. Status of overflow: solidified by reinforced concrete. Assess the current state of overflow: Spill is solidified by reinforced concrete at the tip of the spillway into the lakebed, grass grows on the chute, dissipation tanks. - The water intake: the position of the sewer is on the left shoulder of the dam, with the circular structure of reinforced concrete, size Ø40cm diameter, pressure flow mode. Opening and closing by the	keep the original, do not repair. - The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, the grade-200 concrete structures. Make the trapezoidal-section drainage ditches on both shoulders of the embankment with grade 200 concrete structures. Repair the drainage prism. - Installing equipment for water-level monitoring, displacement monitoring and saturation monitoring for dams. - Doing waterproof for the dam body and base with the form of grouting (traditional jet-grouting). The liquid is clay - cement. The number of borehole lines is 03 rows, with the distance between the rows is every 1.5 m, the distance between holes on a row is 03 m / hole; boreholes on the two lines are staggered. - The current state of the spillway is	 

Location	Actual status	Construction items	Pictures of current
	screw valve below the downstream. Assessing the sewer condition: still good - The downstream canal behind the sewer is mason canals, with dimensions of 0.5x0.5m and 0.3x0.4m. - Management and operation road combined with the rescue of the existing dam is about 600 m long; b = 3.5 m reinforced with concrete. - Due to small works, so the proposal does not build a management house.	good, just need to repair the entrance and narrow section on the chute by grade-300 reinforced concrete. - The water sluice: is good, have not to repair. Renew the steps for the downstream valve house. - Upgrade 150 m of the operation management road. Width of surface B surface = 3.0 m, width of platform B = 4.0 m. Pavement structure is made of #250 concrete, 16 cm thick.	
5) The Khuoi Day reservoir tin Yen Han commune, Cho Moi district	- The earth dam has a width of 4.0 m. The dam's upstream slope is reinforced by without-mortar paving stone; downstream planted grass. The downstream drainage equipment is rock drainage prismatic. There was a phenomenon of infiltration from the dam body to the downstream slope; the infiltration position is located on the top of the drainage prismatic, along the downstream of the dam and wing of the spillway. Therefore, it is necessary to have a solution timely to solve the above seepage phenomenon to ensure that the lake always has enough water according to the design. - The existing earth dam with upstream-slope factor m = 3.0, has been reinforced with without-mortar paving stone, which is quite good. The downstream slope has inclined factor of m = 2.25-2.5, the downstream slope has a stone-drainage band; trees	- The dam crest has to elevate up, perfect the top of the dam. Have to harden the dam crest by the grade-250 concrete structure. Make the upstream wave retaining wall with the reinforced concrete structure grade-250. Make the curb on the downstream side by the concrete structure of grade 250. - The upstream slope: reinforcing the slope by without-mortar paving rock, still under good condition, so keep the original, do not repair. - The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K	

Location	Actual status	Construction items	Pictures of current
	grow much, greatly affecting the drainage of dam body; the downstream slope has much permeable water, cause eroding downstream slope above the drainage prismatic. - The upstream and downstream slope is quite stable. For the upstream slope, has reinforced, solidified by without-mortar paving stone, still good, not peeled. The downstream slope is drained by the stone-drainage band. On this slope, vegetation grew much covered this drainage band, need to clear. Above the drainage band, there also has the phenomenon of seepage through the dam body to the downstream, make a sagging downstream slope, which can be unsafe. - The spillway: location is on the right shoulder of the dam, the width of B spillway 7.0 m, elevation threshold at 382.8 m. Status of overflow: solidified by reinforced concrete, still good. For the tail of the chute is broken, eroded seriously, and caused unsafety for the discharge route. - The water intake: the position of the sewer is on the left shoulder of the dam, with the circular structure of reinforced concrete, size Ø40cm diameter, pressure-flow mode. Opening and closing by the "pyramid" valve in the upstream. Assessing the sewer condition is still good. - Management and operation road combined with the rescue of the existing dam is about 251.27 m long; b = 3.5 m still is aggregate, was degraded much. - The work has a management house on the right	=0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, the grade-200 concrete structures. Make the trapezoidal-section drainage ditches on both shoulders of the embankment with grade 200 concrete structures. Repair the drainage system including drainage prism. - Installing equipment for water-level monitoring, displacement monitoring and saturation monitoring for dams. - Doing waterproof for the dam body and base with the form of grouting (traditional jet-grouting). The liquid is clay - cement. The number of borehole lines is 03 rows, with the distance between the rows is every 1.5 m, the distance between holes on a row is 03 m / hole; boreholes on the two lines are staggered. - The current state of the spillway is good, just need to repair the tail of the chute by grade-300 reinforced concrete and stone with grade-100 mortar. - The water sluice: is good, have not	 

Location	Actual status	Construction items	Pictures of current
	bank.	to repair. - Upgrade 251.27 m of the operation management road. Width of surface B surface = 3.0 m, width of platform B = 4.0 m. Pavement structure is made of #250 concrete, 16 cm thick.	
6) The Khuoi Dang reservoir in Thanh Mai, Cho Moi district	- The reservoir has 1 main dam and 1 auxiliary dam. At present, the width of the dam crests of 4.0 m. Through the survey at the site on 25 Nov 2018 shown that the main dam body is earth, the upstream slope is reinforced by without-mortar paving stone, the downstream planting by grass. The downstream drainage equipment is rock drainage prismatic. There was a phenomenon of infiltration from the dam body to the downstream slope; the infiltration position is located on the top of the drainage prismatic, along the downstream slope and around the spillway. Therefore, it is necessary to have a solution timely to solve the above seepage phenomenon to ensure that the lake always has enough water according to the design. The auxiliary dam is still good, the downstream slope has not any phenomenon of infiltration so it can keep the origin of the auxiliary dam. - The existing earth dam with upstream-slope factor m = 3.0, has been reinforced with without-mortar paving stone, which is quite good. The downstream slope has inclined-factor of m = 2.25-2.5, the downstream slope has many stone-drainage	- The dam crest has to elevate up, perfect the top of the dam. Have to harden the dam crest by the grade-250 concrete structure. Make the upstream wave retaining wall with the reinforced concrete structure grade-250. Make the curb on the downstream side by the concrete structure of grade 250. - The upstream slope: reinforcing the slope by without-mortar paving rock, still under good condition, so keep the original, do not repair. - The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, the grade-200 concrete structures. Make the trapezoidal-section drainage	

Location	Actual status	Construction items	Pictures of current
	prismatic; trees grow much, greatly affecting the drainage of dam body; the downstream slope has much permeable water, cause eroding downstream slope above the drainage prismatic. - The upstream and downstream slope is quite stable. For the upstream slope, has reinforced, solidified by without-mortar paving stone, still good, not peeled. The downstream slope is drained by rock prismatic. On this slope, vegetation grew much covered the prismatic. There also has the phenomenon of seepage through the dam body to the downstream, make a sagging downstream slope, which can be unsafe. - The overflow: spillway on the right shoulder of the dam, the width of spillway: B spillway 7.0 m, elevation threshold at 209.80 m. The status of overflow is solidified by reinforced concrete. Assess the current state of overflow is good. - The water intake: includes 02 sluices, 01 under the main dam, and 01 under the auxiliary dam. + For the sluice under the main dam, now is the circular one, by galvanized pipe D100, closing and opening by the downstream valve. The sluice is still good, keeps the origin. + For the sluice under the auxiliary dam, now is the circular one, by galvanized pipe DN400, closing and opening by the "pyramid" valve in the upstream. The sluice is still good, keeps the origin. - Management and operation road combined with the rescue of the existing dam is about 1416.04 m long;	ditches on both shoulders of the embankment with grade 200 concrete structures. Repair the drainage prism. - Installing equipment for water-level monitoring, displacement monitoring and saturation monitoring for dams. - Doing waterproof for the dam body and base with the form of grouting (traditional jet-grouting). The liquid is clay - cement. The number of borehole lines is 03 rows, with the distance between the rows is every 1.5 m, the distance between holes on a row is 03 m / hole; boreholes on the two lines are staggered. - The overflow route is arranged at the old position of the reservoirs. The spill is preserved. - The sewer line to get water is also arranged at the old position of the sewer and is kept as it is. - Upgrade 1,416.04 m of the operation management road. Width of surface B surface = 3.0 m, width of platform B = 4.0 m. Pavement structure is made of #250 concrete, 16 cm thick. Renew 04 culverts	 

Location	Actual status	Construction items	Pictures of current
	b = 4.0 m is still earth, has degraded much. - Due to small works, so the proposal does not build a management house.	across the road, with the D750 diameter circular sewers, precast reinforced concrete structures.	
7) The Na Leng reservoir in Sy Binh commune, Bach Thong district	- The dam: was designed with a homogeneous earth dam, with a length of 143.31 m, maximum height Hmax = 13.0 m; the upstream slope was reinforced by without-mortar paving stone; the downstream planted by grassing; with 2 drainage ditches on both shoulders. The form of drainage on the downstream slope is by the stone drainage band. Through many years of operation, it has appeared many damages, degraded. - Along the downstream slope, at the elevation of 468.0 m, about 1 m from the top of the stone band, appears the seepage flow quite strong, makes spill out the overall slope, make a sagging, the level increases over time up a - The dam surface has reinforced by gravel, appeared many depression areas, must re-perfect again. The curbs on both sides of upstream and downstream are by ashlar stone, appeared faults. The surface is degraded much; have to repair to ensure safety and convenience for operation and management of the reservoir. - The downstream slope is planted grass, however, it grew free and uncontrolled, mainly are weak and small grass. The drainage stone band on the downstream is by without-mortar paving stone. Some positions are displaced, reduced capacity of operation of the drainage device. Over time, the runoff,	- The dam crest has to elevate up, perfect the top of the dam. Have to harden the dam crest by the grade-250 concrete structure. Make the upstream wave retaining wall with the reinforced concrete structure grade-250. Make the curb on the downstream side by the concrete structure of grade 250. - The upstream slope: reinforcing the slope by without-mortar paving rock, still under good condition, so keep the original, do not repair. - The downstream slope: disposing of the weathered layer, filling back to perfect the section by compacted soil with compacting factor K =0.95; reinforcing the slope by grassing. Making the drainage water ditches with a rectangular section, the grade-200 concrete structures. Make the trapezoidal-section drainage ditches on both shoulders of the embankment with grade 200 concrete structures. Repair the drainage band. - Installing equipment for water-level	 

Location	Actual status	Construction items	Pictures of current
	seepage flow makes erode the earth's slope on the downstream side, appearing in some depression areas. The earth on the downstream slope is always under damp conditions, causes unsafe for the dam. - The overflow is on the right shoulder of the dam, is free spillway type; the width of spillway: B spillway 6.0 m (longitudinal length of the crest of σ = 4.0 m), the width of the chute of B doc = 4.0 m, dissipating energy by dissipation tanks. The structure of the crest is concrete, wall by ashlar stone; the dissipation tank by reinforced concrete for the upper layer, the lower layer is ashlar stone. - The spillway is quite good, however, it also appears some peels on the crest, the platform on the chute, base, and the toe of the wall. Grasses and brush grew bushy, covers all the spillway-wall and stone fallen down on the chute, reduces the capacity of discharge of the spillway. - The water intake: is on the main dam, on the left shoulder. The form of the sluice is circular, by DN400 diameter cast-iron pipe, set on the concrete pedestals, controlled by the "pyramid" valve in the upstream, which set in the valve house. Now it still operates well, has not damaged yet. - The management road is about 43.81 m long, combined with operation access of the reservoir, but now it is still earth, some places are narrow and very sloping, usually destroyed by a rainstorm, causing difficulties for traveling and managing during the storm season.	monitoring, displacement monitoring and saturation monitoring for dams. - Doing waterproof for the dam body and base with the form of grouting (traditional jet-grouting). The liquid is clay - cement. The number of borehole lines is 02 rows, with the distance between the rows is every 2.0 m, the distance between holes on a row is 03 m / hole; boreholes on the two lines are staggered. - The spillway with a width of B=6.0 m, ensure the capacity of discharge. In basically, it is quite good; just keep the origin and clear brush, which overlapped the spillway. - The water sluice: is good, by DN400 diameter cast-iron pipe, controlled by the "pyramid" valve in the upstream side, has not to repair. - Upgrade the operation management road up to the concrete road, with the surface width of B surface = 3.0 m, the width of platform B = 4.0 m. The total length of the road is L = 43.81 m. The surface structure is made of #250 concrete, 16 cm thick.	

Location	Actual status	Construction items	Pictures of current
	- Due to small works, so the proposal does not build a management house.		

Conclusion: In the present, many work items of the 7 reservoirs have degraded seriously, the amount of seepage flow caused lost a lot, affected to the stability of the dam in the rainy season as well as the capacity of taking water into main channels. Therefore, repairing, rehabilitating 7 dams is necessary and urgent.

❖ The correlation of the sub-project implementation area with surrounding objects

The correlation of the sub-project implementation area with surrounding objects is described as below:

Table 5. The correlation of the sub-project implementation area with surrounding objects

Index	The sub-project area	The correlation of the sub-project implementation area with surrounding objects				
		Transportation	**Hydrology and forest**	**Residential area**	**Production, business, and service establishments**	**Cultural and religious works**
1.	The May Day reservoir	- In the Northwest: the provincial road ĐT256 is apart from the reservoir about 4.5 km. - The management road is about 800 m long, being the rural road serving for people's living and managing, operating the reservoir. It is still an earthed road, many narrow and very slopping sections, often damaged by floods and rainstorms, making the difficulty managing the reservoir in the rainy season and traveling of people.	- In the Southeast: There are some aquaculture ponds of the people. The nearest pond is about 0.4 km from the lake.	- Around the lake, there are no residents.	- There are no facilities for production, business, and services around the lake.	- Around the lake, there are no cultural and religious constructions.

Index	The sub-project area	The correlation of the sub-project implementation area with surrounding objects				
		Transportation	**Hydrology and forest**	**Residential area**	**Production, business, and service establishments**	**Cultural and religious works**
		- In the North: Provincial Road DT 256 is about 2 km from the lake. - In the Southeast: Highway 1B is about 15 km from the lake.				
2.	The Coc Thong reservoir	- The management road is about 148.80 m long, which is the management and operation road of the reservoir, but now it is still an earthed road, many small and very slopping sections are often damaged by floods, very difficult for the management of the lake in the flood season and traveling of people living in the area.	- Around the lake, there are a number of aquaculture ponds by local people.	- The residential area around the lake (the nearest household is about 200 m to the east of the lake).	- There are no facilities for production, business, and services around the lake.	- Around the lake, there are no cultural and religious constructions.
3.	Na Kien reservoir	- In the west: about 1 km from the provincial road ĐT254. - The construction, operation, and management road: Currently, it is an earthed road, some sections are very narrow and width of about 2 m; After many years of use, due to rain, the road surface is strongly eroded, protruding, and difficult to access, affecting the operation management and rescue when an incident occurs.	- In the North: it is about 500 m from the lake to Nghia Ta lake. - In the South: There are some aquaculture ponds of the people.	- Around the lake, there are no residents.	- There are no facilities for production, business, and services around the lake.	- Around the lake, there are no cultural and religious constructions.

Index	The sub-project area	The correlation of the sub-project implementation area with surrounding objects				
		Transportation	**Hydrology and forest**	**Residential area**	**Production, business, and service establishments**	**Cultural and religious works**
4.	The Khuoi Sung reservoir	- In the northwest: from the lake to the provincial road DT256 about 1.5 km. - The management and operation road combined with the rescue of the existing dam is about 600 m long; b = 3.5m has been reinforced with concrete and is in good condition.	- Around the lake, there are a number of aquaculture ponds by local people.	- The nearest residential area around the lake is about 150 m to the West.	- There are no facilities for production, business, and services around the lake.	- Around the lake, there are no cultural and religious constructions.
5.	The Khuoi Day reservoir	- In the Southeast: is about 650 m from the lake to the provincial road DT256. - The management and operation road combined with the rescue of the existing dam is about 251.27 m long; b = 3.5 m still is an earthed one, has been degraded much.	- Around the lake, there are a number of aquaculture ponds by local people.	- The nearest residential area around the lake is about 350 m to the West.	- There are no facilities for production, business, and services around the lake.	- Around the lake, there are no cultural and religious constructions.
6.	The Khuoi Dang reservoir	- In the West north: is about 10 km from the lake to the provincial road DT257. - The management and operation road combined with the rescue of the existing dam is about 1416.04 m long; b = 4.0 m still is an earth-rock one, has been degraded much.	- Around the lake, there are a number of aquaculture ponds by local people.	- The nearest residential area around the lake is about 500 m to the East.	- There are no facilities for production, business, and services around the lake.	- Around the lake, there are no cultural and religious constructions.
7.	The Na Leng	- In the East and North: to national road	- Around the lake, there are	- The nearest	- There are no	- Around the

Index	The sub-project area	The correlation of the sub-project implementation area with surrounding objects				
		Transportation	**Hydrology and forest**	**Residential area**	**Production, business, and service establishments**	**Cultural and religious works**
	reservoir	No.3 about 2.2 km - The management road is about 43.81 m long, still is an earthed one, many places narrow and slopping, are often damaged by floods, very difficult for the management of the lake in the flood season and traveling of people living in the area.	a number of aquaculture ponds by local people. - The area adjacent to the protection forest is The Na Leng reservoir. However, this area is not within the scope of the construction. The exploitation of materials and soil discharges from people's houses do not affect or encroach upon the protection forests	residential area around the lake is about 100 m to the Southeast.	facilities for production, business, and services around the lake.	lake, there are no cultural and religious constructions.

Sources: Actual survey in 7/2018 & in 2/2019

2.4 The volume of excavation, filling, and mobilization of the vehicles

2.4.1 The distance of the shipping

Table 6. Distance for material transportation

Project/ reservoir	Materials	The distance to the project	Name of transportation road
May Day	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 20-50 km.	DT256, inter-commune, inter-village
Coc Thong	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 20-40 km.	DT256, inter-commune, inter-village
Na Kien	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 15 km	DT254, inter-commune, inter-village
Khuoi Sung	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 25 km	DT256, inter-commune, inter-village
Khuoi Day	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 20 km	DT256, inter-commune, inter-village
Khuoi Dang	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 20 km	DT257, inter-commune, inter-village
Na Leng	Cement, steel, sand, stone, brick, wood plank structures, back-filling soil	Transport distance of about 30 km	National road 279, inter-commune, inter-village

2.4.2 Mobilization of the vehicle for construction

The number of motorbikes mobilized to build the project's items depends on the construction schedule of various work items. The amount varies from time to time on the construction site. To meet the progress of construction, complete the volume of items, depending on the terrain of the ground, the nature of the work and the supply of materials, it is expected to arrange the main equipment for construction implementation of the sub-project. Often use equipment and machinery for construction of the embankment and dam such as 7T and 10T dump trucks; excavators 0.8-3.6 m^3; spud vibrator, toad compactors, steam compressors, compressed air hammers, diesel compressors 600-1200m^3/h, 108CV bulldozers, mixers, welding machines, etc. See details in Table 7.

Table 7. The list of machines, vehicles for construction

Index	Kind of machine	Number of machines (pcs)							Status	Origin
		May Day	Coc Thong	Na Kien	Khuoi Sung	Khuoi Day	Khuoi Dang	Na Leng		
1	Wheel-mounted crane 16T	1	1	1	1	1	1	1	90%	China
2	Mobile crane 6T	5	4	6	5	4	5	3	80%	China
3	Plate vibrator 1Kw	6	5	7	4	3	6	4	85%	China
4	Pneumatic rammer 18T	6	3	7	3	5	6	4	90%	China
5	Self-moving tamper 25T	1	1	1	1	1	1	1	95%	China
6	Excavator 1,6m^3	1	1	1	1	1	1	1	80%	China
7	Self-moving pneumatic rammer 9T	4	3	5	2	3	4	2	90%	China
8	Welder 23 KW	6	4	7	5	3	4	3	85%	China
9	Concrete mixer 250l	5	3	6	4	3	2	2	90%	China
10	Mortar mixer 80l	6	3	6	4	4	4	3	95%	China
11	Bulldozer 108CV	2	1	2	1	1	1	1	80%	China
12	Hoists 0,8T	4	4	6	3	3	4	2	80%	China
13	dump truck 5-7 ton	5	3	5	2	2	2	2	90%	China
14	Water-spraying lorry 9m^3	1	1	1	1	1	1	1	85%	China
15	Water pump	2	2	2	2	2	2	2	90%	China

Sources: The basic design description of the Sub-project

2.4.3 Construction materials

Construction materials mainly use local materials. The main materials are earth, sand, gravel, stone, cement and construction steel. Source of materials, construction materials here are available, easy to exploit and buy, sell conveniently.

❖ *The May Day reservoir – in Dong Xa commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, materials are taken locally. The volume of the embankment material of the work will be exploited in the land area managed by Mr. Hoang Van Thuc's family as follows:

+ Total area of the quarry: 8,000 m^2

+ Provisional reserves: 34,824.56 m^3

+ Transportation distance: 1km

- Sand and stone materials are purchased at the exploitation sites about (20-50) km from the project, then transported to the construction site by car.
- Steel bars, cement can be purchased at agents in the district provided by the enterprises from the manufacturers and shipping to the works.
- The measurements of jet grouting (According to the TCVN 8644: 2011 - Vietnam National Standard for Irrigation Works - Technical requirements of grout drilling for dike reinforcement):

+ Drilling and grouting for waterproof (as per traditional drilling), the solution is clay - cement. The number of borehole lines is 03 rows, the distance between the rows is 1.50 m, the distance between holes on a row is 03 m / hole, and boreholes on the two lines are staggered. The drilling depth: drilling from the top of the dam through the embankment layer, penetrating into the ground is about 1m deep.

+ Preparation: drilling machine, grout mixer, mud pump, high-pressure hose, circulating plug, automatic jet data recorder

+ Materials: cement solution + clay. The ratio of mortar solution (D/N) = 1/3, the amount of clay in 10 liters of mortar solution is 2.97 kg.

❖ *The Coc Thong reservoir – in Liem Thuy commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, dam materials were taken locally. The volume of embankment material of the work will be exploited in the land area managed by Mr. Ha Van Dai's family. Specifically as follows:

+ Total area of the quarry: 1,000 m^2

+ Provisional reserves: 2,000 m^3

+ Transportation distance: 500 m

- Sand and stone materials are purchased at the exploitation sites about (20-50) km from the project, then transported to the construction site by car.
- Steel bars, cement can be purchased at agents in the district provided by the enterprises from the manufacturers and shipping to the works.
- The measurements of jet grouting (According to the TCVN 8644: 2011 - Vietnam National Standard for Irrigation Works - Technical requirements of grout drilling for dike reinforcement):

+ Drilling and grouting for waterproof by jet grouting, within the scope of the dam body. The length of the grouting curtain is as below; the scope of waterproof from 2 points of shoulders, 5m from the end of dam shoulders; with a width of 103.59 m. The number of borehole lines is 02 rows, the distance from hole to hole in the same line is 2.0 m, the distance between holes on a row is 03 m / hole. The drilling depth: drilling from the top of the dam through the embankment layer, penetrating into the ground is about 1m deep.

+ Preparation: drilling machine, grout mixer, mud pump, high-pressure hose, circulating plug, automatic jet data recorder

+ Materials: cement solution + clay. The ratio of mortar solution (D/N) = 1/3, the amount of clay in 10 liters of mortar solution is 2.97 kg.

❖ *Na Kien reservoir – in Nghia Ta commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, dam materials were taken locally. The volume of embankment material of the work will be exploited in the land area No.119, plot plan No.1 managed by the CPC as follows:

  + Total area of the quarry: 125,035 m^2

  + Provisional reserves: 11,028.78 m^3

  + Transportation distance: 300m

- Steel bars, asphalt materials: provided in Bang Lung town
- Sand, stone, cement and other materials:

  + Materials of sand and gravel for making concrete aggregate are provided in Bang Lung town

  + For macadam material, the results of the field survey showed that at the Lung Vang quarry (about 15km from the headwork) is currently exploiting and selling split rocks, crushed stone and broken stone to make. Concrete aggregates with good quality and abundant reserves. Therefore, it can buy all kinds of stone-built here to serve the construction of works.

  + Cement and other materials are provided in Bang Lung town

  + Na Kien reservoir has not carried out of jet grouting.

❖ *The Khuoi Sung reservoir – in Yen Han commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, dam materials were taken locally. The volume of embankment material of the work will be exploited in the land area managed by Mr. Trinh Van Truong's family. Specifically as follows:

  + Total area of the quarry: 4,500 m^2

  + Provisional reserves: 8,000 m^3

  + Transportation distance: 2 km

- Quarry stones, macadam, and sand: bought at the district center mine, about 25 km distance
- Cement and steel bars: bought in the center of the district

Through detailed analysis above shows that the situation of construction materials in the project area is generally quite favorable for the construction of works. The main material source for constructing the project is macadam purchased at Yen Ninh quarry, very available,

quality guaranteed, abundant reserves, favorable mining conditions.

- The measurements of jet grouting (According to the TCVN 8644: 2011 - Vietnam National Standard for Irrigation Works - Technical requirements of grout drilling for dike reinforcement):

+ Drilling and grouting for waterproof by jet grouting, within the scope of the dam body. The length of the grouting curtain is as below; the scope of waterproof from 2 points of shoulders, 5m from the end of dam shoulders; with a width of 66.05 m. The number of borehole lines is 03 rows, the distance between the rows is 3.0 m. The drilling depth: drilling from the top of the dam through the embankment layer, penetrating into the ground is about 1m deep.

+ Preparation: drilling machine, grout mixer, mud pump, high-pressure hose, circulating plug, automatic jet data recorder

+ Materials: cement solution + clay. The ratio of mortar solution (D/N) = 1/3, the amount of clay in 10 liters of mortar solution is 2.97 kg.

❖ *The Khuoi Day reservoir – Yen Han commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, dam materials were taken locally. The volume of embankment material of the work will be exploited in the land area managed by Mr. Trinh Van Truong's family. Specifically as follows:

+ Total area of the quarry: 3,000 m^2

+ Provisional reserves: 6,000 m^3

+ Transportation distance: 1.5 km

- Quarry stones, macadam, and sand: bought at the district center mine, about 25 km distance
- Cement and steel bars: bought in the center of the district

Through detailed analysis above shows that the situation of construction materials in the project area is generally quite favorable for the construction of works. The main material source for constructing the project is macadam purchased at Yen Ninh quarry, very available, quality guaranteed, abundant reserves, favorable mining conditions.

- The measurements of jet grouting (According to the TCVN 8644: 2011 - Vietnam National Standard for Irrigation Works - Technical requirements of grout drilling for dike reinforcement):

+ Drilling and grouting for waterproof by jet grouting, within the scope of the dam body. The length of the grouting curtain is as below; the scope of waterproof from 2 points of shoulders, 5m from the end of dam shoulders; with a width of 85.0 m. The number of borehole lines is 03 rows; the distance from hole to hole in the same line is 3.0 m; the distance between the rows is 1.5 m. The drilling depth: drilling from the top of the dam through the embankment layer, penetrating into the ground is about 1m deep.

+ Preparation: drilling machine, grout mixer, mud pump, high-pressure hose, circulating plug, automatic jet data recorder

+ Materials: cement solution + clay. The ratio of mortar solution (D/N) = 1/3, the amount of clay in 10 liters of mortar solution is 2.97 kg.

❖ *The Khuoi Dang reservoir - Thanh Mai commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, dam materials were taken locally. The volume of the embankment material of the work will be exploited in the land area managed by Mr. Nguyen Van Tuyen's family. Specifically as follows:

  + Total area of the quarry: 7,500 m^2

  + Provisional reserves: 25,000 m^3

  + Transportation distance: 4 km

- Quarry stones, macadam, and sand: bought at the district center mine, about 25 km distance
- Cement and steel bars: bought in the center of the district

Through detailed analysis above shows that the situation of construction materials in the project area is generally quite favorable for the construction of works. The main material source for constructing the project is macadam purchased at Yen Ninh quarry, very available, quality guaranteed, abundant reserves, favorable mining conditions.

- The measurements of jet grouting (According to the TCVN 8644: 2011 - Vietnam National Standard for Irrigation Works - Technical requirements of grout drilling for dike reinforcement):

+ Drilling and grouting for waterproof by jet grouting, within the scope of the dam body. The length of the grouting curtain is as below; the scope of waterproof from 2 points of shoulders, 5 m from the end of dam shoulders; with a width of 87.0 m. The number of borehole lines is 03 rows, the distance from hole to hole in the same line is 3.0 m; the distance between the rows is 1.5 m. The drilling depth: drilling from the top of the dam through the embankment layer, penetrating into the ground is about 1m deep.

+ Preparation: drilling machine, grout mixer, mud pump, high-pressure hose, circulating plug, automatic jet data recorder

+ Materials: cement solution + clay. The ratio of mortar solution (D/N) = 1/3, the amount of clay in 10 liters of mortar solution is 2.97 kg.

❖ *The Na Leng reservoir – Sy Binh commune*

- Soil materials: Based on the criteria of the material layers and recommendations of the Manager on geology, dam materials were taken locally. The volume of the embankment material of the work will be exploited in the land area managed by Mr. Dang Van Cuong's family. Specifically as follows:

  + Total area of the quarry: 3,600 m^2

  + Provisional reserves: 6,000 m^3

  + Transportation distance: 500 m

- Quarry stones, macadam, and sand: bought at the district center mine, about 20-50 km distance.
- Cement and steel bars: bought in the center of the district
- The measurements of jet grouting (According to the TCVN 8644: 2011 - Vietnam National Standard for Irrigation Works - Technical requirements of grout drilling for dike reinforcement):

+ Drilling and grouting for waterproof by jet grouting, within the scope of the dam body. The length of the grouting curtain is as below; the scope of waterproof from 2 points of shoulders, 5 m from the end of dam shoulders; with a width of 143.31 m. The number of

borehole lines is 02 rows, the distance from hole to hole in the same line is 3.0 m; the distance between the rows is 2.0 m. The drilling depth: drilling from the top of the dam through the embankment layer, penetrating into the ground is about 1m deep.

+ Preparation: drilling machine, grout mixer, mud pump, high-pressure hose, circulating plug, automatic jet data recorder

+ Materials: cement solution + clay. The ratio of mortar solution (D/N) = 1/3, the amount of clay in 10 liters of mortar solution is 2.97 kg

Table 8. The volume of the main construction materials using for the sub-project

Name of the reservoir	Items	Sand (m^3)	Stone (m^3)	Steel (ton)	cement (ton)	Concrete (m^3)	Excavation ($100m^3$)	Soil for filling ($100\ m^3$)
May Day	Sluice	93.7	125.1	25.1	50.8	154.6	60.3	23.1
	Dam	686.7	2645.1	16.8	230.1	567.2	153.6	78.4
	Spillway	752.2	1725.5	120.8	494.3	1452.4	56.5	12.0
	Total	**1532.6**	**4495.7**	**162.7**	**775.2**	**2174.2**	**270.4**	**113.5**
Coc Thong	Sluice	82.2	169.9	12.5	45.6	118.6	5.7	3.5
	Dam	493.9	854.3	5.3	152.4	327.2	23.7	18.2
	Spillway	341.2	398.7	42.5	195.7	515.4	45.5	10.9
	Total	**917.3**	**1422.9**	**60.3**	**393.7**	**961.2**	**74.9**	**32.6**
Na Kien	Sluice	65.8	119.2	5.3	56.8	121.3	46.4	27.2
	Dam	1529.5	3563.5	5.9	477.5	895.3	153.7	92.3
	Spillway	390.5	728.4	56.7	232.4	785.5	55.8	23.2
	Total	**1985.8**	**4411.1**	**67.9**	**766.7**	**1802.1**	**255.9**	**142.7**
Khuoi Sung	Sluice	74.6	143.5	9.7	60.1	154.6	6.5	4.2
	Dam	735.4	1872.2	10.6	159.0	378.0	32.7	17.8
	Spillway	675.1	1185.3	59.0	278.0	535.2	11.2	6.7
	Total	**1485.1**	**3201.0**	**79.3**	**497.1**	**1067.8**	**50.4**	**28.7**
Khuoi Day	Sluice	55.6	97.8	5.6	35.9	92.5	3.1	1.7
	Dam	985.6	2910.5	9.5	230.5	465.6	12.5	9.4
	Spillway	235.5	560.5	45.5	245.5	595.5	8.2	5.1
	Total	**1276.7**	**3568.8**	**60.6**	**511.9**	**1153.6**	**23.8**	**16.2**
Khuoi Dang	Sluice	58.3	152.6	9.7	63.0	108.0	5.8	8.6
	Dam	523.1	1368.3	10.6	153.9	204.6	34.4	65.6
	Spillway	462.2	1077.5	54.0	186.0	385.0	52.8	73.8
	Total	**1043.6**	**2598.4**	**74.3**	**402.9**	**697.6**	**93.0**	**148.0**
Na	Sluice	58.8	108.6	9.5	39.6	981.0	3.5	1.6

Name of the reservoir	Items	Sand (m^3)	Stone (m^3)	Steel (ton)	cement (ton)	Concrete (m^3)	Excavation ($100m^3$)	Soil for filling ($100\ m^3$)
Leng	Dam	289.6	817.2	5.9	11.3	256.6	13.9	9.8
	Spillway	266.2	589.5	45.8	192.6	576.8	8.7	6.3
	Total	**614.6**	**1515.3**	**61.2**	**243.5**	**1814.4**	**26.1**	**17.7**

Sources: The basic design description of the Sub-project

- The volume of soil using for repairing and upgrading is not high. It can be exploited at the existing material mines in the region. The results of a geological survey from the design consultants about the location, reserves, and technical requirements of the material mines are expected to fully meet the ability to supply materials during the construction process of items.
- - The current status of areas where embankment took is vacant lands belonging to local people, managed by the local people, which are currently unused, neither forest land nor technical infrastructure works. Therefore, this use does not affect people's daily life and production and can help them earn more income.

2.5 Auxiliary systems

2.5.1 Electricity, water supply for construction and livings

Due to the nature of the sub-project is building a self-flowing water supply reservoir on a small scale, so the electricity demands not high. It is just mainly serving lighting at night construction and steel formwork processing. At present, in the construction areas, there is a national electricity grid passing through, taken from the national electricity grid from the existing 35KV line. There is also having a backup generator on-site at 110KVA in case of power outages.

Use a pump to get water from the lake, stored in construction tanks at the site. Depending on the quality of the lake water, have to take treatment measures with filter tanks to ensure the quality of water for daily life and water for concrete construction.

2.5.2 Demand on accommodation for workers

Demand for workers involved in the construction of each item at the peak time is needed about 50 people. Most of the construction sites are quite convenient to gather materials. However, the works have a wide dispersion position in many localities of Bac Kan province. The infrastructure of water and electricity supply is limited. The number of workers focusing on the peak time is not large (about 50 workers of contractors for each project, including 35 managers and skilled workers). For simple work items, the Contractor will directly employ about 15 people local labor). The construction time of each item is not long, so some works are expected to rent land or houses from local people in each project area to build camps, ensure environmental sanitation and daily living conditions. For material-gathering yards are arranged near the residential area, for protection of properties and to arrange temporary shelters to shelter from rain and sun. Toilets meet the requirements of QCVN 01: 2011 / BYT on standards of latrines, hygienic. Activities, personal activities are carried out in the housing area.

2.5.3 Waste dumping site

The project feature is to repair and upgrade the existing works, so the volume of excavated soil is small, mainly the peeling of the organic surface. In order to maximize the use of the existing project land and limit compensation and clearance, the contractor will coordinate with local authorities to select a suitable dumping location to ensure environmental sanitation and the needs of reuse waste materials of local people. With regard to the location of the disposal sites, the Investor also worked with the people and local authorities, identifying a number of disposal sites on the vacant land of the people to manage. It is quite suitable and convenient for the transportation, transferring, minimizing the impacts on the environment and activities of the people (The signed agreement is attached in Appendix 7).

- *The May Day reservoir – in Dong Xa commune:* The disposal area is in the area managed by Mr. Hoang Van Dung's family, which can hold an estimated 1187.78 m3. Transportation distance is about 1km.

- *The Coc Thong reservoir - Liem Thuy commune:* The disposal area is in the area managed by Mr. Ha Van Dai's family, which can hold an estimated 12,000 m3. Transportation distance is about 500 m.

- *Na Kien reservoir - Nghia Ta commune:* The disposal area is in the area managed by Mr. Leng Van Khai's family, which can hold an estimated 20,000 m3. Transportation distance is about 1.5 km.

- *The Khuoi Sung reservoir - Yen Han commune:* The disposal area is in the area managed by Mr. Trinh Van Truong's family, which can hold an estimated 8,000 m3. Transportation distance is about 2.0 km.

- *The Khuoi Day reservoir - Yen Han commune:* The disposal area is in the area managed by Mr. Trinh Van Truong's family, which can hold an estimated 6,000 m3. Transportation distance is about 1.5km.

- *The Khuoi Dang reservoir - Thanh Mai commune:* The disposal area is in the area managed by Mr. Ha Van Tuyen's and Ha Duc Chan's family, which can hold an estimated 25,000 m3. Transportation distance is about 4.0 km.

- *The Na Leng reservoir - Nghia Binh commune:* The disposal area is in the area managed by Mr. Dang Van Cuong's family, which can hold an estimated 6,000 m3. Transportation distance is about 500m.

The situation of selected disposal sites: These are all vacant land managed by people, which unused. The people also agreed for rent to take advantage of the dump. Therefore, this use does not affect the lives and producing of people and can help people have more income from renting the premises.

2.5.4 Construction road

Construction conditions are relatively good, traffic is convenient; At all works, there are roads to the lake, serving the construction, meeting the demand for transporting materials during the implementation in the localities.

2.6 The expected activities before construction

Prior to construction, the number of activities such as topographic survey, hydrological survey, meteorological conditions, geological drilling, setting up the landmarks for land acquisition, and mine clearance will be conducted. Within the sub-project, there were demolition activities of 03 affected households, clearing the vegetation shall be done by households affected by losses of trees and crops. The affected households will collect waste from demolition, site clearance, and transport to the waste disposal site of the commune.

The sub-project design has provided alternatives that take into account the risk scenarios due to the impacts of climate change, which are likely to affect the performance of the construction items. The study of climate change factors is presented in the current situation in the sub-project area, recently, as a basis to select the optimal design plan. The impact of climate change in the area recently has been mainly related to changes in rainfall, causing floods, landslides, and drought.

2.7 Material transportation plan

Construction materials will be gathered at the construction site for about 1 week before the commencement of construction. It will be transported to the construction site at the time so that avoiding negative impacts on agricultural activities as well as activities of local people. Workers, machines, and expected material quantities are shown in the sections above.

2.8 Activities of operation and maintenance

Periodic monitoring of dam safety: Once the dam has been filled up and the dam is under operation, the dam owner is responsible for carrying out dam safety monitoring, which is carried out by a qualified independent expert, who does not engage in dam investigation, design, construction or operation. After normal operation, inspections are conducted regularly, including safety checks before and after the annual flood season, in accordance with Decree 114/2018 / ND-CP on a dam and reservoir Safety Management, on September 4, 2018.

After completion of works, the operation of the dam shall belong to the Owner's dam, and by that time, the PPMU's obligation shall be finished.

Regarding the process of reservoirs and valve operation, the dam owner must set up a regulation procedure for reservoir water, regulations on the storage and discharge of water under normal conditions, and in emergencies, to submit them to the competent state authorities for approval and implementation. The dam owner must elaborate and submit to the competent authorities for promulgation or promulgate according to his / her competence a written regulation on operation and operation of gates and operations of each project (hereinafter referred to as project operation). Other issues should conduct following Decree No. 114/2018/ND-CP of the Government on the safety management of dams and reservoirs.

2.9 Plan of dam safety

A dam safety report (DSR) will prepare for the sub-project. The objective of the dam safety report (DSR) is to present, analyze, and make recommendations on:

a) All conditions that may affect the safety of the dam and its auxiliary structures;

b) Impacts when a dam or ancillary structure is broken / unregulated due to harsh natural conditions, human or structural errors;

c) The future institutional framework (at present) and necessary to avoid or minimize adverse conditions for dam safety

After completion of the review at the sub-project screening stage, the CPMU under MARD should provide a DSR for each sub-project identified during the project implementation phase, and send it to the PoE (Panel of Expert) and the World Bank for review. The report must include findings and recommendations for any relevant safety issues, and necessary actions to be taken. Dam safety measures must be incorporated into the design, construction, and operation of the reservoir.

Safety review and analysis of dam structures: The review and evaluation of dams and related structures will include, but is not limited to, the following:

- - Review the survey materials on the geological ground and the source of the material. Note the potential adverse effects that may occur due to known geological features. Evaluate unforeseen conditions and measures to address safety and operational issues of dams and associated structures.
- Assess the suitability of the type of dam and spillway, the response of the dam design, including proposed remedies for foundation treatment, back-filling, bearing capacity parameters of the selected foundation, seepage and other control measures floating pressure. Note the safety viewpoint for any irregularities or omissions that occur and recommend measures to be taken.
- Assessing stability, analyzing intensity and safety factors under normal, abnormal and extremely heavy load conditions for earthen and concrete dams, spillway structures and water discharge facilities, including the identification of impact criteria for geology;
- Considering the factors of reservoir stability, landslide formation, waves, and its effects on dam stability;
- Consider the hydrological calculation method to determine the design flood of the project, the reservoir line and the size of the spillway. Review the design of the spillways including the flow conditions, and the energy dissipation structures. Evaluate the discharge capacity of the spillway for all design floods without risking the dam;
- Consider intake and discharge facilities, including hydraulic designs, emergency drainage capacity of the reservoir, and sedimentation process.
- Evaluate the design of the spillway and the outlet control devices, including the selection of the number and type of major entrances and valves, lifting equipment and other types of control devices. Special attention is given to the backup system to operate spillways with gates and water discharge facilities when there are operational and electrical problems;
- Considering the designs of diversion works, construction schedule, hydrology and risk factors related to diversion during the construction and closing the flow at the beginning of the storing water.
- Consideration of the suitability of the instrumentation, particularly the instruments or milestones, required in the forecast of serious hazards or dam failure;
- Review the operation and maintenance procedures and emergency response plan of the dam owner, including evaluation of operational and maintenance factors, related to dam safety, and force of operators to carry out maintenance, regular inspection of the safety of the project.

Review and assess the dam safety risks: In addition to ensuring the safety of the dam structure, the Project needs to assess the potential dam risks to the population and the environment in the downstream area of the dam, including related works. Dam failure may not occur, but when it does, it will cause serious damage. In this regard, during project preparation, as part of the DSR or the environmental and social management plan, the sub-project owner should conduct an assessment of potential risks to the people in the downstream area. For large and high-risk dams, full data collection, including topographic surveys and land use downstream, should be collected in order to simulate a dam failure, floods downstream of the dam under different conditions/scenarios for the preparation of an Emergency Plan. Data collection from upstream dams and/or upstream related activities may also be necessary for some dams. Planning and implementation of a capacity-building

program for sub-projects with pilot activities to promote the active participation of local communities should be considered. Communities around the dam site can engage in daily monitoring, protect dams from destructive activities by outside parties, and engage in simple maintenance tasks. A model of community participation in dam safeguarding activities should also be considered. Sedimentation and pollution of upstream water sources can be a serious problem for some river basins. The dam owner must commit to devoting funds for proper dam operation & management and periodic dam safety inspections.

2.10 Time and cost for implementation

(1) Implementation schedule:

The project is expected to be implemented within 24 months (from June 2020 to June 2022), specifically for each project as follows:

The Na Kien reservoir:

- Years 2018-2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From January 2020 to June 2021: Construction is completed
- From June 2021 to June 2022: Operation and maintenance of works

The Khuoi Sung reservoir:

- From 2018 to 2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From January 2020 to June 2021: Construction, completion of works
- From June 2021 to June 2022: Operation and maintenance of works

The Khuoi Day reservoir:

- Years 2018-2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From January 2020 to Sept 2020: Construction is completed
- From Sept 2020 to Sept 2021: Operation and maintenance of works

The Khuoi Dang reservoir:

- Years 2018-2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From March 2020 to Dec 2020: Construction is completed
- From Dec 2020 to Dec 2021: Operation and maintenance of works

The May Day reservoir:

- Years 2018-2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From June 2020 to June 2021: Construction is completed
- From June 2021 to June 2022: Operation and maintenance of works

The Coc Thong reservoir:

- Years 2018-2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From June 2020 to June 2021: Construction is completed
- From June 2021 to June 2022: Operation and maintenance of works

The Na Leng reservoir:

- Years 2018-2019: Completed the project's preparation documents, completed the construction drawing design documents, and organized construction bidding.
- From June 2020 to June 2021: Construction is completed
- From June 2021 to June 2022: Operation and maintenance of works

(2) Total investment

The total investment of the sub-project is VND 89,879,750,321.0. Of which the cost for environmental protection is VND 900 million, including the preparation of barrier systems, construction signs, fire extinguishers, contains keeping waste oil, hazardous waste containers, labor protection equipment, water pumps, generators, hiring a company for waste disposal, preparing temporary drainage systems on the site (these costs are included in the civil construction package). Besides, it includes the cost for environmental monitoring activities during the construction period, the first year of operation.

Table 9. Total estimation cost for the Sub-project (unit: VND**)**

index	Contents	Value excluded taxes	VAT	Value included taxes
1	Expenses for compensation, support and resettlement	1,871,268,984		1,871,268,984
2	Construction costs	52,318,661,722	5,231,866,172	57,550,527,894
3	Equipment costs	155,054,360	15,505,436	1,708,559,796
4	Project management cost	1,682,176,948		1,682,176,948
5	Costs for construction investment consultancy	12,393,038,850	1,239,303,885	13,632,342,735
6	Other expenses (including expenses for environmental protection work)	4,656,955,839	465,695,584	5,122,651,423
7	Backup costs			8,312,222,541
	Total			**89,879,750,321**

CHAPTER III. POLICY, LEGAL AND OF ADMINISTRATIVE FRAMEWORK

3.1 Legal documents in Vietnam

❖ ***Laws***

- Law on Environmental Protection No. 55/2014/QH13 issued by the National Assembly of Vietnam on June 23, 2014, effective from July 2015;
- Land Law No. 45/2013/QH13 dated November 29, 2013, issued by the National Assembly of Vietnam;
- Law on Forestry No. 16/2017/QH14 passed on November 15, 2017, issued by the National Assembly of the Socialist Republic of Vietnam, effective January 1, 2019;
- Law on Natural Disaster Prevention and Control No. 33/2013/QH13 promulgated on June 19, 2013, by the National Assembly of Vietnam;
- Law on Water Resources No. 17/2012/QH13 issued by the National Assembly of Vietnam on June 21, 2012;
- Biodiversity Law No.20/2008/QH12, promulgated by the National Assembly of Vietnam on November 13, 2008;
- Construction Law No.50/2014/QH13 passed by the VII National Assembly on June 18, 2014;
- Law on Road Traffic No. 23/2008/QH12 dated November 13, 2008;
- Law on Complaints No. 02/2011/QH13 dated 11/11/2011;
- Law on Cultural Heritage No. 10/VBHN-VPQH issued on July 23, 2013;
- Law on occupational safety and sanitation No. 84/2015/QH13 dated June 25, 2015;
- Dike Law No. 79/2006/QH11 dated November 29, 2006;
- Irrigation Law No. 08/2017/QH14 passed by the National Assembly on June 19, 2017;
- Law on Plant Protection and Quarantine No. 41/2013/QH13 dated November 25, 2013.

❖ ***Decrees***

- Decree No. 40/2019/ND-CP dated May 13, 2019, of the Government on Amendments to Decrees on Guidelines for the Law on Environment Protection;
- Decree No. 38/2015/ND-CP dated April 24, 2015, of the Government on the management of waste and discarded materials;
- Decree 18/2015/ND-CP dated February 14, 2015, of the Government, provides regulations on environmental protection planning, strategic environmental assessment, environmental impact assessment, and environmental protection plan;
- Decree No 44/2014/ND-CP dated May 15, 2014, of the Government, provides regulations on the land pricing methods and the land price bracket;
- Decree No. 47/2014/ND-CP dated May 15, 2014, of the Government, provides regulations on compensation, support, and resettlement upon land recovery by the State;
- Decree 155/2016/ND-CP dated Nov 18, 2016, of the Government, provides regulations on penalties administrative violations against regulations on environmental protection;

- Decree No. 25/2013/ND-CP dated March 29, 2013, of the Government on Environmental protection charge for wastewater decreed;
- Decree 67/2012/ND-CP of the Government, amending and supplementing a number of articles of Decree No. 142/2003/ND-CP on November 28, 2003, detailing the Government's implementation of some articles of the Ordinance on the exploitation and protection of irrigation works;
- Decree No.113/2010/ND-CP dated Dec 03, 2010, of the Government providing for the determination of environmental damage;
- Decree No.112/2008/NĐ-CP dated Oct 20, 2008, of the Government on management, protection and integrated exploitation of resources and environment of hydropower and irrigation reservoirs;
- Decree No. 120/2008/NĐ-CP dated Dec 01, 2008, of the Government on River Basin Management;
- Decree 114/2018/ND-CP dated Sept 04, 2018, of the Government on dam and reservoir safety management.

❖ ***Circulars***

- Circular No. 27/2015/TT-BTNMT dated May 19, 2015, of the MONRE on strategic environmental assessment, environmental impact assessment, and environmental protection plans.
- Circular No. 36/2014/TT-BTNMT dated June 30, 2014, of the MONRE on land pricing method compilation of and adjustment to land price lists;
- Circular No.37/2014/TT-BTNMT dated June 30, 2014 of the MONRE on June 30, 2014 of the MONRE;
- Circular No. 30/2014/TT-BTNMT dated June 02, 2014, on applications for land allocation, lease, repurposing, and expropriation;
- Circular No. 36/2015/TT-BTNMT dated June 30, 2015, of the MONRE on the management of hazardous wastes;
- Circular No. 22/2010/TT-BXD of the MoC on occupational safety in construction;
- Circular No. 19/2011/TT-BYT of the Ministry of Health guiding the management of labor hygiene, laborers' health and occupational diseases;
- Circular No. 05/2007/TT-BXD dated July 25, 2007, of the Ministry of Construction guiding the formulation and management of work construction investment expenditures;
- Circular No. 13/2007/TT-BXD dated December 31, 2007, providing guidance on a number of articles of Decree No. 59/2007/ND-CP on solid waste;
- Circular No. 34/2010/TT-BCT of the MoIT providing regulations on hydroelectric dam safety management

❖ ***Decisions***

- Decision No. 52/2012/QD-TTg of November 16, 2012, on employment and vocational training support policies for laborers subject to agricultural land recovery;
- Decision No. 3733/2002/QD-BYT dated Oct 10m, 2002, promulgating 21 labor hygiene standards, 05 principles and 07 parameters for labor hygiene

- The Directive of the Government at the Statement No. 21/CT-TTg dated October 14, 2013 on strengthening management and assuring reservoir safety.

❖ ***Applicable norms and standards***

- QCVN 01:2009/BYT: National technical regulation on drinking water quality;
- QCVN 02:2009/BYT: National technical regulation on domestic water quality;
- QCVN 08-MT:2015/BTNMT: National technical regulation on surface water quality;
- QCVN 09-MT 2015/BTNMT: National technical regulation on underground water quality;
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater;
- QCVN 40:2011/BTNMT: National technical regulation on industrial wastewater;
- QCVN 38:2011/BTNMT: National technical regulation on surface water quality to protect aquatic;
- QCVN 03-MT: 2015/BTNTM: National technical regulation on allowable limits of some heavy metals in the soils;
- QCVN 15:2008/BTNMT: National technical regulation on the pesticide residues in the soils;
- QCVN 43:2012/BTNMT: National technical regulation on sediment quality;
- QCVN 05:2013/BTNMT: National technical regulation on ambient air quality
- QCVN 06:2009/BTNMT: National technical regulation on hazardous substances in ambient air;
- QCVN 26:2010/BTNMT, QCVN 24:2016/BYT National technical regulation on noise;
- QCVN 27:2010/BTNMT: National technical regulation on vibration;
- QCVN 07:2009/BTNMT: National technical regulation on hazardous waste thresholds;
- QCVN 18:2014/BXD: National technical regulation on safety in construction;
- QCVN 04 - 05:2012/BNNPTNT - National technical regulation on hydraulic structures - The basic stipulation for design;
- In addition, other standards related.

❖ ***Legal documents provided by the Owner***

- Business registration certificate No. 4700233543 issued by Bac Kan Department of Planning and Investment for the first time on June 26, 2012;
- Decision No. 1858 / QD-TTg dated November 2, 2015, of the Prime Minister approving the list of the "Dam Rehabilitation and safety improvement Project" (WB8) borrowing from the World Bank (WB) ;
- Decision No. 4638 / QD-BNN-HTQT dated November 9, 2015, of the Ministry of Agriculture and Rural Development on "Approval of Feasibility Study Report of World Bank-funded Dam Rehabilitation and Safety Improvement Project -WB8".
- Decision No.5492/QĐ-BNN-KHCN dated Dec 30, 2015, of the MARD on “Approval of Dam safety Framework WB8 “Dam Rehabilitation and Safety Improvement

Project";

- Document No. 1936 / CPO-WB8 of November 27, 2015, of the Central Project Office (CPO) on organizing the implementation of the "Dam Rehabilitation and Safety Improvement Project" (WB8);
- Decision No. 5095 / QD-BNN-HTQT dated Dec 6, 2016, of the MARD approving the adjustment of the Manual for implementing the "Dam Rehabilitation and Safety Improvement Project" in Bac Kan province (WB8) by World Bank is attached to the Decision No. 2793 / QD-BNN-HTQT of July 6, 2016, of the MARD.
- Decision No. 331 / QD-UBND dated March 22, 2017, of the Provincial People's Committee of Bac Kan, establishing the Project Management Unit to implement the "Dam Rehabilitation and Safety Improvement Sub-project" in Bac Kan province (WB8) .
- Official Letter No. 598 / UBND-TH dated February 16, 2017, of the Bac Kan PPC on assigning tasks to the investor of the "Dam Rehabilitation and Safety Improvement sub-project" in Bac Kan province.
- Decision No. 878 / QD-UBND dated May 31, 2019, of Bac Kan PPC, approving the Environmental Impact Assessment Report of Dam Rehabilitation and Safety Improvement Sub-project, in Bac Kan Province.

❖ ***Compliance with the environmental and social impact assessment***

The Sub-project's ESIA will be carried out in accordance with the World Bank and the Government's environmental assessment procedures. In particular, it will be subject to the ESMF of the project that the WB reviewed and approved. The social and environmental screening will be conducted for each sub-project to determine the appropriate size and type of environmental assessment. Based on that, TOR will be prepared for ESIA in accordance with the sub-project scope and the potential impacts expected from the sub-project implementation. The environmental and social screening will be conducted by World Bank safeguard specialists. The TOR for the ESIA will also be reviewed and approved by the World Bank Safeguard Specialists prior to carrying out the ESIA. During the process of the ESIA, consultations with affected people and local NGOs should be conducted. ESIA will be publicly disclosed at sub-project sites in the Vietnamese language accessible to locally-affected people and local NGOs, and the English version will be disclosed on the WB's external website before the sub-project appraisal.

3.2 The World Bank's safeguard policies

The objective of these policies is to prevent and minimize impacts on people and the natural environment in the development process. The safeguard policies provide the basis for stakeholders' participation in the project designs and act as an important tool for building ownership among local people.

The effectiveness and development of the WB's projects and programs have been increasing significantly as a result of paying attention to these policies. The World Bank's safeguard policies are available on the website at http://web.worldbank.org, where the environmental and social safeguard policies are published.

3.2.1 Project level

The Project's environmental and social screening has been conducted in accordance with OP 4.01 and indicated that the World Bank's Safeguard Policies on Environmental Assessment (OP/BP 4.01), Natural Habitats (OP/BP 4.04), Indigenous Peoples (OP/BOP 4.10), Physical Cultural Resources (OP/BP 4.11), Involuntary Resettlement (OP/BP 4.12),

Safety of Dams (OP/BP4.37), Projects on International Waterways (OP/BP 7.50) and Pest Management (OP 4.09) will be applied to this Project. According to the environmental screening, the Project is classified as Category A. In addition, the project needs to comply with the World Bank's requirements for public consultation and information disclosure.

3.2.2 Sub-project level

Environmental safeguard policies

- OP/BP 4.01 Environmental assessment
- OP/BP 4.37 Safety of Dams

Social safeguard policies:

- OP/BP 4.10 Indigenous Peoples
- OP/BP 4.12 Involuntary resettlement

❖ *OP/BP 4.01 Environmental Assessment*

This policy is going throughout the process of identifying, preventing and mitigating environmental and social potential negative impacts associated with the World Bank's lending activities. In the Work Bank's operations, the purpose of the environmental assessment is to improve decision-making, ensure that the project alternatives are being reviewed and sustainable and that the community to be likely affected must be consulted. The Borrower is responsible for environmental assessment (EA) and the World Bank advises the Borrower on the policy requirements. The Bank-financed projects will be classified into one of four categories, depending on locations, sensitivity, scales of the projects, nature, and magnitude of potentially environmental impacts, including A, B, C, and FI.

This Sub-project triggers OP 4.01 as it involves construction activities and operation of dams that will have potentially negative environmental and social impacts. Based on the results of the environmental screening, the Sub-project is classified as Category B. As defined in OP 4.01 and the Government's environmental assessment regulations, this ESIA is prepared for the Sub-project to meet the requirements of Government's regulations and the World Bank's safeguard policies. After approved, the ESIA of this Sub-project will be publicly disclosed in the locality, accessible to the locally-affected people and local NGOs on the World Bank external website.

❖ *OP/BP 4.37 Safety of Dams*

This policy shall trigger the whole project because of the safe operation of dams related to environment and socio-economic development. When borrowing from the World Bank for construction of new dams, the dam safety policy based on opinions of experienced and responsible experts in charge of design and construction supervision and, by way of the dam safety measures, will implement them throughout the project cycle. This policy also applies to the rehabilitation and improvement of existing dams, which affect the performance of a project. In this case, the dam safety assessment should be undertaken and additional dam safety measures should be proposed. OP 4.37 recommends that, in an appropriate circumstance, WB staff will discuss necessary measures with clients to strengthen the institutional, legal and regulatory framework for dam safety programs.

❖ *OP/BP 4.10 Indigenous peoples*

This policy is triggered for the subproject since the affected area due to repairing the dam has ethnic minority people's living. In there, about 85 % of households are Tay ethnic minority, Nung people account for 10%, and Kinh people and other accounts for 5% of total households.

This policy definition is that ethnic minorities can be defined in particular geographical areas by the presence of varying degrees of the following characteristics:

- Identifying themselves as members of a distinct indigenous culture group and being recognized for this feature by others.
- Living closely in identity geographic or territorial habitats that they were hesitated from their ancestors in the project areas and close to the nature of such habitats and territories.
- Their cultural, economic, social or political institutions are traditionally different from those of the majority of cultures and societies.
- Native languages are often different from official languages of such region or country.

The obligatory conditions for approving an investment project: OP 4.10 requires the Borrower to undertake consultations and disclosures of information with ethnic minorities that are possibly affected and to establish a broad community support model for its sub-projects and objectives. The project financed by WB shall include the considerations to (a) avoid potential negative impacts on ethnic minority communities; or (b) when avoiding is not feasible, measures should be proposed to minimize, mitigate, or compensate for impacts.

❖ *OP/BP 4.12 Involuntary resettlement*

This policy is applied for the Sub-project because when carrying out, it has land acquisition, assets, and crops of 46 HHs and 01 organization. The Sub-project has 03 HHs affected on houses. However, the level of influence is not significant, not affect much to livelihood and incomes of them, due to items repaired and upgraded almost based on the existing foundation. Exception, some operation and access roads to the dam, which are built and expanded based on the existing roads, affected to trees and crops of some households.

❖ *Environmental, Health and Safety Guidelines of WBG*

The Environmental, Health and Safety Guidelines (EHS) of World Bank Group (WBG)/International Finance Corporation (IFC) was introduced in 2008. This is an important guideline on environmental, health and safety protection in industrial development and other projects. It set out the goals to be achieved and measures to be taken to deliver the best results at reasonable costs. This Guideline can be found on the website http://www.ifc.org.

❖ *World Bank's policy on Access to Information*

In addition to the environmental safeguard policies to promote transparency and accountability, WB issued the Information Access Policy relating to proposed safeguard measures. It sets out the policy to support borrowers' decision-making by allowing them accessing information relating to social and environmental aspects of such projects at the website in the native language, which is easy to understand and intuitive. The WB ensures that relevant environmental and social protection documents related to such projects as well as the preparation procedures related to sub-projects are introduced timely prior to the appraisal. The World Bank's information access policy requires disclosure of information in both English and Vietnamese languages and meets the World Bank's standards.

Table 10. Summary of environmental assessment process of WB & GoV

The stages in the environmental assessment process	WB (OP/BP 4.01 on Environmental Assessment)	Vietnam (Decree No. 18/2015/ND-CP, Circular No.27/2015/TT- BTNMT)

The stages in the environmental assessment process	WB (OP/BP 4.01 on Environmental Assessment)	Vietnam (Decree No. 18/2015/ND-CP, Circular No.27/2015/TT- BTNMT)
Screening	- List of categories (A, B, C, FI) - It is not mandatory for each specific case to classify, apply safety policy and determine environmental assessment tool (EA). - The World Bank will classify a proposed project into one of four categories including A, B, C, or FI depending on type, location, sensitivity and scale of the project and the nature, the importance of its potential environmental impacts. - Category A: Requirement for full EIA. In some cases, the SEMF is required, too. - Category B: ESIA, SEMF or ESMP is required. In most cases, SEMF and/or ESMP are required. - Category C: no EA action - Category FI: SEMF is the most common tool. In the case of a number of sub-projects that have been identified before the appraisal, the FI will prepare specific tools based on the frameworks, e.g. the ESIA or ESMP.	- Categories: I, II, III and IV of Decree No. 18/2015/ND-CP. - Rules, regulations in Appendix I, II and III - List of projects requiring submission of SEA and EIA report for approval. - Not all projects are listed. - Generally, the Project Owners classify their projects based on the classification as stated in Decree No.18/2015/ND-CP and consulted with the Department of Natural Resources and Environment (DONRE) or Vietnam Environment Administration (VEA) to categorize and require EA report such as: • Projects fall into Appendixes: I, II, III: SEA or EIA are required. • Projects fall into Appendix IV: no EIA and EPP are required. • Projects not fall into Appendixes: I, II, III and IV: EPP is required.
Environmental assessment tool	- Depending on the project impacts, a range of tools is used to meet the World Bank's requirements, including ESMF; specific environmental assessment; ESMP; regional and sectorial EA; risk or hazard assessment; Environmental audit. The World Bank provides general guidelines for implementing each tool.	- The EA tools like SEA, EIA or EPP are identified based on Appendixes: I, II, III and IV of Decree No.18/2015/ND-CP.

The stages in the environmental assessment process	WB (OP/BP 4.01 on Environmental Assessment)	Vietnam (Decree No. 18/2015/ND-CP, Circular No.27/2015/TT- BTNMT)
Scope of environmental assessment	- The WB helps the borrower to draft the TOR for EA and to determine the EA scope, procedures, timetable and outline of an EA report. - The A-type project requires ESIA TOR and the determination of scope and consultation will be necessary to prepare the TOR for environmental assessment report.	- TOR for EA is not mandatory. - Normally, after consultation with the local DoNRE or the Environmental Department (VEA) about the type of EA, Project Owner will prepare an EA report.
Community consultation	- During the EA, the Borrower must consult with affected groups and local NGOs on the environmental aspects of the project and focus their views. - For an A-type project, the Borrower shall consult these groups at least twice: (a) immediately after the environmental inspection and before the EA TOR completion; and (b) once a draft EA report has been prepared. In addition, the Borrower will consult with these groups throughout the project implementation process as needed to address issues related to EA that affect them. - For a B-type project, there should be at least one community consultation meeting. - For meaningful consultations, the Borrower provides relevant project documents in a timely manner prior to the consultation in a form and language that the group can understand and be accessible to. - The minutes of the public meeting are included in the report.	- Project owner is responsible for consulting with the People's Committee of the commune, ward or township (hereinafter referred to as the commune) where project is being implemented, consulting with organizations or communities directly affected by project; Research and receive objective opinions and requests from relevant agencies to minimize project negative impacts on the natural environment, biodiversity and public health. - Commune People's Committees where a project is implemented and organized and directly affects will be consulted. The project owner is responsible for submitting the EIA report to the commune-level people's committees where the project is implemented and organized and directly affects, together with a written request for comment. Within 15 working days from the date on which an EIA report is received, the commune-level people's committees and organizations under the direct impact of the project are obliged to submit their responses if they do not approve the project.

The stages in the environmental assessment process	WB (OP/BP 4.01 on Environmental Assessment)	Vietnam (Decree No. 18/2015/ND-CP, Circular No.27/2015/TT- BTNMT)
		- The community consultation is carried out in the form of community meetings co-chaired by the Project Owner and the commune people's committees where the project is implemented together with the participation of the community like Vietnam Fatherland Front, socio-political organizations, socio-professional organizations, population quarters, villages/hamlets. All opinions of participants in the meetings must be fully and truthfully presented in the minutes of the meeting.
Dissemination of information	- Before the World Bank conducts a project appraisal, the EA report must be made public in a way that is easily accessible to project-affected groups and local NGOs. When the World Bank officially receives the report, the World Bank will publish the report in English to the public via WB's website.	- After the EIA report is approved, the Project Owner is responsible for preparing, approving and publicly displaying EMP at the local Commune People's Committee office, in consultation with the community for people's information, inspection, monitoring. (Article 16 of Decree No.18/2015/ND-CP).
Independent environmental specialist	- For an A-type project, the Borrower retains independent EA specialists who have no contact with the project to implement EA. - For a high-risk A-type project or a project with multi-dimensional environmental concerns, the Borrower will also hire a consultative group of independent environmental specialists with international qualifications to advise on the project aspects relating to EA. - Specialists/consultancy companies will be selected through bidding	- This content is not regulated in Vietnamese policy. - The Project Owner shall implement or hire a consulting unit, which satisfies the conditions specified in Clause 1, Article 13 of Decree No.18/2015 to make the EIA report. Project Owner or consultancy companies must fully meet the following conditions: (i) Staff responsible for EIA must have at least BA degree and EIA consultancy certificate; (ii) specialized staff involved in the project must

The stages in the environmental assessment process	WB (OP/BP 4.01 on Environmental Assessment)	Vietnam (Decree No. 18/2015/ND-CP, Circular No.27/2015/TT- BTNMT)
	under the close supervision of the World Bank.	have university or higher degrees; (iii) have laboratory and testing equipment certified for measuring, sampling, processing and analyzing environmental samples for the environmental impact assessment of the project; In the absence of a laboratory, the calibration equipment must meet the requirements and there must be contract with qualified unit.
EA review/ approval process	- The WB reviews EA's findings and recommendations to determine if it provides sufficient grounds for the Bank to process the project. When Borrower has completed all or part of the environmental assessment before the Bank participates in a project, the Bank will consider the environmental assessment to ensure its consistency with this policy. The Bank may, where appropriate, request additional environmental assessments, including public consultation and disclosure.	- The Ministry of Natural Resources and Environment appraise and approve EIA reports of the projects specified in Appendix III to this Decree, excluding the projects relating to defense and security contents. - The Ministries or the ministerial-level agencies shall appraise and approve EIA reports on projects under their competence for investment approval, except for projects listed in Appendix III to this Decree; - The Provincial People's Committees conduct appraisal and approval of EIA reports for projects in their provinces, except the projects mentioned above. - The appraisal will take place at least 45 working days at the MoNRE level and 30 working days at the DoNRE level and 5 working days on the district level after receipt of full Environmental Impact Assessment or full EPP.

The stages in the environmental assessment process	WB (OP/BP 4.01 on Environmental Assessment)	Vietnam (Decree No. 18/2015/ND-CP, Circular No.27/2015/TT- BTNMT)
The number and language of the EA/EIA to be evaluated	- The number of copies are not specified. - Language requirements: English and Vietnamese. EA reports in Vietnamese are required for domestic disclosure and must be in English for publication on the World Bank's website.	- Project Owner must submit at least 07 environmental impact assessment reports (depending on number of appraisal committee members) and 01 feasibility study or technical report of a proposed project.
Content of the EA report	- For an A-type project, the content of an EA report is in line with Appendix B of OP4.01. - The EA scope for a B-type project may vary depending on each project, but the EA's scope is narrower than that of an A-type project. An environmental and social management plan is an integral part of an EA type A (regardless of other tools to be used). EA for a B-type project may also be an environmental and social management plan with the content set out in Appendix C of OP 4.01.	- The content of a EA report must be in line with Circular No.27/2015/TT-BTNMT.
Monitoring EA	- During the project implementation, the World Bank will supervise the implementation of the environmental aspects, based on environmental regulations. The Borrower arranges reports of the agreement in the Loan Agreement, and in other projects, documents to determine if the compliance of the Borrower's Environmental Procedures (mainly with EMP) is satisfactory. If the compliance is not satisfactory, the World Bank will discuss with the Borrower to ensure the compliance, if necessary.	- The local DoNRE is entrusted with monitoring the environmental compliance of the projects. - At the end of the project construction phases, the Environmental Management Unit will coordinate with the Construction Management Unit to monitor the compliance of the environmental management activities, which mentioned in the EAs.

CHAPTER IV. NATURAL, SOCIO-ECONOMIC CONDITIONS AND ENVIRONMENTAL STATUS

4.1 Natural condition

4.1.1 Geographical location

Bac Kan is a mountainous province, which located in the inland center of the Northeastern part of the North; bordering to Bao Lac, Nguyen Binh and Thach An districts, Cao Bang province to the north; bordering to Trang Dinh and Binh Gia districts and Lang Son province to the east; bordering to Vo Nhai, Phu Luong and Dinh Hoa districts, Thai Nguyen province to the south; bordering to Na Hang, Chiem Hoa and Yen Son districts, Tuyen Quang province to the West.

Bac Kan's natural land area is 4,860 km^2, including 8 district-level administrative units, including Bac Kan City and 7 districts (Ba Be, Bach Thong, Cho Don, Na Ri, Cho Moi, Ngan Son, Pac Nam) and divided into 122 commune-level administrative units including 6 wards, 6 towns, and 110 communes.

Figure 9: Administrative map of Bac Kan

4.1.2 Topographic and pedological conditions

Bac Kan's topography is controlled by bow-shaped mountains extending to the East, including alternate “synclines” and “anticlines”. Bac Kan has a high mountainous terrain, higher than the terrain of surrounding provinces and controlled by bow-shaped mountain ranges extending from the North to the South in the West and East of the province. In

particular, Ngan Son Mountain connecting a strip running from Nam Quet (Cao Bang) to the East of Bac Kan province to Lang Hit (North of Thai Nguyen province), which makes a clear bow shape. This is the mountain that plays a significant role in the provincial terrain and an important climate boundary. This mountain range has many high peaks such as Coc Xo peak of 1131m, Phia Khau peak of 1061m, etc. Bow-shapes mountain part along Gam River extends along the West of the province. Its main structure is quartz schist and limestone, a long layer of very ancient crystalline rocks. This area has many different high and low peaks, including the Phja Booc peak of 1502m and many peaks above 1000m. The alternant part between the two bows is a syncline in the river valley system.

Details on the reservoirs are as follows:

a. The May Day reservoir

The work of the May Day reservoir is located in Dong Xa commune, Na Ri district, Bac Kan province, about 10km from the center of the commune. The work has a headwork built on May Day stream the basin of Na Thac river. The location of lake coordinates is: X (m) = 2437561,72; Y (m) = 453719.97.

The topography of the basin is in mountainous areas with strong cuts, alternating with massifs and deep valleys. The Work's basin is at an altitude of about 300m to 700m. The average altitude is about 450m.

The basin has a high slope, vegetation cover is mainly regenerated forest, trees grow sparsely. Due to the high slope, sparse vegetation cover, therefore, the level of water retention is not good; when the rain and floods come and the level of water concentration is fast, it often leads to big and fast floods.

The Work area has a terrain of a basin, surrounded by hills and mountains with 300-700 altitude, local roads and residential areas at the foot of the mountain and adjacent to inter-commune roads and local roads surrounding the lake. The irrigation area is about 20 ha, completely located toward downstream of the May Day Lake of Dong Xa Commune; the irrigation area has terraced structure and water is taken from May Day Lake. The difference between the lake surface and the irrigation area is 1-2.0m.

Geological conditions of the dam, spillway, and sewer system:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in the hard and flexible state from the dam surface to a depth of 3.0m, in the soft and flexible state under 3.0m, grit rate accounts for 5% - 10%; this layer belongs to grade-II soil. The thickness is about 15.5m.

Layer 1b: Old dam surface aggregate: This layer has elements of sand, gravel, and stone aggregated in the dam surface strip, in hard state and compact structure. This layer is distributed on the dam surface; its thickness is about 0.4m.

Layer 2: Clay mixed with grit: When drilling, this layer is found at drill hole HK4. The soil is brown-gray, bluish- grey, in soft and flexible state, moderately compact structure, distributed all over the route; its thickness is from 4.0 m to 6.0 m.

Layer 3: Siltstone mixed with loam: This soil layer has elements of weathered siltstone mixed with loam of golden-brown color, semi-hard to hard state, compact structure. This layer is distributed throughout the area; its thickness has not been drilled through (See the drawing of the longitudinal section along the route). In the survey hierarchy, layer 3 belongs to Grade-IV soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and streambeds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

b. The Coc Thong reservoir

The work of the Coc Thong reservoir is located in Liem Thuy commune, Na Ri district, Bac Kan province, about 50km from the district center along provincial road 256 and Liem Thuy road. The project has a headwork built on 2 main tributaries flowing through Liem Thuy stream. The lake coordinates is: X (m) = 2420796.90; Y (m) = 429385.81.

The Work's area has a pan-shaped terrain, surrounded by hills and mountains with an altitude of 300-700m; local roads and residential areas are located at the foot of the mountain and close to inter-communal and local roads surrounding the lake. The irrigation area is about 46.20 ha, completely located towards downstream of the Coc Thong reservoir in Liem Thuy commune; the irrigation area has a terrace-shaped structure and water is taken from Coc Thong reservoir. The difference between the lake surface and the irrigation area is 1-2.0m.

Geological conditions of the works of the dam, spillway, and culvert :

According to the results of a field survey, and laboratory test, we divided the structural layers of foundation soil as follows:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in the hard and flexible state from the dam surface to a depth of 5.0m, in the soft and flexible state under 5.0m, grit rate accounts for 5% - 10%; this layer belongs to grade-II soil. The thickness is about 23.0 m.

Layer 1b: Old dam surface aggregate: This layer has elements of sand, gravel, and stone aggregated in the dam surface strip, in the hard state and compact structure. This layer is distributed on the dam surface; its thickness is about 0.3m.

Layer 2: Clay mixed with grit: This layer has elements of clays mixed with brown-grey, red- grey colors, in soft and flexible state, moderately compact structure, distributed in the dam's downstream; its thickness is from 1.5 m to 3.0 m. This layer belongs to the grade-III soil.

Layer 3: Siltstone mixed with loam: This soil layer has elements of weathered siltstone mixed with loam of golden-brown color, semi-hard to hard state, compact structure. This layer is distributed throughout the area; its thickness has not been drilled through In the survey hierarchy, layer 3 belongs to Grade-IV soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and stream beds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

c. Na Kien Reservoir

The Work of Na Kien Reservoir is located in Nghia Ta commune, Cho Don district, Bac Kan province, about 15.0km from the center of Bang Lung town. The lake coordinates is: X (m) = 2441629.74; Y (m) = 399289.43.

The topography of soil mountain: The terrain of southern communes of Bang Lung town are mainly soil mountains with a common altitude of 400 m to over 600 m, the average slope of 200-250. The terrain is strongly cut by the dense river and stream system.

The basin has a high slope; vegetation cover is mainly secondary forest, sparsely growing trees. Due to the high slope, the vegetation cover is sparse due to poor water retention. When the rain and floods come, water concentration is rapid, which often leads to flash floods.

The topography of calcareous mountain: The northern communes of Lang Ca Phu karst plateau extend from Ba Be district to Bang Lung town. The topography is complicatedly cut by calcareous mountains with an altitude of over 1000m (Phia Khao mountain in Ban Thi commune), interspersed between narrow valleys and the average slope is from 250 to 300. This is the source of the rivers flowing to Ba Be Lake.

The topography of soil mountain: southern communes of Bang Lung town are mainly soil mountains with a common altitude of 400m to over 600m, the average slope of 200-250m. The terrain is strongly cut by the dense river and stream system.

Valley topography: Distributed along rivers and streams, among high mountain ranges. The natural conditions are generally favorable for the development of agroforestry, fruit trees, and specialty trees.

The lakebed is located in a narrow valley, with a medium slope; in the middle of the lake, there is an island, surrounded by residents' small ponds and there are secondary forests on the hilltop and planted forests in the lower area.

* Earth dams include: 3 main dams and 5 auxiliary dams; the dams connect 2 hills; there are steep hillsides along two sides of the dam and shallow slits at the hill bases.

* Flood spillway: According to the survey, the new spillway is located on the left of main dam No.3

* Culverts which takes water below the dam: including 3 culverts below 03 main dams; 3 lake-through culverts below auxiliary dams No.1; 2; 4; the centerline of the culvert is located at the hill foot adjacent to the road to the lake.

* Construction road cum lake management road: Running along the lake management route, (Inter-village road); the existing road surface is narrow B = (2-3) m.

The engineering geology

Through a geological survey of the Work, make drill holes for stratigraphic investigation and implement field tests, geological sample tests in the laboratory, the geology in the surveyed area has the following structure:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in a soft and flexible state and sometimes in the hard and flexible state; minor grit rate

accounts for 0.5% - 2.0%; this layer belongs to grade-II soil. The average thickness is about 7.5 m.

Layer 2: Clay mixed with grit: Soil has brown-grey, red-grey colors, in hard and flexible state, moderately compact structure, distributed over the route; its thickness is from 1.0 m to 2.0 m. This is the grade-III soil layer.

Layer 3: Siltstone mixed with loam: This soil layer has elements of weathered siltstone mixed with loam of golden-brown color, semi-hard to hard state, compact structure. This layer is distributed throughout the area; its thickness has not been drilled through in the survey hierarchy, layer 3 belongs to Grade-IV soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and streambeds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

d. The Khuoi Sung reservoir

The work of The Khuoi Sung reservoir is located in Yen Han commune, Cho Moi district, Bac Kan province. The work has node clusters built on the Khuoi Sung stream. The lake coordinates is: X (m) = 2426588.38; Y (m) = 442324,62.

The topography of the basin is in mountainous areas, strongly cut, interspersed with mountains and arroyos. The Work's basin is at an altitude of about 420m to 830m. The average altitude is about 510m.

The basin has a high slope; vegetation cover is mainly secondary forest, sparsely growing trees. Due to the high slope, the vegetation cover is sparse due to poor water retention. When the rain and floods come, water concentration is rapid, which often leads to flash floods.

The lake's topography is a long narrow valley, with the steep cliffs along two sides and culverts arranged on the left bank. On the right side of the hill, due to the gentle slope, the spillway is established. In the lake's upstream, there are a forest and cinnamon trees of the residents. Due to the steep terrain, the lake is not too wide.

For the dam connecting the two straits of the mountain, its vertical section is U-shaped because the topography of the headwork area is quite steep and narrow.

The sewer line is located on the left bank of the dam, close to the hillside to increase the stability of the sewer.

The spillway is located on the right bank of the dam; overflow is in the type of water chute. Due to steep terrain, the overflow slope is i = 26.4%.

Construction road cum lake management road: Running along the lake management route, (Inter-village road); the existing road surface is narrow B = 3 m.

Engineering geology

Through field survey and laboratory tests, we have the following results:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in the hard and flexible state from the dam surface to a depth of 3.0m, in a soft and flexible state under 3.0m, grit rate accounts for 5% - 10%; this layer belongs to grade-II soil. The thickness is about 18.0 m.

Layer 1b: Old dam surface aggregate: This layer has elements of sand, gravel, and stone aggregated in the dam surface strip, in hard state and compact structure. This layer is distributed on the dam surface; its thickness is about 0.m.

Layer 2: Clay mixed with grit: This layer has elements of clays mixed with brown-grey, red- grey colors, in soft and flexible state, moderately compact structure, distributed through the area; its thickness has not been drilled through. This survey hierarchy, layer IV belongs to the grade-III soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and stream beds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

e. Khuoi Day reservoir

The Work of Khuoi Day reservoir is located on a small stream of Na Ri river basin, in Yen Han commune, Cho Moi district, Bac Kan province. The Lake coordinates are: X (m) = 2426531.41; Y (m) = 441090.51.

The lake's topography is a long narrow valley, with the steep cliffs along two sides and culverts arranged on the left bank. On the right side of the hill, due to a gentle slope, the spillway is established. In the lake's upstream, there are a forest and cinnamon trees of the residents. Due to the steep terrain, the lake is not too wide.

For the dam connecting the two straits of the mountain, its vertical section is U-shaped because the topography of the headwork area is quite steep and narrow.

The sewer line is located on the left bank of the dam, close to the hillside to increase the stability of the sewer.

The spillway is located on the right bank of the dam; overflow is in a type of water chute. Due to steep terrain, the overflow slope is i = 26.4%.

Construction road cum lake management road: Running along the lake management route, (Inter-village road); the existing road surface is narrow B = 3.5 m.

Engineering geology

Through field survey and laboratory tests, we divide the structural layers of foundation soil as results:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in the hard and flexible state from the dam surface to a depth of 3.0m, in the soft and flexible

state under 3.0m, grit rate accounts for 5% - 10%; this layer belongs to grade-II soil. The thickness is about 19.0 m.

Layer 1b: Old dam surface aggregate: This layer has elements of sand, gravel, and stone aggregated in the dam surface strip, in hard state and compact structure. This layer is distributed on the dam surface; its thickness is about 0.3 m.

Layer 2: Clay mixed with grit: This layer has elements of clays mixed with brown-grey, red- grey colors, in soft and flexible state, moderately compact structure, distributed through the area; its thickness is 1.5-3.0 m. This survey hierarchy, layer 2 belongs to the Grade-IV soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and streambeds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

f. The Khuoi Dang reservoir

The Work of The Khuoi Dang reservoir is located in Thanh Mai commune, Cho Moi district, Bac Kan province. The lake coordinates is: X(m) = 2436419,63; Y(m) = 423232,25.

The lake's topography is a long narrow valley, with the steep cliffs along two sides and culverts arranged on the left bank. On the right side of the hill, due to a gentle slope, the spillway is established. In the lake's upstream, there are a forest and cinnamon trees of the residents. Due to the steep terrain, the lake is not too wide.

For the dam connecting the two straits of the mountain, its vertical section is U-shaped because the topography of the headwork area is quite steep and narrow.

The sewer line is located on the left bank of the dam, close to the hillside to increase the stability of the sewer.

The spillway is located on the right bank of the dam; overflow is in the type of water chute. Due to steep terrain, the overflow slope is i = 26.4%.

Construction road cum lake management road: Running along the lake management route, (Inter-village road); the existing road surface B = 4.0 m and travel is difficult.

Engineering geology

Through field survey and laboratory tests, we divide the structural layers of foundation soil as results:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in the hard and flexible state from the dam surface to a depth of 2.0m, in the soft and flexible state under 2.0m, grit rate accounts for 5% - 10%; this layer belongs to grade-II soil. The thickness is about 22.0 m.

Layer 1b: Old dam surface aggregate: This layer has elements of sand, gravel, and stone aggregated in the dam surface strip, in hard state and compact structure. This layer is distributed on the dam surface; its thickness is about 0.2 m.

Layer 2: Clay mixed with grit: This layer has elements of clays mixed with brown-grey, red- grey colors, in soft and flexible state, moderately compact structure, distributed through the area; its thickness is 1.5-3.0 m. According to this survey hierarchy, layer 2 belongs to the Grade-IV soil.

Layer 3: Siltstone mixed with loam: This soil layer has elements of weathered siltstone mixed with loam of golden-brown color, semi-hard to hard state, compact structure; its thickness has not been drilled through. In the survey hierarchy, layer 3 belongs to Grade-IV soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and stream beds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

g. The Na Leng reservoir

The Na Leng reservoir is located in Sy Binh commune, Bach Thong district, Bac Kan province, about 8km from the district center in the north. The Work has a headwork cluster built on Sy Binh stream. The lake centerline's coordinates is: X(m) = 2465044,11; Y(m) = 439889,40.

The Work's area has a pan-shaped terrain surrounded by hills and mountains with an altitude of 300-700; local roads and residential areas are scattered at the foot of the mountain and close to inter-commune roads and local roads around the lake. The irrigation area is about 25.0 ha, completely located towards downstream of Na Leng Lake in Sy Binh Commune; the irrigation area is in terrace-shape and water is taken from Na Leng Lake. The difference between the reservoir surface and the irrigation area is 1-2.0m.

Engineering geology

Through field survey and laboratory tests, we divide the structural layers of foundation soil as results:

Layer 1: Old dam embankment layer: Yellow gray soil, moderately compact structure, in the hard and flexible state from the dam surface to a depth of 4.0m, in the soft and flexible state under 4.0m, grit rate accounts for 5% - 10%; this layer belongs to grade-II soil. The thickness is about 12.0 m.

Layer 1b: Old dam surface aggregate: This layer has elements of sand, gravel, and stone aggregated in the dam surface strip, in hard state and compact structure. This layer is distributed on the dam surface; its thickness is about 0.2 m.

Layer 2: Clay mixed with grit: This layer has elements of clays mixed with brown-grey, red- grey colors, in soft and flexible state, moderately compact structure, distributed in the dam's downstream; its thickness is 1.5-3.0 m. The layer belongs to the grade-III soil.

Layer 3: Siltstone mixed with loam: This soil layer has elements of weathered siltstone mixed with loam of golden-brown color, semi-hard to hard state, compact structure; the layer

is distributed through the area; its thickness has been drilled through. In the survey hierarchy, layer 3 belongs to Grade-IV soil.

Hydrogeological conditions

Surface water: Surface water includes water from the main effluents and small effluents in the upstream of the dam. The small effluents in the lake are directed to supply water to the mainstream and in the Northwest - Southeast direction. In the dry season, surface runoff is usually found only in the mainstream with the plentiful flow and in the rainy season, the flow will be much greater.

Underground water: Underground water is only found in quaternary unconsolidated sediments in the river and stream beds. And underground water is deeply located in the porous complex of basaltic eruptive rocks; the level of underground water is predicted to be at a depth of 15-20m. In general, the area's soil and rock have weak permeability, the lower water reserves are mainly supplied from surface water and annual rainfall.

4.1.3 Climate conditions

Bac Kan is completely located in the tropical belt of Southeast Asia monsoon, closer to the tropic of Cancer than the equator. In this location, Bac Kan has a clear seasonal climate differentiation in terms of temperature, rainfall, day and night length. Bac Kan territory is located between two bow-shaped mountain systems of the Northeast, so it is strongly influenced by the continental climate of Asia, the weather is cold in winter and the influence of storms is limited in the summer.

The hot and humid rainy season is from May to October, accounting for 70-80% of the annual rainfall; dry season is from November to April next year, rainfall accounts for only 20-25% of the total rainfall in the year.

In Bac Kan Province, there are rain gauge and weather stations: Cho Ra, Ba Be, Dong Lac, Yen Thinh, Tung Ba, Cho Don, Thanh Phong, Ngan Son, Van Vu, Yen Lac, Tran Phu, Tien Phong, Thac Rieng, Bac Kan, and Cho Moi.

Station	Observation time	Station location		Station altitude (m)	Measuring factor
Cho Ra	1961-2010	$22^0 27'$	$105^0 43'$	210	5 factors
Cho Don	1961-2010	$22^0 10'$	$105^0 38'$	210	5 factors
Thanh Phong	1960-2010	$22^0 04'$	$105^0 40'$	250	Rain
Ngan Son	1960-2010	$22^0 28'$	$105^0 58'$	566	Rain
Yen Lac	1960-2010	$22^0 14'$	$105^0 37'$	10	Rain
Na Ri	1960-2010	$21^0 57'$	$106^0 03'$	75	Rain
Thac Rieng	1960-2010	$22^0 05'$	$105^0 53'$	98	Rain
Bac Kan	1956-2010	$22^0 08'$	$105^0 50'$	174	5 factors
Cho Moi	1960-2010	$22^0 52'$	$105^0 47'$	160	Rain

Note: 5 factors include sunshine, wind, temperature, humidity, evaporation, and rain

(Source: Hydrometeorological Center of Bac Kan Province)

❖ *Temperature:*

Bac Kan's climate has seasonal differentiation. Summer has high temperatures and lots of rain. Winter has a low temperature, little rain and is influenced by the Northeast monsoon. In general, the temperature is favorable for the development of agriculture and forestry.

Table 11. The maximum and minimum temperature at Bac Kan weather station (ºC)

Metering stations - characteristics		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Bac Kan	Tmax(ºC)	30.8	33.2	36.4	37.3	39.2	39.4	37.8	37.4	39.6	34.1	33.6	31.9	39.4
	Tmin(ºC)	-0.9	3.3	3.0	10.4	15.3	14.0	17.3	19.3	13.7	8.5	4.0	-1.0	-1.0
	T_{TB} (ºC)	14.8	16.3	19.3	23.0	26.1	27.3	27.4	27.0	25.8	23.1	19.3	15.9	22.1

(Source: Hydrometeorological Center of Bac Kan Province)

❖ *Air humidity*

Humidity is relatively high, the average relative humidity for many years is 84%. During the rainy period, the humidity is up to 89%, the fluctuations in the months are quite stable, and the difference does not exceed 5%.

Table 12. Average air humidity at Bac Kan weather station (%)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Average humidity (%)	82	82	83	84	83	85	86	87	85	84	83	81	84

(Source: Hydrometeorological Center of Bac Kan Province)

❖ *Evaporation*

The annual evaporation of the whole Bac Kan province tends to decrease from North to South, from high to low.

Table 13. Average evaporation of PICHE pipes for months and years (mm)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Year
Z	57.8	58.1	61.7	66.8	82.4	68.7	62.3	59.8	65.4	69.4	63.6	62.5	778.5

(Source: Hydrometeorological Center of Bac Kan Province)

❖ *Number of sunny hours*

The average number of sunny hours in many years in Bac Kan is from 1388 to 1532 hours. The month with the lowest number of sunny hours is the winter season (January; February): 52-55 hours/month. July; August and September have the highest number of sunny hours, are the months with lots of rain, reaching 181.2 hours.

Table 14. The average number of sunny hours in Bac Kan weather station (h)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Total number of sunny hours (h)	73.9	52.8	59.6	96.2	165.2	156.3	172.0	176.9	181.2	151.7	132.6	114.3	1532.8

(Source: Hydrometeorological Center of Bac Kan Province)

❖ *Wind regime*

The prevailing wind directions in Bac Kan are North and Northeast from September to April next year. Strong wind directions of summer months are West and Southwest. The average annual wind speed is only 1.1m/s.

Table 15. Maximum wind with direction according to design frequencies at stations (m/s)

Bac Kan station	Bac Kan station	Vmax designed (m/s)			
		P=2%	P=4%	P=25%	P=50%
1	N	22.1	18.4	9.8	6.2
2	NE	28.0	25.4	18.2	15.1
3	E	18.1	15.9	9.4	6.3
4	SE	19.76	17.17	10.21	7.46
5	S	17.49	15.51	9.77	7.11
6	SW	27.4	23.7	13.3	8.8
7	W	22.2	18.6	9.4	6.1
8	NW	27.34	23.81	13.81	9.44
9	No direction	31.0	28.5	20.8	17.0

(Source: Hydrometeorological Center of Bac Kan Province)

❖ *Rain regime*

The rainy season is from May to September, accounting for 74-78.8% of the total annual rainfall. July has the largest rainfall, accounting for 17-20.5% of the total annual rainfall

The dry season starts from October to April next year; the total rainfall is only accounted for 21-26%. The months of rain are at least December; first; 2. October; 4 is the transition month with fairly heavy rainfall.

Table 16. Total average monthly and yearly rainfall (mm)

Station	Month												Year
	1	2	3	4	5	6	7	8	9	10	11	12	

Bac Kan	22.2	29.0	50.6	104.4	180.8	255.6	280.5	271.3	155.9	72.6	39.0	18.5	1479.7
Na Ri	31.2	34.7	63.7	93.3	182.1	215.8	236.9	232.4	142.2	71.2	38.4	22.3	1364.2
Thac Rieng	17.6	23.5	43.5	94.7	179.4	219.8	250.9	272.1	148.4	78.4	33.6	16.4	1378.6
Cho Moi	15.2	24.4	45.6	101.8	172.5	245.5	300.4	291.2	164.5	92.5	39.2	13.6	1506.4

(Source: Hydrometeorological Center of Bac Kan Province)

4.1.4 Hydrological conditions

The network of rivers and streams in Bac Kan is quite dense, but most are upstream tributaries with a common feature of short, steep, erratic flow and water level. Major river systems include:

- Cau River: originates from the South of Phia Booc peak (1,578 m) of Van On mountain range in Phuong Vien Commune, Cho Don District, Bac Kan Province, flows zigzag between the two Ngan Son and Song Gam mountain ranges in the direction North by Northwest - South by Southeast to the territory of Duong Phong commune, Bach Thong district. After that, changes direction to flow the West by Southwest – East by Northeast through Bac Kan city to My Thanh commune, Bach Thong district. Here it changes direction to flow Northeast - Southwest. The total length of the section passing Bac Kan is about 103 km.
- Nang River: is made up of many small streams in Bao Lac and Bao Lam Districts of Cao Bang province and Pac Nam district of Bac Kan province. The upstream section of the Nang River consists of two tributaries, the northern tributary flows from Cao Bang province, the Western tributary constitutes in the area of Pac Nam district. These two tributaries now converge on the territory of Bang Thanh commune and then become the natural boundary between Cao Bang and Bac Kan provinces. Nang River, after receiving water from Ba Be Lake, flows to Tuyen Quang province and creates a confluence with the Gam river in Na Hang town, Na Hang district. The total length of the section passing Bac Kan is about 87km.
- Ba Be Lake: is a freshwater lake in Bac Kan, Vietnam. It is one of one hundred of the largest freshwater lakes in the world and is located in Ba Be National Park. The lake is about 145m above sea level. The lake has a water surface of more than 650ha, a length of nearly 8km, with a knot in the middle. The lake is surrounded by calcareous mountains with many caves and underground streams. The average depth is 20-25m, at the driest time, it is only 5-10 m. The main source of water is from the three rivers that flow into the lake. Water in the lake moves at a speed of about 0.5 m/s. During the flood season, the speed increases to 2.5-3m/s.

4.1.5 Biodiversity

a) Flora and fauna in Bac Kan province

Bac Kan province has a total natural area of about 4,860 km^2, accounting for 1.47% of the natural area of the whole country. The forest resources of the province are quite diverse and plentiful, considered a center for conservation of plant genetic resources of the Northeast. In addition to providing wood and bamboo, there are many endemic and rare animals and plants with high value. Regarding plants, the survey showed that Bac Kan province has 1791

species of plants, including 300 species of wood, 300 species of medicinal plants, 52 species included in Vietnam's Red Data Book.

b) Flora and fauna of the sub-project area

Regarding animals, interviews with local people showed that the rare animals in the lake bed area are no more, only reptiles (snakes, lizards, salamanders), amphibians (frogs), rodents (mice), birds, butterflies.

Regarding plants: mainly fruit trees, acacia, bamboo, shrubs, eucalyptus, bead tree ... as follows:

Table 17. The ecosystem of the 7-reservoirs area

No.	Names of reservoirs	Diversity of animals	Diversity of plants
1	May Day	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul; frogs, insects, chickens, ducks. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	only fruit trees such as longan, litchi, jackfruit ...; timber trees such as acacia, eucalyptus, and shrubs
2	Coc Thong	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul; frogs, insects. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	The surrounding area is dominated by acacia, bamboo, bead trees, shrubs
3	Na Kien	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul (Pycnonotus jocosus); frogs, clones, insects, chickens, ducks. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	The surrounding area is mainly eucalyptus, acacia, bamboo, shrubs
4	Khuoi Sung	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul; frogs, insects. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	The surrounding area is mainly eucalyptus, acacia, bamboo, shrubs
5	Khuoi Day	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul; frogs, insects, chickens, ducks. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	The surrounding area is mainly eucalyptus, acacia, bamboo, cinnamon, bead trees, shrubs
6	Khuoi Dang	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul; frogs, insects. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	The surrounding area is mainly eucalyptus, acacia, bamboo, reed, bead trees, shrubs

No.	Names of reservoirs	Diversity of animals	Diversity of plants
7	Na Leng	- Terrestrial: mainly flowerpeckers, sparrows, red-whiskered bulbul; frogs, insects, chickens, ducks. - Underwater: mainly feed fishes: amur, mud carp, carp, crucian, ...	The surrounding area is mainly eucalyptus, acacia, reed, magnolia chevalieri, bamboo, bead trees, shrubs

The May Day reservoir

The Coc Thong reservoir

Na Kien reservoir

The Khuoi Sung reservoir

The Khuoi Day reservoir

The Khuoi Dang reservoir

The Na Leng reservoir

Figure 10. Plant diversity in the sub-project implementation area

In general, the flora and fauna of the project area do not contain rare species, species on the red list to be protected, invasive or migratory species.

The fauna and flora in the sub-project area potentially affected by the sub-projects construction activities are also considered as eco-sensitive objects and will need specific mitigation measures for these ecosystems.

4.2 The impact of climate change on Bac Kan province

4.2.1 Prolonged hot weather on high temperature

One of the effects of climate change is most evident in the abnormal changes of weather, prolonged heat waves on high temperatures have significantly affected people's health, causing drought affecting agricultural and fishery production and increasing forest fires. In particular, the record heatwave in June 2017 led to an increase in the number of patients hospitalized. At Bac Kan General Hospital, on June 5th, 2017, the number of hospitalized patients reached 138; The total number of patients being treated at the hospital was 538 people.

4.2.2 Increase of terrible cold and damaging cold waves

Besides prolonged heat waves, climate change also causes long-lasting terrible cold and damaging cold phenomenon, which seriously affects people and livestock.

From January 23rd, 2016, due to the influence of intensive cold surge, the temperature of areas in Bac Kan province is very low, the weather in many regions has scattered small rain and sometimes it has freezing rain (in the form of small ice rain), most localities have snow rains and frost.

According to the Weather Station of Ngan Son district, on January 24th, 2016, the Station measured the lowest temperature of 2°C at 7 AM. In Deo Gio village, according to the people, the lowest temperature was -1°C, the snow and ice began to fall from dawn on January 24th, 2016, until 11:00 in the afternoon, the snow has not thawed.

On Ang Tong pass (Na Ry district), from 12:00-14:00 on January 24th, 2016, frost-covered branches and grass. There are bare trees covered with ice that from a distance look as apricot and plum trees with white blossoms welcome spring. Here are some photos of ice cover on Ang Tong pass:

The appearance of ice and snow has affected the health, crops, and animals of local people, especially the elderly and children. In the face of the above situation, the People's Committee of Bac Kan province directed the agriculture and rural development sector to send officials to closely follow grassroots positions and local authorities to intensify supervision and urge the people of the hamlets and villages to be absolutely not to leave cattle in the forest and in the field freely. At the same time, immediately implementing measures to protect against the cold for cattle, by keeping cattle in the barn, cranking with canvas and existing materials, cleaning the dry floor; feeding animals and giving them a drink with agricultural by-products, decrepit and old calves are feed with refined food to increase their resistance.

4.2.3 Increase of storms and tropical depressions and unpredictable changes

The effects of climate change on Bac Kan are most evident in the number and frequency of storms and tropical depressions in the province. Data from the Steering Committee for Disaster Prevention and Search and Rescue, the Department of Agriculture and Rural Development, and the Hydrometeorological Station of Bac Kan province showing the frequency, characteristics of forecasting and the scale of the impacts of the storms since 2009 have been abnormal and not followed the rule. It caused many difficulties for forecasting, preventing and responding to incidents.

4.2.4 Forest fires, floods and dam break

With mountainous terrain with a steep slope and sharply divided terrain, Bac Kan is often affected by extreme weather phenomena due to climate change such as flood, flash flood, drought, forest fire, landslide, erosion, biodiversity loss and destruction of ecosystems ... threatening people's lives and production.

In recent years, along with global climate change, the natural disaster situation in Bac Kan province has become more complicated and serious, greatly affecting people's lives, activities, and economy. According to 2017 statistics of natural disasters, the whole province had 03 deaths, 04 injuries; 877 houses damaged; 29 points of schools, classrooms, and schools affected; 966ha of crops and 109.7ha of small ponds damaged; 997 pets died; 172 irrigation works damaged; over 770m^3 of soil and rock eroded; 29 electric poles broken; 05 water and sanitation facilities damaged. Total damage of crops and assets in 2017 caused by natural disasters was estimated at more than 167.7 billion VND, 3.7 times higher than in 2016. In the first 4 months of 2018, the situation of natural disasters was very complicated. As of April 23rd, 2018, natural disasters caused damage estimated at over 69.6 billion VND.

Prolonged heat waves with high temperatures are an objective cause of the dryness causing forest fires. In the period from 2013 to December 2017, there were 24 forest fires in

the province, 37 reed fires, all were rescued and stamped out in time to prevent a big fire with a total area of 120, 75 hectares, total damaged area was 37.6 hectares, damage estimated was 8 billion Vietnam dong.

4.3 The current state of the environment

The current state of the background environment is expressed through parameters of soil, water, and air quality, which were measured in the field and analyzed in the laboratory. As a basis for assessing the environmental impact during the construction and operation of the reservoir, this is a necessary condition to control and minimize impacts due to construction, and operation of reservoir and dam safety.

The current state of the environment in the project area is assessed by two main methods as follows:

+ Method of quick environment measurement by field measuring devices.

+ Laboratory analysis method according to Villas standard (ISO/IEC 17025: 2005).

Due to the mountainous topography, 7 reservoirs are located in valleys, surrounded by hills and mountains for forest cultivation and agriculture. The consultant undertook field surveying and sampling at the sub-project implementation areas in July 2018 and February 2019. Specifically, the total number of samples taken was 7 gas samples, 10 surface water samples, 10 underground water samples, and 7 soil samples. The samples were analyzed by the Center for Environmental Monitoring and Modeling Research, registration number VILAS 864 - VIMCERTS 198 *(location details, comparison table and sample sheet in Appendix 6).*

4.3.1 Air environment

The location and quantity of air sampling are as follows

Table 18. Location and quantity of air sampling

Sample notation	Location and quantity of sampling	Coordinates
KK1	Na Kien Lake (1 sample)	22º04’05” N; 105º31’26” E
KK2	May Day Lake (1 sample)	22º02’40” N; 106º02’02” E
KK3	Khuoi Sung Lake (1 sample)	21º56’05” N; 105º55’44” E
KK4	The Khuoi Dang reservoir (1 sample)	22º01’26” N; 105º45’23” E
KK5	The Khuoi Day reservoir (1 sample)	21º56’00” N; 105º55’45” E
KK6	Coc Thong Lake (1 sample)	21º57’22” N; 106º03’28” E
KK7	Na Leng Lake (1 sample)	22º16’58” N; 105º55’10” E

Microclimate conditions are as follows:

Table 19. Microclimate conditions in the project area

Indicator	Unit	Analytical results						
		KK1	KK2	KK3	KK4	KK5	KK6	KK7
Temperature	^oC	31.5	32.0	31.2	20.5	21.7	18.3	19.8

Humidity	%	58.2	55.3	56.9	93.1	87.3	92.8	88.4
Wind speed	*m/s*	0.4	0.5	0.3	0.5	0.4	0.6	0.7
Wind direction	-	S	SE	S	NE	N	NE	SE

Surveying results showed that the air quality in the sub-project implementation area meets the standard, the area of 7 lakes has cool climate, production forest vegetation and shrubs are well developed, the surveying parameters (Noise, total dust, CO, SO_2, NO_2) are within limits according to QCVN 05: 2013 - National Technical Regulation on ambient air quality and QCVN 26: 2010/BTNMT - National Technical Regulation on noise.

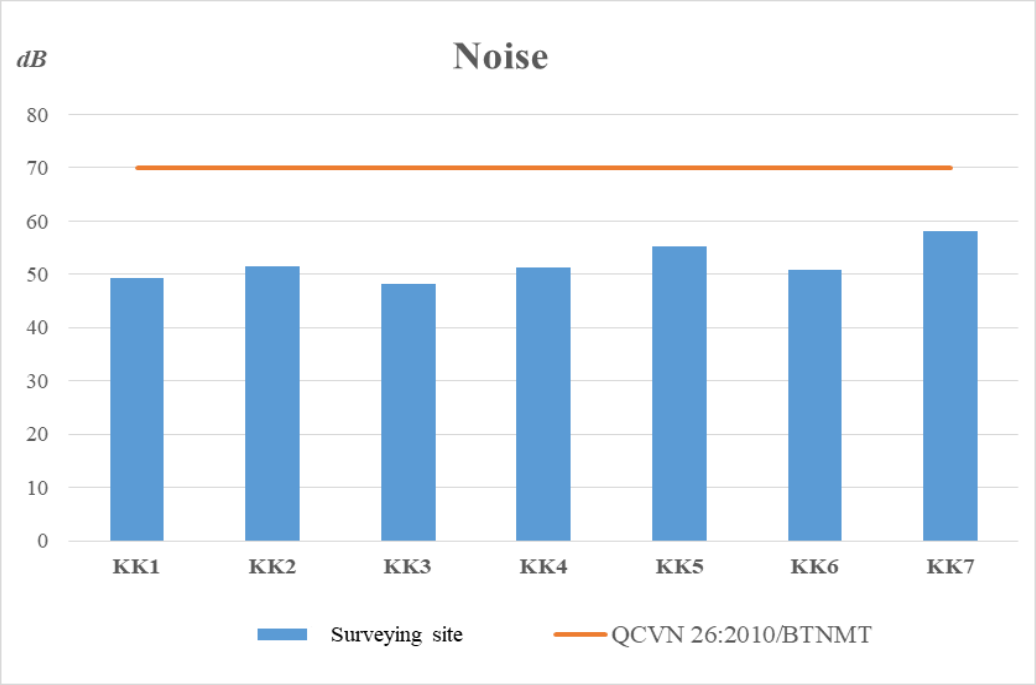


Figure 11. The current state of noise at the surveying sites of the sub-project

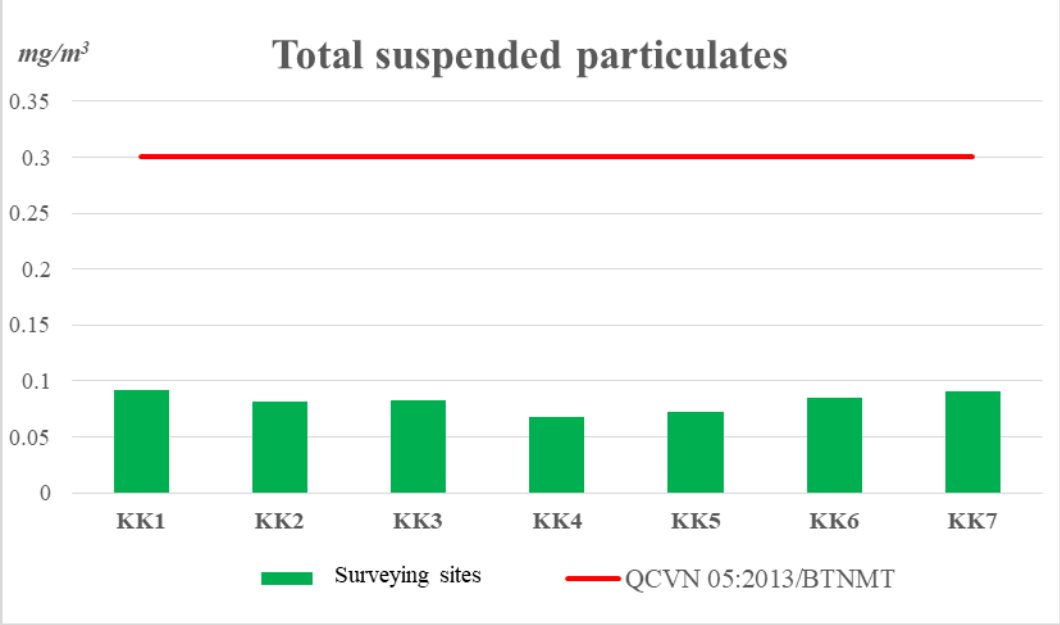


Figure 12. The concentration of total suspended particles at the surveying sites of the sub-project

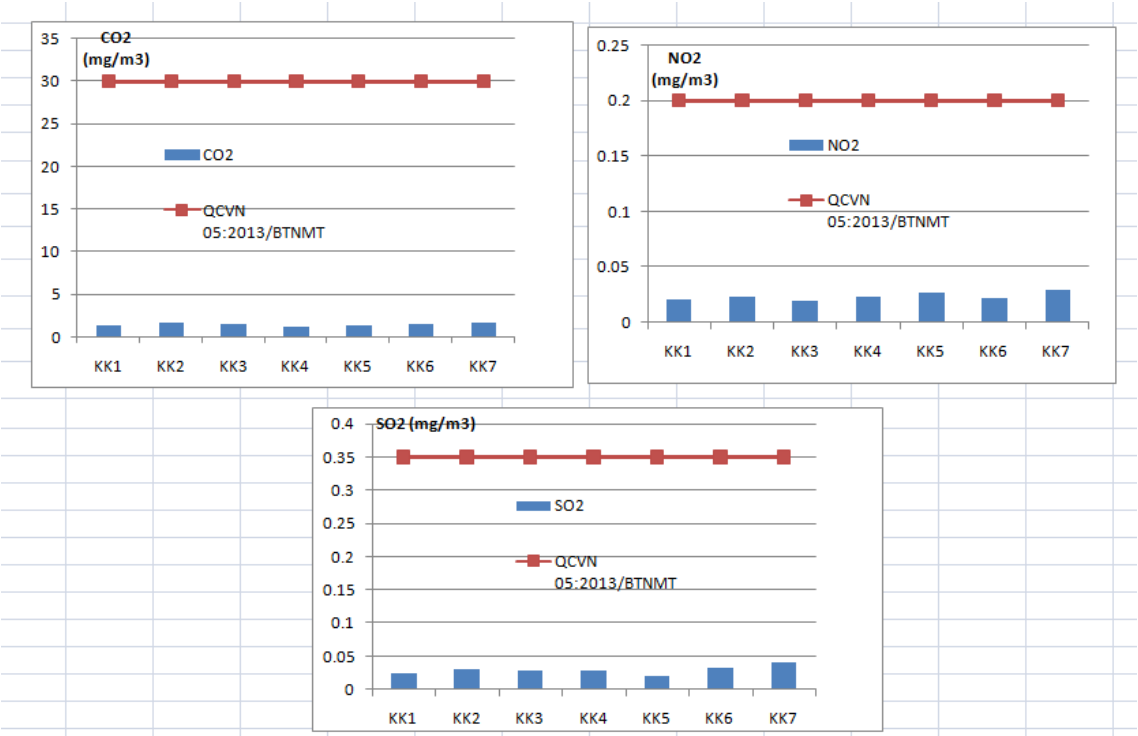


Figure 13. Comparison of concentration of CO, SO_2, NO_2 at surveying locations

4.3.2 Water environment

(1) Surface water

Conducting surveying, taking surface water samples in 7 lakes with specific locations as follows:

Table 20. Location and quantity of surface water sampling

Sample notation	Location of sampling	Coordinates
Na Kien Lake (2 samples)		
NM1	Na Kien lake, near to the upstream	22º04'15" N; 105º31'16" E
NM2	Na Kien lake, near to the downstream	22º04'22" N; 105º31'31" E
May Day Lake (2 samples)		
NM3	May Day lake, near to the upstream	22º02'35" N; 106º02'01" E
NM4	May Day lake, near to the downstream	22º02'45" N; 106º02'08" E
Khuoi Sung Lake (2 samples)		
NM5	Khuoi Sung lake, near to the upstream	21º56'02" N; 105º55'40" E
NM6	Khuoi Sung lake, near to the downstream	21º56'10" N;105º55'49" E
The Khuoi Dang reservoir (1 sample)		
NM7	The Khuoi Dang reservoir, located 30m	22º01'26" N; 105º45'23" E

	from the dam	
The Khuoi Day reservoir (1 sample)		
NM8	The Khuoi Day reservoir, located 20m from the dam	21°56'00" N; 105°55'44" E
Coc Thong lake (1 sample)		
NM9	Coc Thong lake, located 20m from the dam	21°57'22" N; 106°03'27" E
Na Leng lake (1 sample)		
NM10	Na Leng lake, located 25m from the dam	22°16'59" N; 105°55'11" E

The analysis results showed that surveying parameters of surface water quality (pH, temperature, TSS, BOD_5, COD, DO, Fe, NH_4^+, PO_4^{3-}, NO_3-, coliform) in all 7 areas are good, lower than QCVN08-MT: 2015/BTNMT, column B1.

The sub-project implementation area is rural, industrial production activities in the basin of lakes are almost absent, the main source of emissions to the environment is from farming, agricultural production, and husbandry activities. However, this source of waste is insignificant, the surface water quality in the project areas is quite good, can be used for irrigation or other uses with similar water quality requirements.

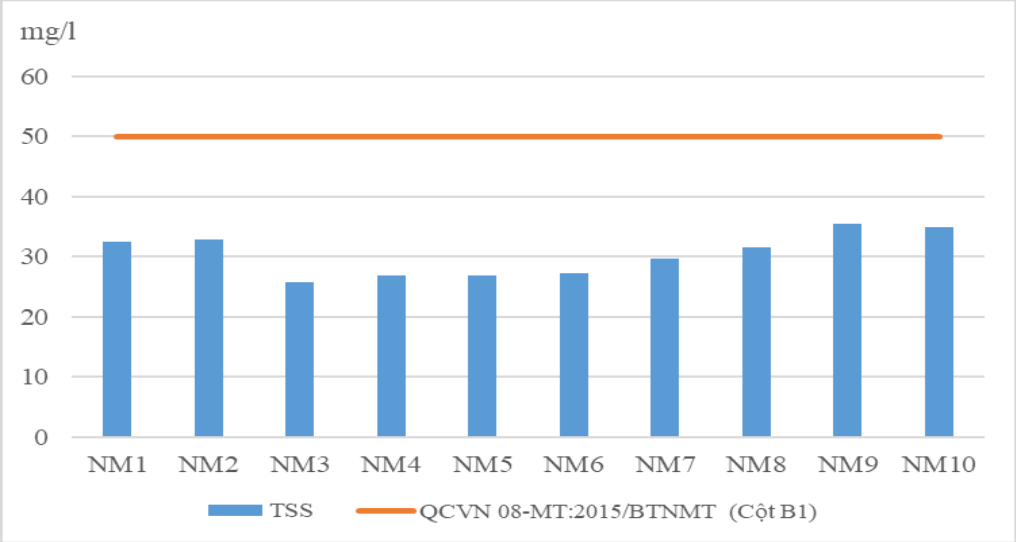


Figure 14. TSS content at surveying locations of the sub-project

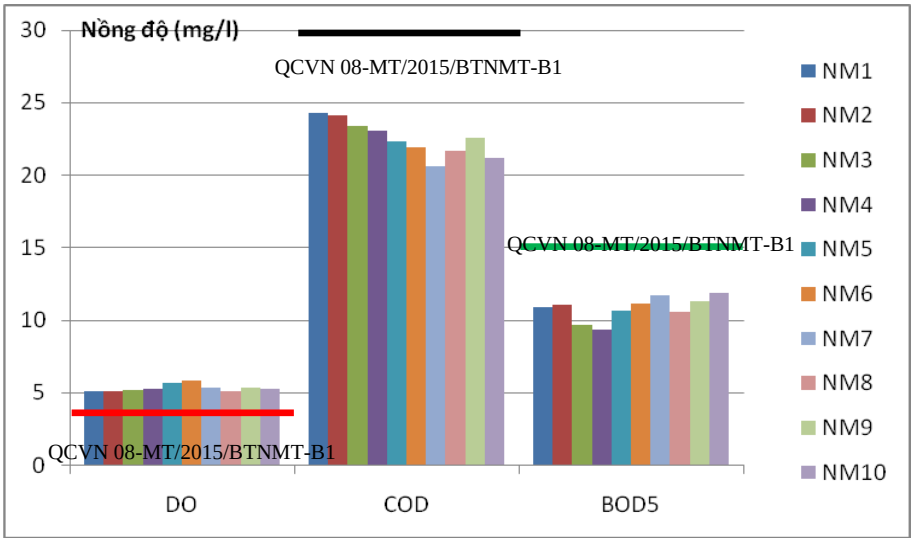


Figure 15. Comparison of DO, COD, BOD content of surface water at surveying locations of the sub-project

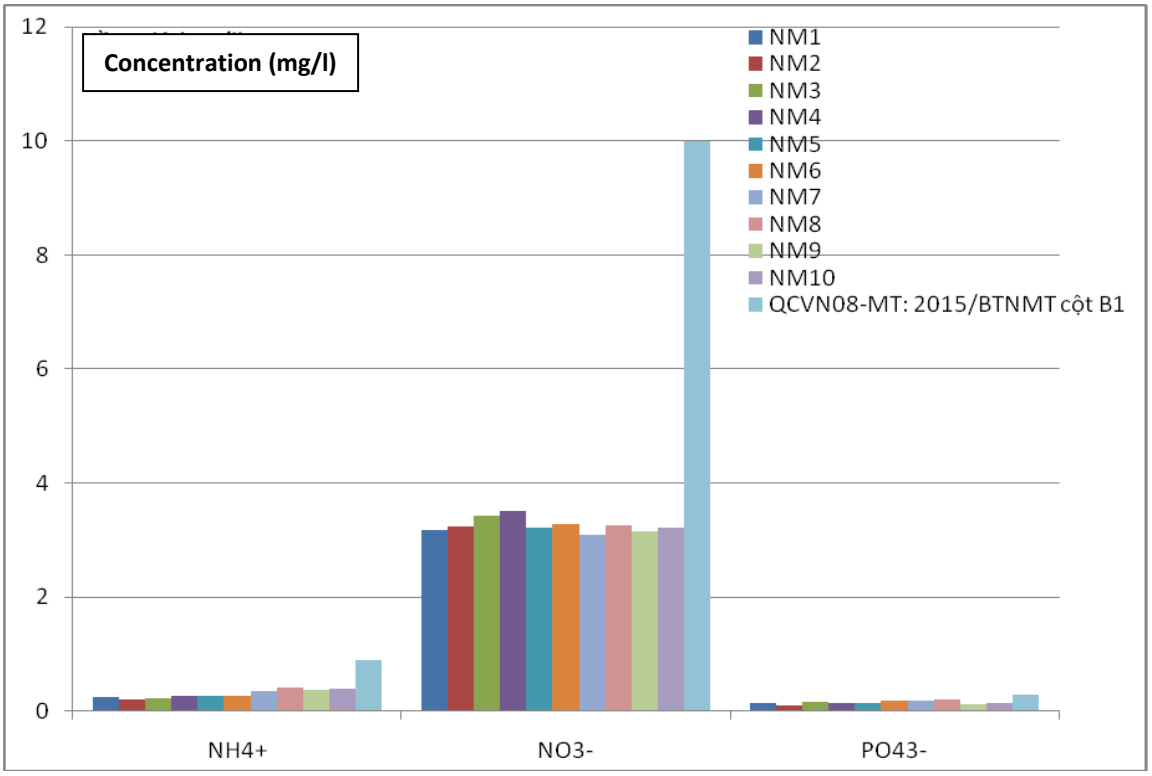


Figure 16. Comparison of NH_4^+, NO_3-, PO_4^{3-} content in surface water at surveying locations of the sub-project

(2) Groundwater

Carrying out the surveying and taking samples for analysis of groundwater quality in the project area with specific location and quantity as follows:

Table 21. Location and quantity of groundwater sampling

Sample notation	Location of sampling	Coordinates
Na Kien Lake (2 samples)		

NN1	Water from drilled well to a depth of 60m, houses in Na Kien village, Nghia Ta commune, Cho Don district	22º04’03” N; 105º31’41” E
NN2	Water from drilled well to a depth of 60m, houses in Na Kien village, Nghia Ta commune, Cho Don district	22º03’44” N; 105º31’46” E
May Day Lake (2 samples)		
NN3	Water from drilled well to a depth of 20m, houses in Na Vang village, Dong Xa commune, Na Ri district	22º02’31” N; 106º02’13” E
NN4	Water from drilled well to a depth of 23m, houses in Khoi Na village, Dong Xa commune, Na Ri district	22º02’36” N; 106º02’10” E
Khuoi Sung Lake (2 samples)		
NN5	Water from drilled well to a depth of 17m, houses in Na Lang hamlet, Yen Han commune, Cho Moi district	21º55’49” N; 105º57’19” E
NN6	Water from drilled well to a depth of 20m, houses in Nao Sao village, Yen Han commune, Cho Moi district	21º55’49” N;105º57’12” E
The Khuoi Dang reservoir (1 sample)		
NN7	Water from drilled well to a depth of 22m, houses in Ban Ty village, Thanh Mai commune, Cho Moi district	22º01’22” N; 105º45’40” E
The Khuoi Day reservoir (1 sample)		
NN8	Water from drilled well to a depth of 20m, houses in Tra Lau village, Yen Han commune, Cho Moi district	21º55’55” N; 105º55’49” E
Coc Thong Lake (1 sample)		
NN9	Water from drilled well to a depth of 25m, houses in Ban Cai village, Liem Thuy commune, Na Ri district	21º57’21” N; 106º03’33” E
Na Leng Lake (1 sample)		
NN10	Water from drilled well to a depth of 20m, houses in Na Leng village, Sy Binh commune, Bach Thong district	22º16’56” N; 105º55’14” E

The test results show that the analytical parameters (pH, hardness, NH_4^+, Fe, Mn) are all low, below QCVN 09-MT: 2015/BTNTM.

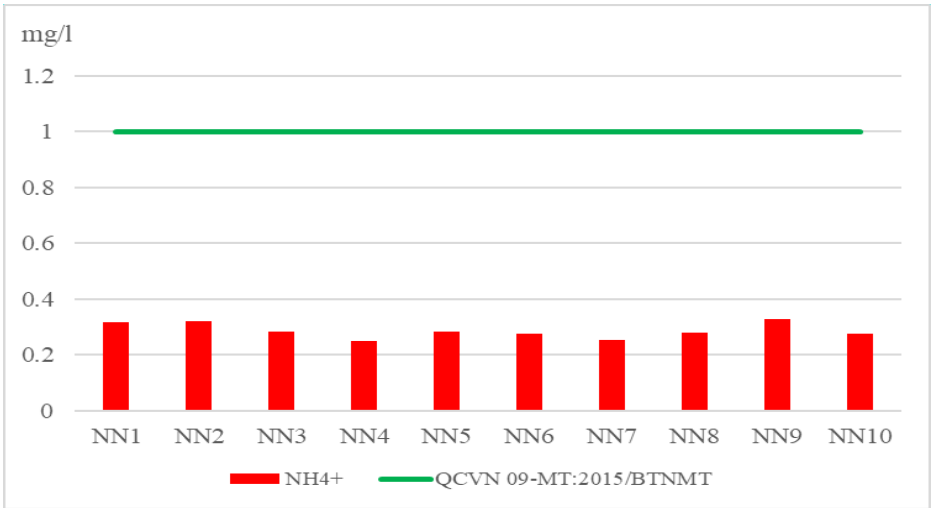


Figure 17. NH_4^+ content at surveying locations of the sub-project

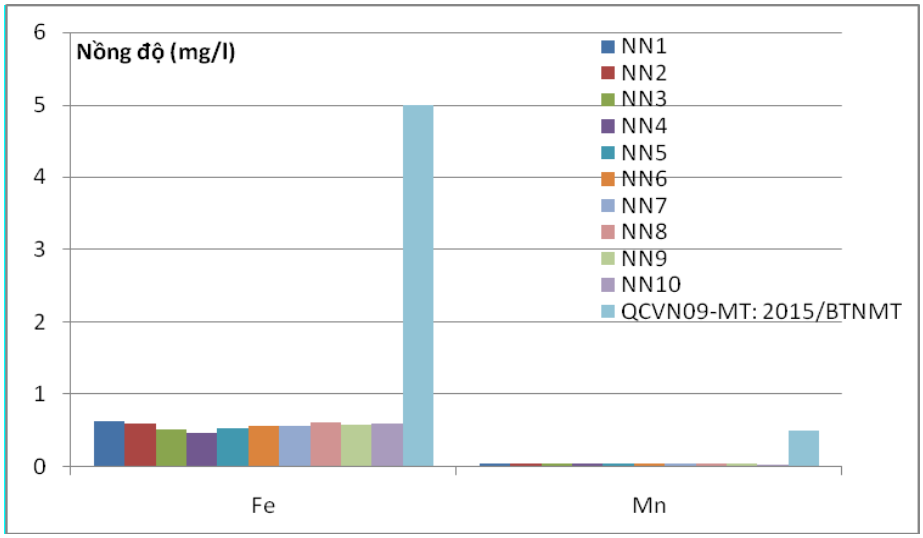


Figure 18. Comparison of Fe, Mn content in groundwater at the surveying sites of the sub-project

4.3.3 Soil environment

Location and quantity of soil sampling are as follows:

Table 22. Location and quantity of soil sampling

Sample notation	Location and quantity of sampling	Coordinates
Đ1	Na Kien Lake (1 sample)	22º04’12” N; 105º31’27” E
Đ2	May Day Lake (1 sample)	22º02’42” N; 106º02’05” E
Đ3	Khuoi Sung Lake (1 sample)	21º56’08” N; 105º55’47” E
Đ4	The Khuoi Dang reservoir (1 sample)	22º01’27” N; 105º45’23” E
Đ5	The Khuoi Day reservoir (1 sample)	21º56’01” N; 105º55’45” E
Đ6	Coc Thong Lake (1 sample)	21º57’20” N; 106º03’29” E
Đ7	Na Leng Lake (1 sample)	22º16’57” N; 105º55’09” E

According to the analytical results, the content of heavy metals in typical soils such as Cu, Pb, As, Zn, Cd, Cr in the project areas is within the allowable limits according to Vietnam National Technical Regulations (QCVN 03-MT: 2015/BTNMT).

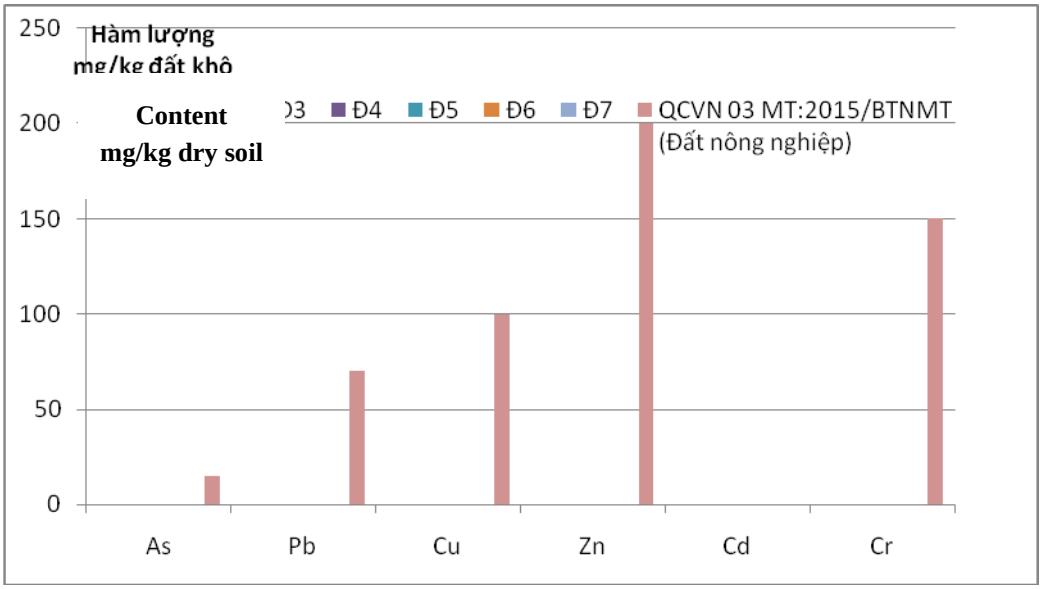


Figure 19. Comparison of content of heavy metals in the soil at the surveying sites of the sub-project

Thus, the environmental quality in the project area does not show signs of pollution for the environmental components, the surveying parameters are within the allowed standards (Details of surveying parameters in Appendix 6).

4.4 Socio-economic conditions in the sub-project implementation area

The total area of the communes in the project area is 25,978 ha. In particular, the forestry land area is about 18,950 ha, the rice land area is 652 ha, including 2 crops: the winter crop (starting to sow at the end of May, harvesting in mid-November every year) and the spring rice crop (starting to sow at the end of October, harvesting at the end of May next year). Dong Xa commune in Na Ri district has the largest forestry land area (7,139 ha) and Yen Han commune of Cho Moi district and Sy Binh commune of Bach Thong district have the smallest total area (Yen Han of 2,124 ha and Sy Binh of 2.137 ha). Sy Binh has the largest rice land area (169.02ha) and Dong Xa has the smallest one (46.52ha).

Use of pesticides: Agricultural production conditions are improved, the investment in production to increase profits increases the use of fertilizers and pesticides, thereby increasing the potential for environmental pollution. Currently, all localities are applying safe farming solutions such as IBM, ACM, "3 decreases, 3 increases", "1 must, 5 decreases", planting flowers on the banks of the fields, ... all these activities are aimed at limiting the effects from fertilizers, pesticides on people's health. However, there is still a need for good management of production and proper operation of the irrigation system, including continuing to encourage and guide people to apply new and environmentally friendly production methods.

The total population of the communes is 12,508 people with a total of 2,893 households. In particular, men account for 52.9% (6,621 people) and women account for 47.1% (5,887 people). Thanh Mai commune has the largest population with 2,817 people. The following are 2 communes Dong Xa and Yen Han. The commune with the lowest population is Liem Thuy with 1,418 people. Thanh Mai commune has 732 households (the highest population among all sub-project area communes), while Liem Thuy commune has only 310 households.

The average income per capita of the communes in the sub-project area is about 18.6 million/person/year. In which, the average income per capita in Thanh Mai and Sy Binh communes reaches the highest value of about 23 million VND/person/year and the lowest value is in Liem Thuy commune with the average income per capita of 12 million VND/year. The main occupation of the households in the communes of the project area is agriculture (planting rice, corn), forestry (afforesting, acacia, eucalyptus, cajuput, etc.). In addition, in Thai Nguyen province, there is a Yen Binh Industrial Park with a Samsung factory so the number of local people working in industrial parks is relatively high.

The total number of poor households in the communes of the project area is 564 households, accounting for 18.9% of the total households in 6 communes. In particular, Liem Thuy commune, Na Ri district has the highest poverty rate of 33.2% (103 households), Dong Xa commune, Na Ri district has the lowest poverty rate of 3.8% (59 households). Other communes have poverty rates ranging from 14.5% to 26.5%. There are 411 near-poor households in 6 communes of the project area. In which, Thanh Mai commune has 162 households (5.8%), accounting for the highest rate in 6 communes. The percentage of near-poor households is low in the following communes: Dong Xa, Nghia Xa, Sy Binh, Liem Thuy, and Yen Han.

100% of the people in the project area are ethnic minorities, the Tay is the majority.

In the sub-project area, all communes and wards have communal health stations, serving the needs of medical examination and treatment for people. 100% of households use electricity for daily activities.

The water source in the communes is mainly from drilled wells, dug wells and water coming from ravines. The quality of water is relatively good for domestic and production water supply. However, the groundwater level is low in the dry season, so some wells lack water for domestic use and drinking water for cattle. The percentage of households with hygienic toilets is very low, only 10.4%. Dong Xa and Liem Thuy communes have the highest percentage of hygienic toilets (20% - 25%), the lowest percentage is in Sy Binh commune with the interview result: no households have hygienic toilets.

Utility services in the area have met the needs of daily life in the commune (market, telephone network, internet ...). 6 communes have temporary markets serving people's daily trading needs. People in the communes of the sub-project area also face difficulties in trading and exchanging goods due to the specific mountainous topography.

For waste disposal infrastructure:

- Regarding rainwater and wastewater drainage: The survey results show that only 3% of the total number of households answer that there is a discharge sewer in the alley/hamlet where they are living. In general, the drainage system in the sub-project area is still very weak, not synchronized, discharge sewers are only constructed in some main roads of the commune, rainwater and domestic waste are mainly for natural overflow into lakes, ponds, gardens... This is also a potential risk of outbreaks of infectious diseases.
- Regarding solid waste treatment: Most of the waste generated is collected by garbage trucks of the local environmental sanitation team with a frequency of every 2-3 days. In the center, 6/8 of districts and cities have been invested to build a domestic waste treatment area by incinerator technology combined with burial; 7/110 of communes have been invested to build a domestic waste treatment model by incinerator technology combined with garbage tanks. 05 districts have been invested in domestic waste incinerators from the budget for environmental services, including Cho Don, Ba Be, Ngan Son, Pac Nam, and Cho Moi districts; and domestic waste of 02/8 of

districts is collected and buried in the temporary landfills such as Phuong Linh commune landfill (Bach Thong); Yen Lac town landfill (Na Ri)

Irrigation work system:

- The Khuoi Dang reservoir (Thanh Mai commune, Cho Moi): the capacity of 0.24 million m^3. The commune has a system of irrigation canals currently irrigating 45 hectares of rice, crops and fruit trees of Thanh Mai commune, Cho Moi district. Water from the lake is led through 2 intake sewers (main dam sewer made of D100 galvanized steel, secondary dam sewer made of DN400 diameter cast iron pipe) into concrete channels with a size BxH = 0.30 x 0.35 (m) and flows into this irrigation canal system. Therefore, the lake after the repair is completely able to connect well with the irrigation system of the commune.
- The Khuoi Day reservoir (Yen Han commune, Cho Moi): a capacity of 0.194 million m^3. The commune has a system of irrigation canals currently irrigating 40 hectares of rice, crops and fruit trees of Yen Han commune, Cho Moi district. Water from the lake is led through DN400 cast iron sewer into concrete channels with a size BxH * T = 0.50 x 0.50 x 0.15 (m) and flows into this irrigation canal system. Therefore, the lake after the repair is completely able to connect well with the irrigation system of the commune.
- The Coc Thong reservoir (Liem Thuy commune, Na Ri): the capacity of 0.23 million m^3. The commune has a system of irrigation canals currently irrigating 46.2 hectares of rice, crops and fruit trees of Liem Thuy commune, Na Ri district. Water from the lake is led through DN400 cast iron sewer into concrete channels with a size BxH * T = 0.4 x 0.5 (m) and flows into this irrigation canal system. Therefore, the lake after the repair is completely able to connect well with the irrigation system of the commune.
- Na Leng Lake (Sy Binh commune, Bach Thong): the capacity of 0.115 million m^3. The commune has a system of irrigation canals currently irrigating 25 hectares of rice, crops and fruit trees of Sy Binh commune, Bach Thong district. Water from the lake is led through DN400n cast iron sewer into concrete channels with a size B * H * T = 0.4 x 0.7 x 0.15 (m) and flows into this irrigation canal system. Therefore, the lake after the repair is completely able to connect well with the irrigation system of the commune.
- Khuoi Sung Lake (Yen Han commune, Cho Moi): the capacity of 0.212 million m^3. The commune has a system of irrigation canals currently irrigating 40 hectares of rice, crops and fruit trees of Yen Han commune, Cho Moi district. Water from the lake is led through DN400n cast iron sewer into concrete channels with sizes of 0.5 x 0.5 and 0.3 x 0.4 (m) and flows into this irrigation canal system. Therefore, the lake after the repair is completely able to connect well with the irrigation system of the commune.
- May Day Lake (Dong Xa commune, Na Ri): the capacity of 0.102 million m^3. The commune has a system of irrigation canals currently irrigating 20 hectares of rice, crops and fruit trees of Dong Xa commune, Na Ri district. Water from the lake is led through a sewer by D250 steel pipe into three concrete channels with a size B×H×T = 0.4 x 0.4 x 0.12 (m) and flows into 3 irrigation areas through this irrigation canal system. the lake after the repair is completely able to connect well with the irrigation system of the commune.
- Na Kien Lake (Nghia Ta commune, Cho Don): the capacity of 0.21 million m^3. The commune has a system of irrigation canals currently irrigating 52 hectares of rice, crops and fruit trees in Nghia Ta commune, Cho Don district. Water from the lake is led through 3 D300 stair-type intake sewer built of stone under 3 main dams, bringing

water to the irrigation area with a concrete channel with a size B×H = 0.5 x 0.5. The irrigation canal system is in good condition, but the intake water is damaged. The reworking of these works by D300 bridge iron will ensure the ability to connect the lake to the existing irrigation canals.

The situation of security and order of hamlets in the sub-project area is ensured; The public security department of villages and communes cooperated with district public security in the sub-project area to organize a conference to control and investigate drug crimes. Organizing the signing of contracts with households in the commune committing not to harbor, trade, use, broker social evils or prostitution and ensure security in the villages.

4.5 Specific works

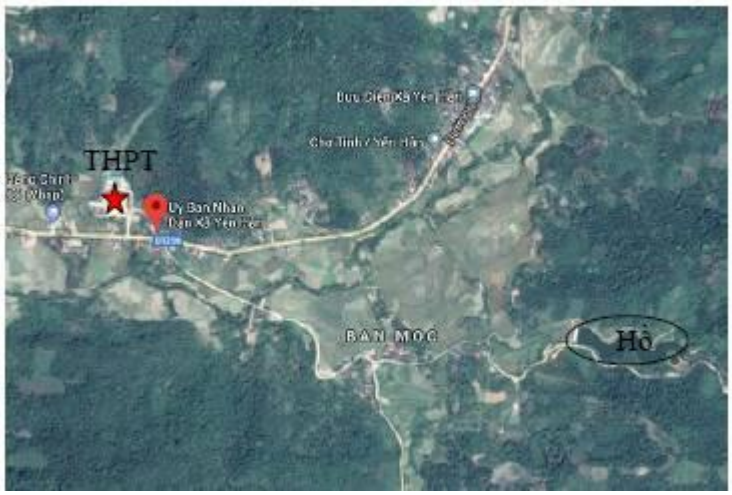
The sub-project is implemented in 06 communes, scattered in 4 districts of Bac Kan province. However, the location of the lakes is isolated and located quite far from the center of the commune (about 2-3km on average). There are no communal houses, pagodas, cemeteries or historical sites around the lake. The main transport routes are provincial roads and internal roads of communes/ villages, only scattered houses of households along the route. In the area of 7 lakes, the specific locations are determined as follows:

Table 23. Specific works

Projects	Location/descriptions
The Na Leng reservoir – Nghia Binh commune	
1, The siphon carrying water from a stream running through a household's lake 	The position running across the surface of The Na Leng reservoir, over the dam and leading down to people's houses
2, **The market in Nghia Binh commune**	Adjacent to Highway 279, the route for materials transporting, about 1.3 km from the lake

Projects	Location/descriptions
	
3, The house is next to the dam of the lake 	Located downstream of The Na Leng reservoir, 50-100m away, near the construction area
The Coc Thong reservoir – Liem Thuy commune	
1, The water siphon is located close to the path to the lake 	Running along the right of the dirt road leading to the lake
2, location of the Liem Thuy commune middle school	Location middle school is away from the project area (2.2 km), close to the road, there may be vehicles traveling back and

Projects	Location/descriptions
	forth
3, The house is next to the dam of the lake 	About 20-100 m located downstream of the dam and the lake side.
The Khuoi Day reservoir – Yen Han commune	
1, **Secondary school area** 	High school location is far away from the project area (2.1 km), close to DT256 road, there may be vehicles traveling back and forth.
2, **Market area of Yen Han commune** 	The location of the market area is far from the project area (3.1 km), close to DT256 road, there may be vehicles traveling back and forth.
The Khuoi Sung reservoir – Yen Han commune	

Projects	Location/descriptions
1, Yen Han High School 	High school location is far away from the project area (1.5 km), close to DT256 road, there may be vehicles traveling back and forth
2, The location of Yen Han commune market 	Location of the market area is far away from the project area (1.9 km), close to DT256 road, there may be vehicles traveling back and forth.
The Khuoi Dang reservoir – Thanh Mai commune	
The lake is isolated, around 3km there are no specific structures	The location of the lake is 3km from the People's Committee, along the road to the lake is about 2.5km without any houses.

Projects	Location/descriptions
	
The May Day reservoir – Dong Xa commune	
The lake is isolated, the road to the lake is 3.3 km. Downstream from the lake from 500-1km, there are a few households scattered. Also no other works 	The location of the lake is 3km from the People's Committee, isolated
Na Kien reservoir – Nghia Ta commune	
1, The house is located close to the road to the lake 	The road leading to the lake has 3 households located close to the road leading to the lake, about 250m away.

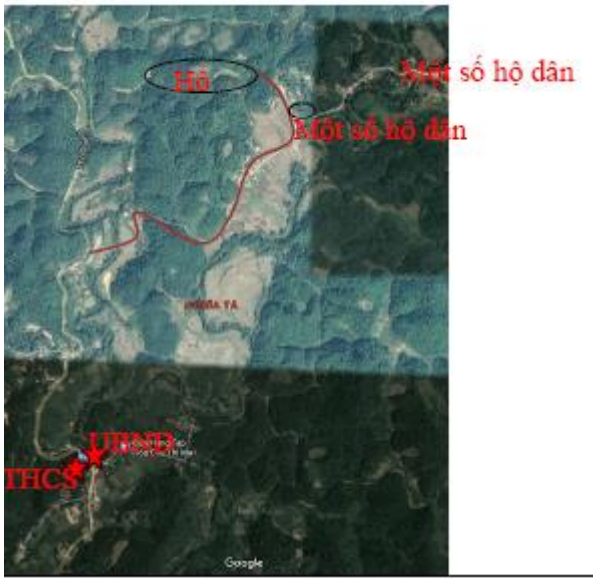
Projects	Location/descriptions
The lake area is relatively isolated, 2.4 km from the People's Committee, the secondary school, but the road to the lake is a unique route to the CPC, so the households inside this route may have difficulty moving when mobilizing vehicles during the construction. 	

Table 24. Socio-economic characteristics of communes in the sub-project area

	Unit	Yen Han	Thanh Mai	Dong Xa	Liem Thuy	Sy Binh	Nghia Ta	Total
Village/mountainous village	number	10					9	63
Number of culture house	number	10	13	13	6	11	9	62
Total land area	ha	2,659	4,118	7,876	4,564	2,752	4,010	25,978
- Annual crop land	*ha*	*180*	*46*	*387*	*231*	*257*		*1,100*
- Land for perennial crops	*ha*	*125.03*	*58.5*	*134.31*	*165.13*	*101.22*		*8,301*
- Rice land	*ha*	*137.18*	*163.46*	*46.52*	*135.54*	*169.02*		*652*
- Aquaculture land	*ha*	*0*	*30.56*		*13.51*	*6.59*		*51*
- Forest land	*ha*	*2,124*	*3,682*	*7,139*	*3,868*	*2,137*		*18,950*
- Residential land	*ha*	*9.94*	*12.18*	*19.61*	*13.73*	*46.03*		*101*
- Public land	*ha*	*3.21*	*0.2*		*37.86*	*34.93*		*76*
- Land for the cemetery	*ha*	*1.54*		*0*	*0*	*0.01*		*2*
- Unused land	*ha*	*0*	*52.65*	*40.4*	*13.46*	*0.19*		*107*
- Other land	*ha*	*78.14*	*124.83*	*108.57*	*86.19*	*0*		*397.73*
Population								
- Number of household	household	437	732	651	310	446	407	2,983
- Population	people	1,942	2,817	2,809	1,418	1,885	1,637	12,508
- Male	people	1020	1709	1413	708	937	835	6,621
- Female	people	922	1108	1396	710	948	802	5,887

	Unit	Yen Han	Thanh Mai	Dong Xa	Liem Thuy	Sy Binh	Nghia Ta	Total
Ethnic group								0
Kinh	household	7	22	3	3	35	15	85
Tay	household	429	679	257	65	210	264	1904
Dao	household	1	31	227	56	102	123	540
Nung	household	0		164	186	99	4	453
Mong	household						1	
Local economy								0
Total budget revenue	1000 VNĐ	146,000	235,000	49,538.9	96,893.8	108,000	41,171	676,603.7
Total budget expenditure	1000 VNĐ	3,977,000	4,927,000	1,417,100	3,670,578.5	6,060,754.5	4,186,876.8	24,239,309.8
Average income per capita	people/year	17,000,000	23,000,000	17,000,000	12,000,000	23,000,000	20,000,000	18,666,667
Local infrastructure								0
High School	school	*1*	*0*	*0*	*0*	*0*	*0*	*1*
Secondary School	school	*1*	*1*	*1*	*1*	*1*	*1*	*6*
Primary school	school	*1*	*1*	*1*	*1*	*1*	*1*	*6*
Nursery school	school	*1*	*1*	*1*	*1*	*1*	*1*	*6*
Temples	each	*0*	*1*	*0*	*0*	*0*	*0*	*1*
Pagoda	each	*0*	*0*	*0*	*0*	*0*	*0*	*0*
cemetery	each	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Historical sites	Point		*0*	*0*	*0*	*0*	*0*	*0*

	Unit	Yen Han	Thanh Mai	Dong Xa	Liem Thuy	Sy Binh	Nghia Ta	Total
Traffic road								**0**
- Soil road	*Km*	*4*	*17*	*15*	*30*	*5*	*23*	94
- Asphalt road	*Km*	*6*	*35*	*40*	*43*	*13*	*42*	179
- Gravel road	*Km*	*0*	*25*	*34*	*4*	*2*	*21*	86
- Concrete road	*Km*	*10*	*35*	*47*	*5.6*	*9*	*32*	138.6
Water and electricity for living								**0**
- water supplied from public network	household		0	17	0	0		17
- Water supplied from wells	household		715	50	49	120		934
- Water supplied from lakes. rivers and streams	household		0	0	82	0		82
- Water taken from the slit. small stream in the forest	household		17	584	179	326		
- Electricity is supplied	household	437	732	613	310		407	2499
Current situation of health facilities and public health								0
- Number of doctor	people	1	1	1	2	0	1	6
- Number of nurse practitioner	people	3	2	3	3	3	2	16
- Number of nurses	people	1	2	0	2	1	2	8

	Unit	Yen Han	Thanh Mai	Dong Xa	Liem Thuy	Sy Binh	Nghia Ta	Total
- Number of beds for patient	bed	2	7	4	26	10	10	59
Poor household	household	116	173	25	103	88	59	564
Near-poor households	household	85	162	19	61	47	37	411

(Source: Socioeconomic situation and new rural Report in 2018)

CHAPTER V. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

5.1 Types and scale of impacts

The Sub-project to be implemented in the area will potentially cause certain impacts during the construction stage, however, the impact level is not high and can be minimized. Upon the completion of construction, the residential areas in the 07 reservoirs will be benefited from the restoration of public services/facilities, which promote economic growth and access to social services. Important flood control structures that are roads and dams to be repaired, solidified, rehabilitated will increase the safety for people and their property in extreme weather conditions.

Potential negative impacts are identified and screened at each sub-project component from the preparation phase to the operational phase and classified according to the nature of the construction works. Almost all of negative impacts are temporary, localized and reversible due to small to medium scale of construction works. Impacts can be minimized by applying appropriate technologies and specific mitigation measures with the close monitoring of the Consultant, PPMU and local communities.

The table below defines the levels of negative impacts based on the levels of waste generation by construction activities[1].

Table 25.The criteria for classification of negative impacts

Impact/Level	Low	Moderate	High
Waste water discharge (domestic and industrial wastewater)	Exceeding the technical waste regulation from 1.1 times to less than 1.5 times and the discharge volume is less than 5 m^3/day	Exceeding the technical waste regulation from 1.1 times to less than 1.5 times and the discharge volume is less than 5- 10 m^3/day	Exceeding the technical waste regulation to more than 3 times and the discharge volume is more than 10 m^3/day
Dust and Emissions	Exceeding the standard of 1.1 times to less than 1.5 times with the emission level of less than 500 m^3/hour	Exceeding the standard of 1.5 times to less than 3 times with the emission level of less than 500 - 5000 m^3/hour	Exceeding the standard of 3 times with the emission level more than 5000 m^3/hour
Noise	Exceeding the standard of 2 to 5 dB	Exceeding the standard of 5 to 10 dB	Exceeding the standard of 10 dB
Vibration	Exceeding the	Exceeding the	Exceeding the

[1] Based on a reference to Decree 155/2016/NĐ-CP on regulation on administrative punishment in environmental protection.

	standard of 2 to 5 dB	standard of 5 to 10 dB	standard of 10 dB
Domestic solid waste	Generating less than 1,000 kg/day	Generating from 1,000 to 2,000 kg/day	Generating more than 2,000 kg/day
Hazardous, solid waste	Generating less than 100 kg/ day	Generating 100 - 600 kg/day	Generating 600 kg/ day
Explosion-fire incidents and oil spillage	Less than 2,000 kg	2,000 to 10,000 kg	More than 10,000 kg

The potential impacts of the project are classified as follows: None (N) without impact; low (L) - small works, minor impacts, localized, reversible, temporary; medium (M) - small works in urban/sensitive areas, medium scale with moderate, reversible, local and temporary impacts; High (H) - large scale urban/sensitive works, large scale works with significant impacts (social and/or environmental), irreversible and compensatory.

Table 26. The level of negative impact of implementation of the Sub-project

Items	Physical			Biological		Society				Other		Note
	Air, noise, vibration	Earth, water	Solid waste, dredged sludge	Forests, natural ecosystems	Fish, aquatic	Land acquisition, resettlement	Native people	Physical cultural resources	Livelihood, disturbance to the community of people	Local flooding, traffic, safety	Impact outside the project area	
The May Day reservoir - Dong Xa commune												
Preparation	L	L	N	L	L	L	L	N	L	N	N	- Small and medium-sized structures with small impacts (see also note (2) below)
Construction	M	M	L	N	N	N	N	N	L	M	L	
Activity	N	N	N	N	N	N	N	N	N	N	N	
Na Kien reservoir - Nghia Ta commune												
Preparation	L	L	N	L	L	L	L	N	L	N	N	- Large-scale structures with significant impacts (see also note (2) below)
Construction	M	M	L	N	N	N	N	N	L	M	L	
Activity	N	N	N	N	N	N	N	N	N	N	N	
The Khuoi Sung reservoir - Yen Han commune												
Preparation	L	L	N	L	L	L	L	N	L	N	N	Medium scale structures with medium impacts (see also note (2) below)
Construction	M	M	L	N	N	N	N	N	L	M	L	
Activity	N	N	N	N	N	N	N	N	N	N	N	
The Khuoi Day reservoir - Yen Han commune												

Preparation	L	L	L	N	N	M	N	N	L	L	L	- Medium scale structures with medium impacts (see also note (2) below)
Construction	M	M	M	N	N	N	N	N	M	M	M	
Activity	L	N	M	N	N	N	N	N	L	L	M	
The Khuoi Dang reservoir - Thanh Mai commune												
Preparation	L	L	N	L	L	L	L	N	L	N	N	- Medium scale structures with medium impacts (see also note (2) below)
Construction	M	M	L	N	N	N	N	N	L	M	L	
Activity	N	N	N	N	N	N	N	N	N	N	N	
The Coc Thong reservoir - Liem Thuy commune												
Preparation	L	L	N	L	L	L	L	N	L	N	N	- Medium scale structures with medium impacts (see also note (2) below)
Construction	M	M	L	N	N	N	N	N	L	M	L	
Activity	N	N	N	N	N	N	N	N	N	N	N	
The Na Leng reservoir - Nghia Binh commune												
Preparation	L	L	N	L	L	L	L	N	L	N	N	- Medium scale structures with medium impacts (see also note (2) below)
Construction	M	M	L	N	N	N	N	N	L	M	L	
Activity	N	N	N	N	N	N	N	N	N	N	N	

Note:

(1) The following criteria are used for impact assessment: No (N) has no impact; Low (L) - small works, minor impacts, localized, reversible, temporary; Medium (M) small works in urban/sensitive areas, medium-sized buildings with moderate impacts including reversible, minimized and manageable, local, temporary; High (H) - Medium and small scale urban/sensitive buildings, large scale buildings have significant impacts (and social/or environmental) in which many cases are irreversible and require compensation, Both M and H need to monitor and implement the mitigation measures and adequate institutional capacity for safety.

(2) Small and medium-sized buildings, most of their impacts are localized, temporary, and can be mitigated through the application of good

engineering solutions and construction management practices, with supervision, inspection and close consultation with the local community.

Potential negative environmental and social impacts are also divided by types such as direct, indirect, short-term, long-term and cumulative impacts.

Direct impacts: The direct impacts occur through the direct interaction of a sub-project activity with environmental and social or economic components.

Indirect impacts: The indirect impacts on the environment and society that are not direct results of the Sub-project, which is often created later or as a result of a real complex impact. Indirect effects are also known as secondary effects or even tertiary effects.

Cumulative impacts: the impacts that occur as a result of a combination of the Sub-project with other projects that cause associated impacts. These impacts occur when the incremental impact of the Sub-project is combined with the cumulative effects of past, present, or future projects that have the potential for predictability.

Temporary impacts: the impacts that occur during the construction or within a short period after the construction.

Long-term impacts: the impacts that arise during the construction but most of the results appear in the operational phase and can last for decades.

5.2 Positive environment and social impacts

5.2.1 Social impacts

The Sub-project after being completed will bring benefits to the community and local authorities, namely, dam body and dam slope to be rehabilitated will ensure safety for downstream areas in rainy seasons, limit leakage and loss of water, ensure the flow of irrigation water for agricultural production in the downstream in accordance to the local government's production regulation plan, increase productivity and agricultural productivity as well as crop yields and aquaculture development. The works to be rehabilitated will ensure the stable supply for paddy and vegetable areas throughout the year in the downstream of 10 communes. They supply water for aquaculture areas and limit negative impacts on the environment, landscapes of the reservoir areas and downstream. They stabilize the aquaculture water surface non-agricultural production and business, increase income and living standard as well as create more jobs and income, especially for unskilled and seasonal workers.

Increased proactive irrigation area

The investment in rehabilitation of 07 dams/reservoir will stabilize the irrigation water for 268.2 hectares to be active in planning cultivation, crop seasons, seedling structure for the downstream to step by step contribute to improving infrastructure and living conditions in difficult areas.

Impact on management capacity, operation of irrigation systems

The DRSIP project will improve the safety of the reservoirs and help the local authorities in the project area to develop long-term rural development strategies and scenarios, taking into account climate change scenarios and realizing activities to implement the national target program on climate change mitigation and adaptation, the water resources development strategy up to 2020 with a vision to 2050; the National strategy for rural clean water supply and sanitation up to 2020; the Program on socio-economic development in mountainous areas up to 2020; and the National target program for building new rural areas.

5.2.2 Environment impacts

(a) Impact on air quality and micro climate condition

The rehabilitation of the reservoir construction works will affect the air environment at the construction phase but in small space and impacts are local and intermittent. When the reservoirs are operated, they will have positive impacts on the change of some meteorological factors in the areas. The stabilization of the water surface will change the micro climate condition of each reservoir area and the moisture which is related to the continental dry, nature of the climate in dry seasons. In the operation phase, the Sub-project will increase the stability of water resources and safety for the works and the dam downstream.

(b) Impact on the landscapes

At present, 07 reservoirs being exploited have spillways but some draining culverts are leaked, the slopes are not concreted and there are not roads for management and operation. As proposed by the Design Consultant, to ensure the safety of the dam body, draining culverts, it needs reinforcement, replacement and concretion of the works to ensure water storage, avoid water loss and create convenience for regulating water for production and operation of the reservoirs, which will ensure the development conditions for coastal vegetation communities, creating landscapes around reservoirs and local traffic.

After repairing, solidifying the management roads of 07 reservoirs will create a new look for the reservoir landscape and the surrounding area. The reservoir area will be beautiful, modern and safe.

(c) Impact on the ecosystem

After the construction works in 07 reservoirs are complete, the stable flows of water and irrigation will contribute to the development of aquatic and plant ecosystems in the reservoirs and the downstream areas. There will be continuously and positive impacts on the ecosystem for long time, which help diversify and enrich the flora and the fauna in the sub-project area.

(d) Impact on groundwater

The completion of the construction works in 07 reservoirs will stabilize the water levels and increase the water level in reservoirs and ponds, which is higher than the downstream areas, therefore, after the reservoirs are operated, the downstream water level is always maintained year round to meet the demand for water for daily life and cultivation of local people.

5.3 Potential negative impacts

5.3.1 Preparation phase

The Sub-project consists of 07 components scattered in 6 communes, belonging to 4 districts. The scale of each component is small and medium. The construction period is not long. The works during this period were mainly geological survey drilling for feasibility study and detailed design, demarcation of land acquisition, demining and site clearance. Therefore, during this period, we only assess impacts from (1) compensation and land acquisition, (2) risks related to clearance of mines and bombs and (3) geological survey.

- ***Impact of land acquisition***

The inventory of loss results (IOL) in July 2018 to Feb 2019 implemented by the Consultant prepared the RAP; then implementation of the DRSIP Project shall cause effects on 7 villages/6 communes/ in 4 districts. However, in total of 7 reservoirs, only the Khuoi Sung reservoir in Yen Han commune is not affected on land acquisition.

The total affected area is 46,387 m2, including 9,255 m2 of permanently land acquisition (41 households) and 37,132 m2 of temporarily acquired land (public land of 6 communes). A total of 46 affected households, including 41 households permanently affected by the loss of land and trees, crops, 5 indirectly affected households due to cultivation on the area of the dam corridor and public land of 6 communes during the construction of camps, material yards ... No households are severely affected (due to loss of 20% of total productive land, or 10% for vulnerable households), no affected households will be relocated. No households are affected by production and business. All 46 affected households are ethnic minority people in vulnerable groups.

Table 27. Number of affected households by the Sub-project

index	District/ communes	Number of AHHs					Number of affected households due to trees cultivation on the land of the dam corridor	Total of HHs
		Residential land	Annual crops land	Land for perennial crops	Aquatic land	Production Forest land		
I	**Cho Moi dist.**	**0**	**2**	**0**	**1**	**5**	**2**	**9**
1	Yen Han	0	1	0	1	1	2	4 (due to 1 AHH affected on over 2 kinds of land)
2	Thanh Mai	0	1	0	0	4	0	5
II	**Na Ri dist.**	**0**	**4**	**4**	**1**	**6**	**1**	**13**
3	Dong Xa	0	3	4	1	5	0	10 (due to 3 AHHs affected on over 2 kinds of land)
4	Liem Thuy	0	1	0		1	1	3
III	**Bach Thong dist.**	**0**	**0**	**0**	**1**	**1**	**2**	**4**
5	Sy Binh	0	0	0	1	1	2	4
IV	**Cho Dong dist.**	**3**	**2**	**4**	**3**	**16**	**0**	**20**
6	Nghia Ta	3	2	4	3	16	0	20 (due to 8 AHHs affected on over 2 kinds of land)
	Total	**3**	**8**	**8**	**6**	**28**	**5**	**46 (12 AHHs affected on over 2**

index	District/ communes	Number of AHHs					Number of affected households due to trees cultivation on the land of the dam corridor	Total of HHs
		Residential land	Annual crops land	Land for perennial crops	Aquatic land	Production Forest land		
								kinds of land)

(Source: Result of RAP, in July 2018 to Feb 2019)

In 46 AHHs affected, there are 3 AHHs whose residential land is partly affected (not affected by houses). The implementation of the sub-project work items will directly influence on 9,255 m² of the land of 41 households, of which:

- Area of affected land: 200 m^2 (3 HHs)
- Annual crop land affected : 1.113 m^2 (8 HHs)
- Area of land for perennial crops affected: 745 m^2 (8 HHs)
- Affected production forest land: 6.370 m^2 (28 HHs)
- Aquatic area: 827 m^2 (6 HHs)

The total area of temporarily affected is 37,132.0 m^2 of public land, in 6 communes, using for construction of camps, materials gathering yard, during construction time. At the time preparation of the Report, the construction methods of Contractors still have not defined specifically. Therefore, this data is just preliminary estimations, shall be updated specifically impacts during construction time of them, which based on the actual construction solutions and updating into the periodic monitoring reports.

Affecting to structures, houses…there are 3 households affected by structures with an area of 55 m^2, of which 15 m^2 is a temporary house (leaf-roof hut) (1 household), 25 m^2 wall (1 household) and 15 m^2 of poultry farm (1 household).

Impacts on crops and trees: There 725 crops of all kinds will be affected, of which: 129 are fruit trees; 596 timber trees of all kinds are affected by the project.

Impacts on public works: The WB8 sub-project in Bac Kan province will affect 04 low-voltage poles and 400 m of electrical line under the management of Cho Don and Na Ri districts Electricity companies.

No affected households will be considered severely affected households according to the project's policy due to the rate of land loss over 20% of the total productive land area and from 10% for vulnerable households.

Interruption of water during the construction process: According to the design, the construction measures are proposed to build the dike during the construction of the sluice gate. Conduct diversion and still provide enough water to serve the production of people at a certain level. Carry out the construction after the people in the sub-project area harvest the crops, to avoid affecting the supply of water for production for communities living in the

downstream areas. In case of the urgency of the construction schedule, leading to the loss of water due to the construction, the Contractor, the investor, the local government will coordinate to carry out the inventory and make compensation plan, support for affected households due to water interruption during construction. Specific data on affected areas of irrigated households due to construction water interruption (if any) will be updated in the RAP update reports, internal monitoring reports, and periodic independent monitoring reports.

The impact of land acquisition on each project item is shown in the table below:

Table 28. Summary of land acquisition by the Sub-project

No.	Item	Location	Permanently affected area										Total permanently affected area (m^2)		Temporarily affected area (m^2) managed by CPC		Total area affected	Total of AHHs
			Residential land		Annual crop land		Land for perennial crops		Area of land for perennial crops		Production forest land		HH	(m^2)	Public area affected	Number of AHHs due to cultivating crops on the dam corridor		
			HH	(m^2)	HH	(m^2)	HH	(m^2)	HH	(m^2)	HH	(m^2)						
1	Khuoi Sung	Yen Han	0	0	0	0	0	0	0	0	0	0	0	0	4,700	2	4,700	2
2	Khuoi Dang	Thanh Mai	0	0	1	225	0	0	0	0	4	1,926	5	2,151	4,700	0	6,851	5
3	Khuoi Day	Yen Han	0	0	1	394	0	0	1	230	1	1,309	2 (1 HHs affected over 2 kinds of land)	1,933	4,700	0	6,633	2
4	May Day	Dong Xa	0	0	3	225	4	540	1	30	5	690	10 (3 HHs affected over 2 kinds of land)	1,485	3,672	0	5,157	10

5	Coc Thong	Liem Thuy	0	0	1	214	0	0	0	0	1	145	2	359	6,000	1	6,359	3
6	Na Leng	Sy Binh	0	0	0	0	0	0	1	427	1	210	2	637	6,000	2	6,637	4
7	Na Kien	Nghia Ta	3	200	2	55	4	205	3	140	16	2090	20 (8 HHs affected over 2 kinds of land)	2,690	7,360	0	10,050	20
	Total		**3**	**200**	**8**	**1,113**	**8**	**745**	**6**	**827**	**28**	**6,370**	**41 (12 HHs affected over 2 kinds of land)**	**9,255**	**37,132**	**5**	**46,387**	**46**

(Sources: As the survey result of RAP, from 7/2018 to 2/2019)

Note: Nghia Ta commune, Dong Xa commune, Yen Han commune have some households affected over 2 kinds of land.

- ***The risk of mines (UXO)***

Vietnam experienced two wars against France and the US, and Bac Kan is also one of the fierce battlefields. Therefore, bombs and landmines from wartime may remain in the province. Therefore, the risk of landmines and UXO in the sub-project area is possible, otherwise clearance will cause serious consequences to human life and property.

- ***The site clearance***

The site clearance during this period is mainly carried out by the affected households on the agricultural and forestry land that is temporarily or permanently acquired. As a result, some waste from the site clearance will be generated. These activities will also affect the fauna in the sub-project area due to habitat loss and ecological landscapes change.

However, for the sub-project, 7 reservoirs are located in separate areas with each other and for each reservoir, the construction area is not large, small luminescence area within the surface and dam slope, the recovered area (from 360m^2 to 2670 m^2 for each reservoir area). Therefore, this luminescence does not mean much to the habitat of plants and animals as well as the general landscape. The impact of vegetation clearing on the landscape is small.

According to the results of IOL, the project will affect trees and crops including 129 fruit trees; 596 timber trees of all kinds are affected by the works. These are all familiar trees, the number of affected is not large, so the impact on the landscape is small.

Table 29. Summary of trees, crops affected by the sub-project

Index	Works	Locations	Affected timbers (trees)					Crops					Rice area affected (m^2)	Aquaculture water surface	
			Acacia tree >15 cm	Jackfruit	Bead-tree	Manglietia conifera trees	Cinnamon trunk	Banana	Dragon tree	Orange	Persimmon tree	Beach-tree		area (m^2)	HHs
1	Khuoi Sung	Yen Han	0	0	13	0	0	0	0	0	0	0	0	0	0
2	Khuoi Day	Yen Han	0	0	0	0	0	0	0	0	0	0	394	230	1
3	Khuoi Dang	Thanh Mai	0	0	0	0	0	0	0	0	0	0	225	0	0
4	May Day	Dong Xa	0	0	4	0	0	0	0	0	0	0	225	30	1
5	Coc Thong	Liem Thuy	0	0	5	0	0	50	0	30	0	0	0	0	0
6	Na Leng	Sy Binh	35	0	7	2	0	40	0	0	4	1	0	427	1
7	Na Kien	Nghia Ta	0	10	5	505	10	0	4	0	0	0	55	140	3
	Total		**35**	**10**	**34**	**507**	**10**	**90**	**4**	**30**	**4**	**1**	**899**	**827**	**6**

(Sources: as per RAP Report, 7/2018 – 2/2019)

➢ ***Impact due to geological drilling***

Prior to the design for the construction works, it needs to survey geological conditions, which imposes risk of impurities affecting the quality of underground water. Conduct drilling for exploration 3 or 4 locations depending on the topography of each reservoir: dam shoulder, dam centerline, spillways, sluice route.

5.3.2 Impact during construction

a) Construction activities and sources of impact

❖ **Construction activities**

- Site clearance and leveling
- Repair and construction of culverts
- Upgrading upstream, downstream dam slopes
- Repair and construction of spillways
- Repair and construction of management roads
- Building the management houses

❖ **Waste sources**

➢ *Sources of solid waste*

- Waste from site clearance, site preparation
- Domestic waste from workers at construction sites;
- Waste from building materials at site: stones, soil, cement bags ...

➢ *Sources of liquid waste*

- Water for washing stone, sand, gravel
- Waste oil
- Domestic wastewater from workers at construction sites and camps

➢ *Sources of emission*

- Excavation, levelling ground
- Building construction, management roads
- Exploiting, transporting and loading materials
- Concrete, mortar mixing
- Operation of transport vehicles, machines;
- Operation of construction equipment as bulldozers, excavators, compactors, trucks etc.

❖ **Sources of impacts which are not relating to waste**

Due to the geological conditions, heavy rains, storms, winds, floods that possibly occur during construction, making the soil layers in hills and slopes exposed to the risk of landslides.

As the construction method of ground leveling, removing waste stone layer at sloping topography along rivers and reservoirs, the amount of sand and soil is washed into the water, increasing turbidity which directly affected the supply and use of water

downstream.

The bad awareness of local people and workers in the management of domestic waste, water, washing machines, and construction equipment can affect surface water, groundwater, and soil quality. During the construction period, due to the characteristics of the works, many items may affect the amount of water in the downstream area.

(b) Impact of temporary termination of water supply during construction

Due to the practice of agricultural cultivation and downstream use of water, the Project Owner requires the contractors to take suitable construction solutions not affect the flow and quality of water needed. However, there will be no temporary impact during the construction of the dams. The irrigation water supply for agricultural production of the communes within the sub-project area will be sufficient during the sub-project implementation.

(c) Environmental impact

i) Air quality

- **Dust and exhaust fumes**

(i) Dust from ground leveling and digging

According to the Emission Factor Documentation for AP- 42, Section 13.2.4, US EPA, the dust pollution coefficient from earthworks is calculated by the following formula:

$$E = k \times 0.0016 \times (U/2.2)^{1.3}/(M/2)^{1.4}$$

Where: - E is the dust emission coefficient (kg/ton).

- 0.0016 is the empirical coefficient.

- *k* is the dust-structure coefficient, with average value of 0.35

- *U* is the average wind speed (m/s).

- *M* is the average moisture content of the material (%).

- The average wind speed in the areas within the sub-project is 1.1 m/s, the moisture content of the (soil) material averages about 4%.

Therefore, the result is, E= 0.054 (kg/ton)

Table 30. Estimate the concentration of dust in the air from earthworks, weathering soil disposal

No.	Name of reservoir	Area (m^2)	Volume of earthwork (m^3)	No. of days digging, filling back of soil	Total content of dust (ton)	Amount of dust during the day (ton/day)	Average dust concentration (mg/m^3)
1	Khuoi Sung reservoir (Yen Han)	1933	7910	20	0.60	0.03	0.19
2	Khuoi Dang reservoir (Thanh Mai)	2151	24100	60	1.82	0.03	0.18
3	Khuoi Day reservoir (Yan	1922	4450	20	0.34	0.02	0.11

	Han)						
4	May Day reservoir(Dong Xa)	1485	38390	60	2.90	0.05	0.41
5	Coc Thong reservoir(Liem Thuy)	1525	10750	20	0.81	0.04	0.33
6	Na Leng reservoir (Sy Binh)	1435	4380	20	0.33	0.02	0.14
7	Na Kien reservoir (Nghia Ta)	2690	39860	65	3.01	0.05	0.21

Note:

+ The volume affected on the project site V = S ×H

With S is area of plane, H is the height of point where measuring the meteorological parameters (H= 10m)

+ Dust load (kg/day) = Total dust load (kg)/No. of day of construction

+ The average dust concentration (mg/m^3) = Dust load (kg/day) x $10^6/8/V$ (m^3)

Conclusion:

In comparison with the National standard QCVN 05:2013/BTNMT showed that: Dust concentration estimated from the earthwork during construction time is about 0.19-0.41 mg/m^3. There are two places that exceeded allowable concentration ($0.3mg/m^3$). In general, due to residential area is quite far from the reservoirs (apart from 300m to 1 km) so dust from the leveling activity not affected directly to workers who joining to build within the project area.

(i) Dust and emissions from material transportation

Dust:

To evaluate the impact of dust during transportation of vehicles (*according to Handbook of Atmospheric Science: Principles and Applications* of C. Nick Hewitt, Andrea V. Jackson, 2003, page 514) was determined by the formula as below:

$$E = 1.7 \times k \times (s/12) \times (S/48) \times (W/2.7)^{0,7} \times (w/4)^{0,5} \times [(365-p)/365]$$

Where:

- E = Emission factor (kg of dust/(vehicle.km))
- k = Coefficient referring to dust size (k = 0.8 for dust particles <30 micron).
- s = Coefficient of road surface (s = 11, For earthed roads, refer to Emission Factor Documentation for AP-42 , Section 13.2.2, US EPA)
- S = Average speed of the truck (taken S = 30km/h)
- W = Load of trucks (choosing an average load of 6 tons)
- w = Number of vehicle tires(average w = 6)
- p = Average number of rainy days in a year
- (taken p = 153.6 days, as per the national standard *QCVN 02:2009/BXD – National technical regulation on data of natural conditions in construction*).

When the specific values are plugged in, we get the result: E = 0.97 kg/km.

Using a 7-ton truck, estimate the average number of vehicles per day and the emission

factor as follows (Material is expected to be purchased in the area with an average transport distance of about 25 km for a distance of both way to the point of purchase and return):

Table 31. Average number of vehicles and emission factor

No.	Name of reservoir	Volume of transportation (ton)	Time for transportation (day)	Average number of vehicles per day (vehicle / day)	Dust emission factor (mg/m.s)
1	May Day	81.757	240	49	1.64
2	Coc Thong	27.312	240	16	0.55
3	Na Kien	123.187	360	49	1.65
4	Khuoi Sung	26.428	360	10	0.35
5	Khuoi Day	53.880	210	37	1.23
6	Khuoi Dang	19.174	210	13	0.44
7	Na Leng	59.845	240	36	1.20

The amount of dust entrained during transportation in the project area ranges from 0.44 -1.65 mg/m.s

(ii) Dust from construction activities:

According to *Fugitive Dust Handbook, 2006* of Western Regional Air Partnership, section 3.2, dust emission factors due to construction can be used to estimate dust emissions as follows:

E = 0.27 ton/ha/building-month.

The common emission factor for all types of construction activities is 0.11 ton/ha/month, equivalent to 0.27 ton/ha/month.

Table 32. Dust content from construction activities

No.	Name of reservoir	Area (m^2)	Construction time	Total amount of dust during the period (ton)	Amount of dust during the day (kg/day)
1	Khuoi Sung reservoir (Yen Han)	1933	18	0.94	2.61
2	Khuoi Dang reservoir (Thanh Mai)	2151	9	0.52	2.49
3	Khuoi Day reservoir (Yen Han)	1922	9	0.47	2.22
4	May Day reservoir (Dong Xa)	1485	12	0.48	2.00

5	Coc Thong reservoir (Liem Thuy)	1525	12	0.49	2.06
6	Na Leng reservoir (Sy Binh)	1435	12	0.46	1.94
7	Na Kien reservoir (Nghia Ta)	2690	18	1.31	3.63

Conclusion:

The amount of dust generated from construction ranges from 1.94-3.63 kg/day and affects workers on the site. In general, this amount of dust is not large. However, depending on the time and progress of construction, it is necessary to mobilize machinery, focus on construction, so the amount of dust may increase higher than the theoretical calculation. On the construction site, it is necessary to take measures to minimize this impact.

The level of impact is medium.

- ***Emissions:***

Based on the method of quickly identifying the emission sources of vehicles according to the "air pollution coefficient", based on the World Health Organization (WHO) document, Environmental Technology Handbook, vol. 1: "Assessment of sources of air, water, and soil pollution": With the over 3.5-tons diesel engine, the dust pollution coefficient is 1.6kg / 1000km.vehicle, CO is 28kg/1000 km. vehicle, 20S kg / 1000km .vehicle, 55kg / 1000km.vehicle (sulfur S = 0.05%).

Dust amount (mg/m.s) = Number of vehicles per day * Emission factor / Construction time within a day. Therefore, the pollutant emissions generated by construction vehicles are:

Table 33. Summary table of estimated emissions load during construction of items

No.	Name of reservoir	Number of shift per day	E_{CO} (mg/ms)	E_{SO2} (mg/ms)	E_{NOx} (mg/ms)	E_{dust} (mg/ms)
1	Khuoi Sung reservoir (Yen Han)	10	0.097	0.0003	0.191	0.006
2	Khuoi Dang reservoir (Thanh Mai)	13	0.126	0.0005	0.248	0.007
3	Khuoi Day reservoir (Yen Han)	37	0.360	0.0013	0.707	0.021
4	May Day reservoir (Dong Xa)	49	0.476	0.0017	0.936	0.027
5	Coc Thong reservoir (Liem Thuy)	16	0.156	0.0006	0.306	0.009
6	Na Leng reservoir (Sy Binh)	36	0.350	0.0013	0.688	0.020
7	Na Kien reservoir (Nghia Ta)	49	0.476	0.0017	0.936	0.027

Calculate the spread of dust and emissions due to transportation, construction activities:

From the number of pollutants calculated above, to calculate the average concentration of emissions generated by transport activities in transporting soil and rock, many models and

formulas can be used. The most common and typical is the formula for calculating the concentration of pollutants through the Sutton's model, which is an improved form based on Gauss's theory, applied to sugar sources. The solution of the equation is calculated for infinite and continuous emission sources (when x $\rightarrow\infty$), the wind blowing perpendicularly to the road has the following form:

$$C = \frac{0{,}8 * E\left\{\exp\left[\frac{-(z+h)^2}{2\sigma_z^{\,2}}\right] + \exp\left[\frac{-(z-h)^2}{2\sigma_z^{\,2}}\right]\right\}}{\sigma_z u}$$

Where:

C: The concentration of pollutants in the air (mg/m^3)

z: The height of the calculation point z = 1,5

σ_z: The diffusion coefficient in the z direction (m) is the function of the x distance in the wind direction as determined by the Slade formula:

$$\sigma_z = 0.53 * \mathbf{x}^{\mathbf{0.73}}$$

x: The distance (coordinates) of the calculated point against the waste source, according to the wind direction

u: The average wind speed (in Bac Kan is 1.1 m/s)

h: The vehicle height compared to the surrounding ground (m): 0.5m

E: The pollutant load from the waste source (mg/ms).

Ignoring the influence of other pollution sources in the area, influencing factors of the terrain,.. based on the calculated pollutant load, plugging the values into the formula, the concentration of pollutants at different distances from the source (centerline of road) are shown in the following table:

Table 34. The concentration of dust dispersed during the process of transporting materials in the project area

No.	Distance (m)	Dust (µg/m^3)	CO (µg/m^3)	NO_x (µg/m^3)	SO_2 (µg/m^3)
The Khuoi Sung reservoir (Yen Han)					
1	40	180.8	17.969	35.381	0.056
2	60	134.7	13.386	26.357	0.041
3	80	109.2	10.856	21.376	0.034
4	150	69.1	6.864	13.516	0.021
The Khuoi Dang reservoir (Thanh Mai)					
1	40	181.0	23.341	45.940	0.093
2	60	134.8	17.387	34.223	0.069
3	80	109.3	14.101	27.755	0.056
4	150	69.1	8.916	17.550	0.035
The Khuoi Day reservoir (Yen Han)					
1	40	183.6	66.7	131.0	0.241
2	60	136.8	49.7	97.6	0.179

3	80	110.9	40.3	79.1	0.145
4	150	70.1	25.5	50.0	0.092
The May Day reservoir (Dong Xa)					
1	40	184.7	88.2	173.4	0.315
2	60	137.6	65.7	129.2	0.235
3	80	111.6	53.3	104.8	0.190
4	150	70.6	33.7	66.2	0.120
The Coc Thong reservoir (Liem Thuy)					
1	40	181.4	28.9	56.7	0.111
2	60	135.1	21.5	42.2	0.083
3	80	109.6	17.5	34.2	0.067
4	150	69.3	11.0	21.7	0.042
The Na Leng reservoir (Sy Binh)					
1	40	183.4	64.8	127.4	0.241
2	60	136.6	48.3	94.9	0.179
3	80	110.8	39.2	77.0	0.145
4	150	70.1	24.8	48.7	0.092
Na Kien reservoir (Nghia Tan)					
1	40	184.7	88.2	173.4	0.315
2	60	137.6	65.7	129.2	0.235
3	80	111.6	53.3	104.8	0.190
4	150	70.6	33.7	66.2	0.120
Allowable limit as per QCVN 05:2013/BTNMT	**Average in 1h**	**300**	**30.000**	**200**	**350**

Captions:

As can be seen, the construction site is far from residential areas (from 300m-1km) so the amount of dust and emissions generated during the construction process has little impact on the population but mainly affects the workers on the site. Also along the transport route, according to the calculation results, the concentration of dust generated by vehicles on the transport routes, dust from the road surface during transportation does not exceed the permissible standards according to QCVN 05: 2013/BTNMT. The concentration of exhaust gas meets the standards under QCVN 05: 2013/BTNMT. However, this is the average amount of waste for the whole construction process. At many times, it is necessary to focus on construction to ensure the progress, the number of vehicles transported in the day may increase sharply, leading to a greater emission level, especially the impact of dust will be more pronounced in the dry season.

Impact due to emissions is assessed as medium.

❖ **Noise**

In the process of repairing and upgrading the construction items that many construction machines and equipment must be used. Noise from the operation of equipment and machinery will affect workers and residents living near the construction sites and along the

provincial roads, and local roads. For each construction item, noise levels are calculated from the specific noise level of each type of machinery and equipment.

The noise level shall be reduced according to the affected distance and can estimated as following formula:

$$L_p = L_p(X_0) + 20.\log_{10}(X_0/X)$$

(Sources: *Architectural acoustics - Theoretical basis and applied solutions, Pham Duc Nguyen, 2000)*

Where:

- *$L_p(X_0)$: noise level away from source Xo meter (dBA)*
- *X_0= 15m*
- *$L_p(X)$: Noise level at the position to be calculated (dBA)*
- *X: Location to calculate (m)*

Thus, the maximum noise level by the distance from the operation of construction equipment is presented as below:

Table 35. The maximum noise level of some machines

No.	Machines	Distance (m)				Allowable limit as per QCVN 26:2010/ BTNMT
		15*	50	100	200	
1	Truck	70 ÷ 96	59.5 ÷ 85.5	53.5 ÷ 79.5	47.5 ÷ 68.5	From 6h÷21h: 70dB From 21h÷6h: 55 dB
2	Crane	72 ÷ 96	61.5 ÷ 85.5	55.5 ÷ 79.5	49.5 ÷ 69.5	
3	Roller	72 ÷ 88	61.5 ÷ 77.5	55.5 ÷ 71.5	49.5 ÷ 65.5	
4	Tractor	73 ÷ 96	62.5 ÷ 85.5	56.5 ÷ 79.5	50.5 ÷ 68.5	
5	Motor grader	77 ÷ 95	66.5 ÷ 84.5	60.5 ÷ 78.5	54.5 ÷ 68.5	
6	Concrete mixer	71 ÷ 90	60.5 ÷ 79.5	54.5 ÷ 73.5	48.5 ÷ 67.5	
7	Generator	70 ÷ 82	59.5 ÷ 71.5	53.5 ÷ 65.5	47.5 ÷ 59.5	
8	Vibrator	70 ÷ 80	59.5 ÷ 69.5	53.5 ÷ 63.5	47.5 ÷ 57.5	
Decision No. 3733/2002/QĐ-BYT: Noise at production area: 8 hours exposure time is **85 dBA**						

*(Sources: * US Environmental Protection Committee - Noise from construction equipment and construction machinery NJID, 300.1, 31/12/1971)*

The results showed that, from the noise source, the noise level from machinery is within the permitted limits of the standards of the Ministry of Health.

According to the standard QCVN 26: 2010/BTNMT, in constructing in the night time, then construction machines can cause a noise level exceed the allowable limitation. During construction during the day time, most vehicles cause noise at the allowable level at a distance of 200m. At distances of less than 100m, most construction equipment can cause noise. The nearest concentrated residential area is about 300m-1km away from the Project area, so the noise level of machinery and equipment operating on the construction site has almost no impact on the project area's residents. The noise only affects a part of workers at the site. In addition, the population density in the area is low, and there is a large density of trees, limiting the impact so *the impact due to noise is assessed at a medium level* and can be controlled by the mitigation measures in the chapter 7.

Noise from vehicles transporting materials will impact households living along the transportation route. However, this impact is assessed to be negligible because most of the earthwork materials are transported within the sub-project area (material yards near the main dam). Part of materials such as iron, steel bar, and cement only accounted for about 10% of transported materials, with the transportation time is not prolonged, so the impact is negligible.

❖ **Impact by vibration**

Construction may be the cause of ground vibration due to the means of construction and equipment. This vibration propagates in the soil environment but will be drastically reduced by distance. The vibration levels of some construction equipment are as follows:

Table 36. The vibration levels of some construction equipment

No.	Machine/equipment	PPV at 7.62 m (mm/s)	Lv at 7.62 m (dBV)	Allowable limit as per QCVN 27:2010/BTNMT (dB)
1	Compactor	0.064	94	75
2	Driller	0.027	87	
3	Heavy truck	0.023	86	
4	Concrete mixer	0.023	88	

(Source: D.J. Martin. 1980, J.F. Wiss.1974, J.F. Wiss. 1967, David A. Towers. 1995)

In fact of construction activities, the object of the direct impact are workers in the site, but structures such as schools, market, residential area are far from the reservoir (about 30 to 1000 m), so influence from vibration is trivial. For households locating on the transportation route, in fact, the reservoir laying in front of the residential area, market, along the route to the reservoir, just some households scattered. On the other hand, the vehicles just pass through in a short period, so impact by vibration is less. For workers on the site, within a distance of 10 m, the vibration of machines most exceeding the allowable values of the QCVN 27:2016/BYT: National technical regulation on vibration - Permissible value at site work.

Level of impact due to vibration just at moderate level.

ii) *Waste*

➢ ***Domestic solid waste:***

Domestic solid waste is mainly packaging bags, plastic bags, bottles, cans, vegetables, tubers, fruits, and leftovers ... This is the main source of pollution due to the decomposition of odorous organic substances, leachate, and pathogenic micro-organisms. This source of pollution, if not collected properly, will cause environmental pollution. Based on the guidance of Circular 02/2010/TT-BXD dated February 5, 2010, of the Ministry of Construction on national technical standards of urban technical infrastructure, works, solid waste generation coefficient at in rural areas, about 0.5 kg/person/day, a total of 07 works of about 175 kg/day (50 people × 0.5 kg/person/day × 7 works). Specifically, each construction site area is as follows:

Table 37. The domestic solid waste incurred

No.	Name of reservoir	No. of workers (people)	Solid-waste generation coefficient (kg/person.day)	Solid-waste volume (kg/day)
1	May Day	50	0.5	25
2	Coc Thong	50	0.5	25
3	Na Kien	50	0.5	25
4	Khuoi Sung	50	0.5	25
5	Khuoi Day	50	0.5	25
6	Khuoi Dang	50	0.5	25
7	Na Leng	50	0.5	25

Percent of components in the domestic solid-waste as below:

Table 36. Rate of components in the domestic solid-waste

Index	Garbage component	Proportion (%)
1	Organic matter	50.35
2	Paperboard	2.74
3	Wood, plastic, rubber, leather	7.10
4	Seashells, shells	1.00
5	Glass	7.73
6	Pebbles and bricks	7.46
7	Metal	1.00
8	Solids mixed <10mm	22.62

Sources: Environmental management in developing countries, episode 1

With the percentage of such components, the amount of domestic solid waste calculated by components in a day in the sub-project implementation area is shown in the following table:

Table 38. Pollution load in domestic solid waste is calculated by total number of people

No.	Components of waste	The amount of solid waste (kg/day)

No.	Components of waste	The amount of solid waste (kg/day)
1	Organic matter	12.5875
2	Paperboard	0.685
3	Wood, plastic, rubber, leather	1.775
4	Seashells, shells	1.9325
5	Glass	1.865
6	Pebbles and bricks	5.655
7	Metal	12.5875
8	Solids mixed <10mm	0.685

Comments:

Although the volume of domestic solid waste is not much, if there are no appropriate collection and treatment measures, the possibility of accumulation during construction is increasing and affecting the air quality due to waste decomposition, organic matter as well as the impact on surface water by increasing turbidity of water sources, obstructing the flow, causing sedimentation. In addition, it also facilitates the development of pathogenic micro-organisms, posing a risk of arising and spreading pathogens affecting the health of workers and, furthermore, to residential areas.

However, due to the priority projects using local labor, it is able to meet the needs of living and accommodation by itself. The site only retains about 3-5 people to ensure the security and order, construction materials on the site, so the actual amount of solid waste generated at the site is very small compared to the theoretical calculation. When deployed in 07 lake areas, the amount of domestic waste is not large, most of it is organic waste, has a short decomposition time, and is signed by the construction contractor with the local specialized unit, the impact is assessed below.

- ***Construction solid waste:***

During the construction process, the volume of solid waste includes residual construction materials, scrap iron and steel, all kinds of cement bags, residual iron, scrap wood, broken bricks, etc. If the amount of waste will not be collected and treated, then rainfall will running into the drainage ditches, polluting surface water sources (mainly increasing the turbidity of water). However, the amount of sand, stone and broken bricks is not much and will be collected and transported as prescribed, while the types of cement, iron and steel bags will be used to sell to purchaser in need.

According to the norms of works construction estimate (Published together with Decision No. 587/QD-BXD dated May 29, 2014), the loss norm in construction is 0.5%. It is possible to estimate the number of raw materials and waste rock in each project as shown in Table 29.

In addition, a large amount of excavated soil is generated during the whole earthwork (within 1.5 months, details as mentioned in Table 37). All of this stone and soil will be collected and dumped at locations, where have been selected by the design consultant, the contractor and the local authorities. It is an appropriate dump site, ensuring environmental sanitation, also can help the local people reuse waste soil materials.

Table 39. Estimating the amount of soil / raw materials discharged during construction

Soil, stone disposed / Reservoir	Volume of soil		Volume of stone, disposed materials
	m^3	ton	m^3
May Day	27,040.0	35,152	22.5
Coc Thong	7,490.0	9,737	7.1
Na Kien	25,590.0	33,267	22
Khuoi Sung	5,040.0	6,552	16
Khuoi Day	2,380.0	3,094	17.8
Khuoi Dang	9,300.0	12,090	13
Na Leng	2,610.0	3,393	7.6

The amount of solid waste such as soil, sand, and gravel, spilled out as a result of material transportation during construction cannot be accurately estimated. However, it is expected to be negligible, because this is a construction material that has to purchase. Therefore, construction contractors are aware of thrift and avoid loss.

For disposal areas and embankment areas:

Based on the sub-project needs, the Investor cooperated with the Consultant to prepare a Feasibility Study report, also worked with local authorities and local people, surveyed and agreed on embankment grab locations (Described in section 2.5.3). The filling areas all meet the reserves, because the volume of the embankment is not much, and meet the technical standards. In addition, the area of filling soil is located in the area where the construction works are, thus limiting the transport distance (from 500m-4km), limiting the arising environmental problems. The current status of the areas where the land is filled in that not belongs to the people, or managed by the people, unused, not forest land, nor is it entangled in technical infrastructure works. Therefore, this use does not affect the lives and productivity of people, does not affect infrastructure works, and can help people have more income.

For disposal sites: The project feature is to repair and upgrade the existing works, so the volume of excavated soil is small, mainly the peeling of the organic surface. The Investor, in coordination with the Feasibility Study Consultant, also worked with local residents and authorities, identifying a number of disposal sites managed by the people (as described in section 1.4.6.4 - Chapter 1). This area is also where the is the source for the embankment, so it can be leveled on the spot, not affecting the environment, limiting transportation distances.

Therefore, the impact of waste generated during construction is assessed to be small and highly mitigable.

- ***Hazardous solid waste:***

Being generated in camps and construction machinery repair points along the roads, including mops, grease-stained papers generated during the cleaning equipment, machinery and plastic boxes, iron containers for gasoline, oil, grease.

According to research by the Military Science and Technology Center (2002), the

amount of grease generated by each truck, construction machinery, and each oil change is about 7 liters/time. The average time to replace oil and grease and maintenance of construction equipment is 3-6 months depending on the intensity of the operation of these machines/equipment. The average amount of waste grease and oil generated on the construction site is: (10 vehicles x 7 liters / time) / 3 months = 23.3 liters of grease / month (163 liters / 07 items). However, in reality, repairing and maintaining vehicles are often done in garages. Only minor repairs are performed on the construction site, so the amount of grease generated is small or may not be available. For rags and oil sludge, it is difficult to estimate the amount used, but it is estimated that about 3 ÷ 5 kg/month of rags mixed oily. Regarding the collection and treatment of hazardous waste at the construction site, the environmental safety policy of the sub-project is strictly regulated, specifically, ECOP and regulations on environmental protection in bidding; Hazardous wastes generated are collected and treated by appropriate functional units, ***so the impact rating is low***.

iii) Wastewater

- ***Domestic wastewater:***

Domestic wastewater of construction workers emitting on the site is also a significant source of pollution to surface and groundwater quality of the project area during the construction process. The composition of domestic wastewater mainly contains organic matter, suspended solids, and microorganisms.

According to Decree No. 80/2014 / ND-CP dated August 6, 2014, providing for drainage and wastewater treatment, the amount of wastewater is calculated as 100% of the consumed water.

Table 40. The amount of domestic waste discharged into the environment

No.	Name of reservoir	Number of workers (people)	Water supplying standard (liter/person/day)	Amount of wastewater (liter/day)
1	May Day	50	100	5000
2	Coc Thong	50	100	5000
3	Na Kien	50	100	5000
4	Khuoi Sung	50	100	5000
5	Khuoi Day	50	100	5000
6	Khuoi Dang	50	100	5000
7	Na Leng	50	100	5000

Note: Water supply standards are determined according to TCXDVN 33: 2006 of the Ministry of Construction on water supply - pipeline networks and constructions.

Based on the WHO document, the coefficient of pollutant load discharge daily is presented in the following table:

Table 41. Coefficient of pollutants load in domestic wastewater

No.	pollutants	Unit	Value
1	BOD_5	g/person/day	45 ÷ 54
2	COD	g/person/day	72 ÷ 102

No.	pollutants	Unit	Value
3	TSS	g/person/day	70 ÷ 145
4	Total N	g/person/day	6 ÷ 12
5	Total P	g/person/day	0.8 ÷ 4.0
6	Ammonia	g/person/day	2.4 ÷ 4.8
7	Animal and vegetable fats and oils	g/person/day	10 ÷ 30
8	Total Coliform*	MPN/100ml	$10^6 \div 10^9$

Source: World Health Organization (WHO), 1993

Note: (*): Author Nguyen Xuan Nguyen, Wastewater and wastewater treatment technology, 2003

The estimated construction process of each reservoir item using the same number of employees. Therefore, a load of pollutants in domestic wastewater generated during the construction period per site unit is presented in the following table:

Table 42. Estimate Loads of pollutants in domestic wastewater of worker for each reservoir items

No.	Pollutants	Unit	Value
1	BOD_5	g/person/day	2250 ÷ 2700
2	COD	g/person/day	3600 ÷ 5100
3	TSS	g/person/day	3500 ÷ 7250
4	Total N	g/person/day	300 ÷ 600
5	Total P	g/person/day	40 ÷ 200
6	Ammonia	g/person/day	120 ÷ 240
7	Animal and vegetable fats and oils	g/person/day	500 ÷ 1500
8	Total Coliform*	MPN/100ml	$5*10^7 \div 5*10^{10}$

Comment:

Domestic wastewater is generated from personal hygiene such as cooking, eating and drinking, personal hygiene, etc., at 07 construction works, due to the construction volume spread over 07 areas within 24 consecutive months. The characteristic of domestic wastewater is that it contains many total suspended solids (TSS), BOD5 and Coli bacteria. If this amount of wastewater is not collected and treated but discharged directly into the environment, it will pollute the environment and affect the ecosystem of the receiving water body, as well as the health of people when using polluted water sources.

The calculated data showed that a load of pollutants in the domestic wastewater of workers is relatively low. Therefore, the level of impact on the surrounding environment is expected to be negligible. Moreover, during the construction of the sub-project, construction contractors will prioritize recruit local workers, capable of ensuring their own living and accommodation conditions; in the job site, only 3 ÷ 5 employees are required to stay back ensure the security of the site. Therefore, the actual domestic wastewater generated on the construction site will be much lower than the theoretical calculation above, only about 300-500 l/day/each site.

The impact is assessed at the moderate level.

- ***Construction waste water:***

Construction wastewater is mainly generated from activities such as car washing, maintenance of equipment and machinery, vehicles, treating and cleaning of raw materials, etc. The major components of pollutants in wastewater are suspended solids, inorganic substances, construction sandy soil are of a less toxic type. This type of wastewater is easy to deposit, accumulating right on the temporary construction drainage routes. Therefore, the possibility of infiltration polluting the surface water of the area is only low.

According to the research of the Urban and industrial zone environment technology Center - The Hanoi University of Construction, then discharge and concentration of pollutants in domestic wastewater during construction are presented as below:

Table 43. Discharge and concentration of pollutants emitted in construction water

No.	Kinds of wastewater	Discharge *(m^3/day)*	COD *(mg/l)*	Grease, oil *(mg/l)*	SS *(mg/l)*
1	Waste water from machine maintenance	1,0	20 ÷ 30	-	50 ÷ 80
2	Waste water from cleaning machines	5,0	50 ÷ 80	1,0 ÷ 2,0	150 ÷ 200
3	Waste water from cooling machine	1,5	10 ÷ 20	0,5 ÷ 1,0	10 ÷ 15
Allowable limit as per QCVN 40:2011/BTNMT (B)			**150**	**10**	**100**

(Sources: from the Urban and industrial zone environment technology Center - The Hanoi University of Construction)

Comments: This number of water is relatively small, so the impact on the surrounding environment is negligible.

- ***Rainfall overflowed:***

When construction in the rainy season, rainwater runoff through the sub-project area will entrain soil, sand, spilled materials, and grease into the drainage system of the area. To calculate the rainfall-runoff on the site, when preparing this EIA report had considered the surface area of the catchment, the largest rainfall every day, and the surface flow coefficient.

The rainfall-runoff is calculated according to the formula:

$$Q = \psi \times q \times F/1000 \ (m^3/day)$$

(According to the TCVN 7957:2008 – Water drainage – External networks and Facilities – Design standard)

Where:

- Q: Flow of runoff (m^3/day)
- Ψ: Surface flow coefficient, taken 0.52 with a large slope surface
- q: The largest rainfall in 1 day(mm/day)
- F: Area of the calculation region (m^2)

Table 44. Flow of run off

No.	Name of reservoir	The biggest rainfall of the day(mm/day)	Area of construction (m^2)	Flow of rainwater overflows (m^3/day)
1	May Day	283.4	1,254.5	184.9
2	Coc Thong	283.4	2,516.3	370.8
3	Na Kien	263.5	1,242.4	170.2
4	Khuoi Sung	338.0	2,232.5	392.4
5	Khuoi Day	338.0	2,171.2	381.6
6	Khuoi Dang	260.73	3,044.4	412.8
7	Na Leng	251.9	1,185.6	155.3

Note: *Maximum daily rainfall is referenced from the Hydrographic report of lake in the Project area.*

Thus, rainwater runoff at the construction area of the lakes ranges from 155.3 to 124.8 m3/day. According to WHO studies, the concentration of pollutants in normal storm-water runoff is about 0.5 ÷ 1.5 mg N/l; 0.004 ÷ 0.03 mg P/l; 10 ÷ 20 mg COD/l and 10 ÷ 20 mg TSS/l. Estimated pollutant discharge load in a storm-water runoff in the sub-project area is as follows:

Table 45. Estimated load of emissions in run off

No.	Parameters	Concentration of pollutants (mg/l)	Pollution load (kg/day)
1	TSS	10 ÷ 20	1.55 ÷ 8.26
2	COD	10 ÷ 20	1.55 ÷ 8.26
3	Total N	0,5 ÷ 1,5	0.08 ÷ 0.62
4	Total P	0.004 ÷ 0.03	0.0006 ÷ 0.012

Comment: In practical terms, the rainfall-runoff may be lower than the calculated storm runoff due to the project area of canals and reservoirs to ensure good drainage.

iv) *Ecological impact*

- ***Aquatic ecosystems***

The construction activities on-site as soil excavation, drainage for construction... make water reservoir turbid, the water quality changes due to leakage of oil, grease... Soil/stone encroachment losses habitats, spawning areas, kills juvenile off-spring, reduction of photosynthesis of algae ... It will disrupt and alter the habitats of fish and other aquatic, affect the life of aquatic ecosystems. However, due to the poor biodiversity and the rapid ecosystem recovery time in the region, *the impact is considered low.*

- ***Terrestrial ecosystems***

The levelling ground will cause loss of habitat, residence, reproduction and death of some species of animals living inland such as insects, animals living in caves like snakes, frogs... Dust, emissions from construction affect the living and the development of the fauna and the flora in the area and the surrounding areas. Dust sticking on leaves reduces photosynthesis of trees and heats leaf. SO_2, CO, H_2S cause leaf disease and affect the growth of plants. However, this effect does not affect much on the development of the surrounding vegetation. Clearing trees, vegetation and ground excavation causes soil erosion.

The impacts are short-term and limit in the construction area and the native ecosystem fast recovers, ***the impact level is assessed to be small.***

v) Impact on soil environment

The exploitation of construction materials: exploitation of filling soil, construction activities, transportation, material gathering... will affect the soil environment, breaking the surface structure, changing the fertility of the topsoil.

Construction waste such as cardboards, steel scraps, plastic boxes, soil, waste stones... without collection will mix on land. Non-degradable wastes such as nylon, iron, etc. will affect the soil environment.

Domestic wastes from workers on site easily disintegrate and create bad odors. If workers are not equipped with hygienic toilets, they will discharge directly into the environment, which will affect soil environment. However, this type of waste is mostly concentrated in the workers' houses, it is easy for the collectors to treat, therefore the impact is not significant. Solid waste containing grease and oil is hazardous waste but there is small volume. This is a non-degradable type of waste in the soil environment, so if there is no waste treatment method, it will affect the soil environment.

Construction wastewater contains cement. Wastewater from repair points, washing equipment, trucks contains toxic oil, grease. These types of wastewater, when seeping into the soil, will make the soil harden but it is little and its impact scope is small.

Preliminary survey results showed that during the construction of the sub-project works will also affect temporarily public land of 6 communes, with a total temporary affected land area of 37,132 m^2. Temporarily affected land during construction is mainly used as a place for gathering materials, constructing roads, transporting materials during construction, etc. Compensation and support for the area temporary affected land will be paid by the Contractor based on the level of affected and the specific construction time of the project. In

the event of any other buildings, structures, crops, and trees affected by construction activities, compensation will be provided in accordance with the project policy.

According to the design, construction measures are proposed for dike construction during construction of the sluice. Conducting diversion of flow still provides enough water to serve the production of the people to a certain extent; construction is done after the people in the sub-project area have finished harvesting the crops, without affecting the water supply for the serving production for communities living downstream. In case of urgency of the construction progress leading to the interruption of water due to the construction of the Contractor, the investor, the local government will coordinate to carry out the inventory and make compensation plans, support for the effects by water interruption. Wastewater and garbage arising during the construction time at site are collected and thoroughly treated, which does not affect the soil environment. *Therefore, the impacts are assessed at small level*.

vi) Impact due to grouting

According to the design, there are 6/7 lakes carrying out the drilling method (The May Day reservoir in Dong Xa commune, The Coc Thong reservoir - Liem Thuy commune, The Khuoi Sung reservoir, Khuoi Day– Yen Han commune, The Khuoi Dang reservoir - Thanh Mai commune, The Na Leng reservoir - Nghia Binh commune) uses a solution of cement mortar + clay. This solution is injected into the dam body through the drill holes, making it less likely to leak into the environment. In addition, due to its fast adhesion, insolubility, and waterproofing, penetration into the polluting water is low. With the control of pumping through the borehole into the dam body, the possibility of penetrating into the aquifer is not available. Although infiltration into the environment is rare, the process of gathering this material in the field to prepare for the drilling operation is also likely to cause cement, clay powder shall be rolled into the lake or surrounding areas if not properly managed. However, this effect is not great.

vii) Social impact

- ***Community Health and Safety***

In addition to environmental issues, the construction activities can result in significant increases in the activity of vehicles for the transportation of building materials and waste soil, which is potential for traffic accidents and injuries to local communities as there are households living along the roads near the construction sites, traffic accidents and material spills may occur.

During the construction, workers are potentially at risks of contagious diseases and disease transferring, which may threaten their health and local communities. Contagious diseases that threat public health often involve in such activities as poor hygiene and low living conditions, sexually transmitted diseases and disease transferring. The most concerned infectious diseases in the construction phase due to labor migration are sexually transmitted diseases such as HIV/AIDS, gonorrhea, syphilis, etc.

In fact, the subproject implementation period within 24 months is discontinuous. The sites are scattered at 7 locations. The number of officials and workers from other localities includes about 50 workers/01 work (of which 35 people mainly engineers and skilled workers, and for the simple works are reserved for local laborers about 15 people per each work). There are many scattered work items. The control of security and order and disease in the area is good, surplus workers-rent local houses with sanitary toilets, meet QCVN 01: 2011/BYT standard for hygienic latrines. It helps limit the spread of infectious diseases

caused by flies, mosquitoes, and insects is restricted. Therefore, ***the impact should be considered average.***

- ***Impact due to the flow of workers into the subproject area***

Construction activities require about 35 workers from other places to come at each construction site, mainly key staff and skilled workers (some items use local labor). Therefore, social impacts such as social security and disorder, especially: i) the potential impact of the spread of infectious diseases from workers to local communities and vice versa; ii) the potential impact of prostitution, drugs, and gambling; iii) potential conflicts between workers and local communities due to cultural and behavioral differences, and iv) conflicts over the need to use local service infrastructures such as power systems and Water supply and transportation lead to lack of electricity and water supply and traffic congestion for the region, but the number of people from other localities coming to work in the sub-project implementation is small, so the above issues can be managed. *The impact level is assessed at a low level.*

- ***Risks about gender***

Social surveys showed that, gender equality has improved significantly locally in the following areas: 56.3% of survey respondents believe that, the decision of having a child and the number of children is based on the consensus of both men and women; 37.5% said that they decided together about their children's study and choosing a career; 79.2% said that they both decided to make big family expenses. However, some surveyed households still believe that men have more decision-making power than women. Especially for making investment decisions, production activities; 42.7% think that men make decisions while this rate is 11.5% for women. Activities that determine big family expenses and decision-making on children's career choices, 12.5% believe that men will decide these issues while the ratio for women is 8, 3%. Participating in community activities has a uniform time distribution between men (37.5%) and women (36.5%). Some argue that men are still more engaged in activities than women. Especially for participating in training on production, men are 74.0%, while women are only 11.5%, taking part in sociopolitical activities men tend to be more than women. Specifically, men are 67.7% and women are 12.5%. Therefore, gender risks during project implementation are still possible, as follows:

Gender inequality:

During the construction period, repairing the dam maybe make short of water available for agricultural irrigation at some point in time, which would lead to women having to spend more time fetching water (according to custom and distribution of labor by gender). The construction of local projects with a high demand for local labor will create favorable conditions and opportunities for men to participate in labor to earn money because most of them are hard work. This also limits the income of women, women continue to do housework, resulting in the distance and status of women continues to be lower than men. For households that still hold a gender prejudice, having a gap in their position can lead to the risk of gender violence.

Agricultural land and cash crops decreased will affect directly on women's income, which may be an indirect reason for them to find a new job in other localities.

Risk of abuse, sexual harassment:

In addition, during the construction process, there will be a flow of workers from other places coming to the locality. This can increase the potential impacts of social evils such as violence, prostitution, and harassment sexuality ... affecting local people, especially women.

However, these impacts are considered small due to the short construction time. It is not considered as cumulative impacts, causing long-term harm to local life.

The impact is assessed at the medium level.

- ***Risk to children***

Use of child labor, in general, at the site of lakes, the maximum workers mobilized is approximate 50 people, with 15 local laborers. The labor demand is small, so using child labor is unlikely to happen.

Accident risk: The construction process of children can meet the risks brought by water. Typically, cases of young children died from drowning. Therefore, there must be a child safety policy, protecting children's rights, and un-allowing children to sell or service near the repairing and upgrading area.

Roads will be more difficult and dirtier in the rainy season. This issue can affect the psychology of children who afraid to go to school and cause the children to cease from school. Therefore, the contractor has chosen a construction plan in the dry season is most.

The impact is assessed at the medium level.

- ***Impact from risks and accidents***

Risks of landslides and flash floods: Because the reservoirs are at a high position (from 450-510 m), with a steep slope, during the construction process, if in the rainy season, there will be risks of landslides and flash floods. According to statistics, the highest daily rainfall in the project area is from 251.9-338.0 mm (Hydrological report of the Project). The total rainfall in the rainy season accounts for about 74-78.8% of the year. Therefore, this risk is likely to occur without proper construction methods, affecting the lives of people, workers as well as property.

Labor accidents: labor accidents may occur in any of the working items during the construction.

Fire, explosion and fuel leakage. These incidents may occur in transport and storage of fuel, or temporary power supply system is unsafe, causing deaths and property damage during construction.

Welding: Welding creates extremely strong light and may cause serious injury to workers ’eyes. In extreme cases, it can lead to blindness. In addition, welding may create toxic fumes that prolonged exposure can cause severe chronic illness.

Drowning: During the construction, workers may die of downing due to bathing near the water bodies.

Short-circuits and electric shock: The construction activities may cause short-circuiting hazards to the health of workers and people as well as their property. The temporary power supply for machinery and equipment during construction may cause problems relating to voltage, electric shock, etc., causing economic losses and labor accidents for workers.

During the implementation of the subproject, the construction sites are mainly in the dam bodies and canals, therefore accidents due to working at heights hardly occur.

Due to the characteristics of the works, the volume and construction items need to use electricity is not large, the management and supervision is strict, therefore *the impact level is medium*.

- ***Impact on traffic safety and infrastructure***

The operation of vehicles serving the works will increase traffic density, affecting local traffic, damaging roads and causing traffic congestion and potential traffic accidents if the traffic law is not complied with and having a suitable mean of transportation.

The rapid increase in the number of vehicles in small areas will put pressure on the traffic conditions, especially the route of the management and construction roads. Approximately 10 - 49 turns of vehicles per day with loads of 5-7 tons will travel on the roads of 7 construction sites to truck material, sand, gravel, cement, steel... However, the area of the reservoirs is located in different communes and districts, so far apart so the cumulative impact from the construction of works is not happening. The increase in transport means will increase traffic safety risks for people, mainly on inter-village transport routes.

In addition, the direct route to the lake is mainly dirt road (6/7 lakes, except The Khuoi Sung reservoir) from 2-4m wide. There are very few households along this route. However, these are the unique routes to the lake and people from the center to the commune, so during the construction process, the increase in the number of vehicles can damage roads and traffic congestion causing difficulties for people traveling. Especially on rainy days, it will be more difficult to move. Particularly for The Na Leng reservoir (Nghia Binh commune), because the lake is quite close to national road 279 (about 50m), the access road can be opened from national road 279 so it will have less impact on the internal roads of the village. However, the construction work is not continuous for 9-18 months and the impact is manageable, therefore**,** ***the assessment is medium.***

The Khuoi Sung reservoir - Yen Han

The Na Leng reservoir - Sy Binh

The Coc Thong reservoir - Liem Thuy

The Khuoi Dang reservoir - Thanh Mai

Figure 20. Actual status of local traffic condition in the sub-project area

Local roads and rural infrastructure may be damaged by large means of transport. Roads through residential areas and inter-field roads are concreted with small load-bearing, which can be broken, crushed or sagged when large trucks pass or there is a high density of vehicles, specifically:

- The Khuoi Sung reservoir, Khuoi Day - Yen Han commune, The Coc Thong reservoir - Liem Thuy commune, The May Day reservoir - Dong Xa commune. When constructing a sudden increase in the number of tanks, note the DT256 route. Road to the lake is an earthed road, note the rainy day easy to muddy, in addition to transporting materials can cause road damage
- Na Kien reservoir - Nghia Ta commune. The route DT254 through Nghia Ta commune area has deteriorated, so when paying attention, it should not let large trucks go through.
- The Khuoi Dang reservoir - Thanh Mai commune. The road for transporting raw materials from provincial road DT257 into the reservoir area is mainly dirt road, pay attention to rainy days that easily causes subsidence.
- The Na Leng reservoir - Nghia Binh commune. Highway 279 is located close to the lake, the road quality is still good, it needs to pay attention to other vehicles passing through this area when transporting materials and avoiding traffic jams.

Regarding the potential impact on roads, the Project Owner required the Construction Contractors to commit to repair and recover to the status quo if damages occur during the construction process, *therefore the impact is considered low.*

➢ ***Chance finding***

During the earthwork, workers may find some underground cultural heritages. However, these works are usually located near the reservoirs where there are long-term cultivation activities. These areas we resurveyed and confirmed that they are not archaeological sites and cultural heritages; therefore, the probability of *finding artifacts and cultural heritages is low*.

(d) Site-Specific impacts

The construction of the different subproject items may affect some sensitive areas near the construction site. However, the levels of impacts are assessed from low to average, in short time and can be minimized

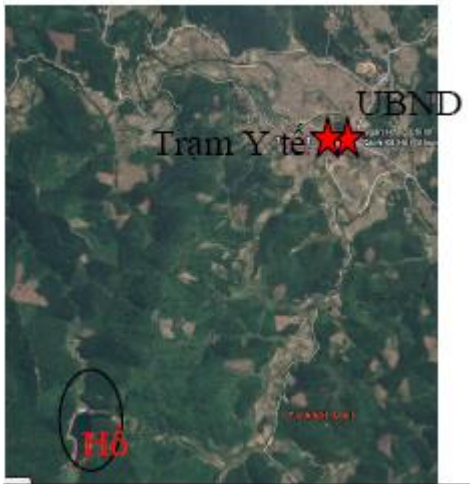
Table 46. Potential impacts during the construction to sensitive works

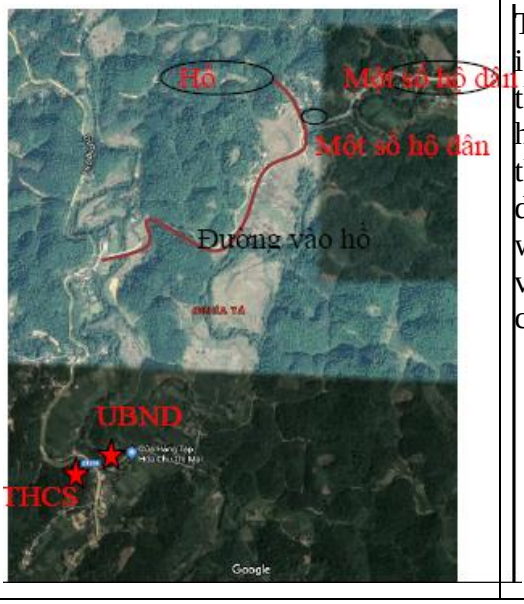
Works	Location/Description	Potential impact	Severity
The Na Leng reservoir – Nghia Binh commune			
1, **The siphon carrying water from a stream running through a household's lake**	The position running across the surface of The Na Leng reservoir, over the dam and leading down to people's houses	During the process of reinforcing the dam face, drilling bore, mobilizing machines that can break, crack pipe	Low

Works	Location/Description	Potential impact	Severity
			
2, **The market in Nghia Binh commune** 	Adjacent to Highway 279, the route for materials transporting, about 1.3 km from the lake	Risk of a traffic accident, traffic congestion when there are many vehicles traveling in crowded areas.	Average
3, The house is next to the dam of the lake 	Located downstream of The Na Leng reservoir, 50-100m away, near the construction area	Construction and material transportation activities may cause noise and dust. Rainwater can sweep solid waste from affecting people's homes.	Average
The Coc Thong reservoir – Liem Thuy commune			
1, **The water siphon is located close to the path to the lake**	Running along the right of the dirt road leading to the lake	During the process of reinforcing the dam face, drilling bore, mobilizing machines that can	Low

Works	Location/Description	Potential impact	Severity
		break, crack pipe.	
2, **location of the Liem Thuy commune middle school** 	Location middle school is away from the project area (2.2 km), close to the road, there may be vehicles traveling back and forth	Risk of traffic accidents, traffic congestion maybe occur when there are many vehicles traveling during and after school.	Low
3, The house is next to the dam of the lake 	About 20-100 m located downstream of the dam and the lake side. The road to the dam is narrow.	Construction and material transportation activities may cause noise and dust. Rainwater can sweep solid waste from affecting people's homes The access road to the lake may be damaged due to many vehicles joining traffic.	Average
The Khuoi Day reservoir – Yen Han commune			
1, **Secondary school area**	High school location is far away from the project area (2.1 km), close to DT256 road, there may be vehicles traveling back and forth.	Risk of traffic accidents, traffic jams maybe occur when there are many vehicles traveling around and after school, or going to	Low

Works	Location/Description	Potential impact	Severity
		school.	
2, **Market area of Yen Han commune**	The location of the market area is far from the project area (3.1 km), close to DT256 road, there may be vehicles traveling back and forth. 	Risk of traffic accidents, traffic congestion maybe occur when many vehicles are traveling in crowded areas.	Average
3. Road to the reservoir	Earth road	The access road to the lake may be damaged due to many vehicles joining traffic.	Average
The Khuoi Sung reservoir – Yen Han commune			
1, Yen Han High School	High school location is far away from the project area (1.5 km), close to DT256 road, there may be vehicles traveling back and forth. 	Risk of traffic accidents, traffic jams maybe occur when there are many vehicles traveling between and after school or going to school.	Low
2, The location of Yen Han commune market	Location of the market area is far away from the project area (1.9 km), close to DT256 road, there may be vehicles traveling back and forth.	Risk of traffic accidents, traffic congestion maybe occur when many vehicles are traveling	Average

Works	Location/Description	Potential impact	Severity
		in crowded areas.	
3. Road to the reservoir	Earth road	The access road to the lake may be damaged due to many vehicles joining traffic.	Average
The Khuoi Dang reservoir – Thanh Mai commune			
The lake is isolated, around 3km there are no specific structures The access road to the lake is earth.	The location of the lake is 3km from the People's Committee, along the road to the lake is about 2.5km without any houses. 	The access road to the lake may be damaged due to many vehicles joining traffic.	Average
The May Day reservoir – xã Dong Xa			
The lake is isolated, the road to the lake is 3.3 km. Downstream from the lake from 500-1km, there are a few households scattered. Also no other works	The location of the lake is 3km from the People's Committee, isolated	The unique route into the lake, and the people from the inside to the center of the commune, so during the construction process, when the increase in the number of	Average

Works	Location/Description	Potential impact	Severity
The access road to the lake is earth		vehicles can damage roads, traffic jams cause difficulties for people to travel. Especially on rainy days, it will be more difficult to move.	
Na Kien reservoir – Nghia Ta commune			
1, The house is located close to the road to the lake 	The road leading to the lake has 3 households located close to the road leading to the lake, about 250m away.	Construction and material transportation activities may cause noise and dust. Rainwater can sweep solid waste from affecting people's homes.	Average
The lake area is relatively isolated, 2.4 km from the People's Committee, the secondary school, but the road to the lake is a unique route to the CPC, so the households inside this route may have difficulty moving when mobilizing vehicles during the construction.		The road to the lake is a unique route to the CPC, so the households inside this route may have difficulty moving when mobilizing vehicles during the construction.	Average

5.3.3 Impact during operation

During the operation phase of the reservoirs, some of the major negative impacts are identified and assessed.

5.3.3.1 Risk of drowning

Reservoirs can be bathing and washing area of local people. Therefore, the risk of drowning always likely happens if appropriate preventive measures are not taken into account.

5.3.3.2 Activities of reservoir operators

Daily activities of reservoir operators may generate a large amount of domestic solid waste and wastewater. However, the number of reservoir operators in each reservoir ranges from 1 to 2 people, so the amount of wastes is not large, about 0.5 kg/day and wastewater is about 100 liters/day, seldom. In addition, there will be waste arising from the tourist activities in the local and neighboring provinces. If this amount of waste is not well managed, it will have a direct impact on the reservoir environment, such as water pollution that indirectly affects the reduction of dissolved oxygen in the water and therefore it affects the life of aquatic species in the reservoirs. However, this impact is considered small because of the small amount of waste.

5.3.3.3 Repair and maintenance work

These activities can lead to water cut-off in a short time. This will have a direct impact on the agricultural activities and the living activities of the downstream population. It also will indirectly cause effects such as the reduction of income due to the non-cultivation period, environmental pollution and diseases from lack of water. However, this effect is considered minor because the repair and maintenance do not last long (about a few weeks).

5.3.3.4 The emergency of flood dewatering and dam breakage

Due to the subproject particularity, which is improving dam safety, the risk of dam breakage is very low. Emergency flood dewatering likely affects downstream communities without prior notice, which directly affects downstream flooding, damage to property, crops, and livelihoods, and leads to indirect impacts such as environmental pollution and outbreaks and loss of income.

When the risk of dam failure, emergency flooding will affect the downstream households. In this case, numbers of households will be affected are 9 households in Khuoi Sung reservoir, 5 households in Khuoi Dang reservoir, 19 households in Khuoi Day reservoir, 24 households in Coc Thong reservoir, 10 households in Na Leng reservoir, 10 households in Na Kien reservoir, particularly May Day reservoir has no affected households (According to the Dam Safety Report of the subproject).

5.4 Analysis of impact types

5.4.1 Cumulative impacts

The sub-project consists of many dams, however, the dams are scattered and independent in the province. Moreover, the size and nature of the sub-project activities are small and simple, so that the implementation of the sub-project activities is not likely to cause cumulative effects. According to the surveys and exchanges with the concerned agencies, at present, in the construction area of the WB8 Sub-project in Bac Kan province, there are without major projects being implemented on the same spatial scale and time, so the cumulative effects created by other projects are considered to be non-existent.

5.4.2 Direct impacts

The subproject implementation will have direct impacts on the environmental and social conditions in the subproject area. Subproject activities will result in temporary or permanent land loss. Construction activities will have direct impacts on the quality of the surrounding environment such as the air, the soil and the water due to the generation of waste like emissions and wastewater and the removal of vegetation.

5.4.3 Indirect impacts

The temporary or permanent loss of land will affect the livelihoods of affected people like reducing or losing income, occupation change and possible social contradictions. Indirect impacts are also identified through the risk of deterioration of water quality due to soil erosion caused by vegetation clearing from the construction. Water pollution due to waste generated from the construction may lead to a decline in the composition and decline in number of individuals of aquatic species. Soil compaction due to the use of heavy equipment on farmland possibly leads to a decline in the number of useful soil microorganisms due to changes in soil structure. Loss of vegetation will also lead to loss of habitat for many animal species in the subproject area and increase of the risk of erosion and flooding.

5.4.4 Short-term impacts

In general, most impacts associated with construction activities within the subproject area such as noise, vibration, dust and emissions, and the generation of solid waste and wastewater are short. They will no longer exist when construction activities are completed.

5.4.5 Long- term impacts

The permanent loss of productive land will be a lasting impact on the affected people as some households are perceived as losing productive material and leading to a change in their occupation. Also, environmental incidents such as oil spills or hazardous chemicals will create long-term effects on the environment and human health as these chemicals get long decomposition, which penetrates into the soil, the water, and the food chains. In addition, the risks of occupational accidents will be addressed with long-term effects when workers' health is diminished or lost.

CHAPTER VI. ALTERNATIVE ANALYSIS

Aiming at improving investment efficiency, ensuring safety and minimizing environmental and social impacts on the downstream areas of the reservoirs, the subproject proposes the scenarios to select a design alternatives that are suitable for the objectives and the actual socio-economic, natural conditions in the areas of 07 reservoirs. The main construction activities are the solidification and the repair of the existing works. Because of the design options, the selection of technical solutions, technology in the construction of construction items of the Sub-project is not different. Therefore, the focus of the alternative analysis makes differences in the environmental and social impacts in the "with" and "without" alternatives of the sub-project and the optimal construction solution option will be selected.

6.1 Without subproject

The works were built for a long time and have been seriously degraded: the dam elevation is not efficient against floods, the dam quality is not good, and the coefficient of permeability is high.

The upstream slope has not been reinforced or has been reinforced but the structure was damaged and landslide and did not ensure dam safety. The downstream slope is convex, landslide and filled with trees, which makes favorable conditions for termite and affects seriously the quality of the dam body.

The spillway is degraded. The stone building is decayed. The spill width does not meet the drainage requirement that increases the reservoir water level.

The water-intake culverts have been seriously damaged at inlets and outlets, which cannot use for the water supply as required.

Draining culverts: control valves are damaged, water overflows through culverts to the dam toe causing reservoir dehydration and affecting the dam safety due to soaking water, erosion in the dam toe.

There is no monitoring system, which is not effective in warning of natural disasters. Roads for management and operation and rescue are rural roads, which are difficult to drive and only rudimentary vehicles can circulate.

There is no operation and management system, causing difficulties in reservoir operation and management.

The current status of the reservoirs is the constraint to the agricultural development, productivity and economic efficiency as the irrigation water is not proactive. This affects the selection and rotation of plants and animals and is unable to exploit the economic values of land resources.

The roads for operation and management are not fully reinforced, which is difficult to drive, operate, manage and respond to natural disasters in reservoirs and residential areas.

When the subproject is not deployed, the ecosystem of the area around the reservoirs will remain stable. However, due to the current status of the degraded reservoirs, the potential for damming will cause a catastrophe, facilities, and disruption of indigenous ecosystems in areas, particularly downstream reservoirs.

In recent years due to abnormal weather changes, floods appear a lot with intense intensity, in addition to small size reservoirs, the risk of high unsafely increases. Therefore, synchronous construction solution like an investment in construction, repair, and upgrading

of reservoirs is extremely urgent, ensuring the safety of life and property of the households in downstream areas and serving the local people's demand for economic development.

6.2 With subproject

7 reservoirs in the subproject area are important works for flood prevention and irrigation for nearly 12,000 people in mountainous communes belonging to 4 districts are Cho Moi, Cho Don, Na Ri, and Bach Thong districts of Bac Kan province. This is a significant contribution to the improvement of the lives of local people, creating a solid foundation for the irrigation of mountainous communes.

The works when completed will ensure stable active watering for over 268.2 ha of rice production area and 27ha of vegetables and crops all year round in the downstream area of 6 communes; proactively planning cultivation, changing plant varieties and domestic animals lead to increasing economic efficiency on the local agricultural land.

The sub-project will provide water for aquaculture and recover adverse impacts on the environment and the landscapes of the reservoirs and the downstream areas. Once the reservoirs are repaired, the volume of nearly 1,5 million m3 of water will create favorable conditions for aquaculture with large values. It will stabilize the water surface for aquaculture, non-agricultural production, and business, increase income and living standards. It will create more jobs, income, and improve living conditions for people, especially for unskilled labor, seasonal labor.

Construction, repair, and upgrading of reservoir works will cause potential negative environmental and social impacts as analyzed above. However, the construction period is short, the scope of activities It is not large and implemented within a limited space, so the negative impacts are considered to be minor, temporary, local and likely to be mitigated. Compared with the effectiveness of environment, economy and society after the subproject completed and operational, compared to the potential environmental and social adverse impacts, the subproject implementation is acceptable. When the reservoir is completed and operated, it will positively influence to change some meteorological factors in the area. Stabilizing the water surface will improve the microclimate conditions of each reservoir area; humidity changes are related to the dry continental properties of this region's climate during the dry season. During the operation phase, the subproject will increase the stability of the water source; ensure the safety of the project and the downstream of the dam.

In present, 07 reservoirs being exploited have some spillways and sluice gates are leaked water, without slope concrete and management roads. As proposed by the Design Consultant, to save the dam bodies, sluice gates, the reinforcement, replacement, and concretion should be to ensure water storage, avoid water loss and convenience in the process of regulating the production water, operation of reservoirs. It also ensures development conditions for vegetation communities, landscapes around reservoirs and local transport, opening opportunities for visitors, especially in the Coc Thong reservoir Liem Thuy commune.

After completion of construction works in 7 reservoirs, the stable water flow and irrigation will develop plant and animal ecosystems in reservoir areas, coastal areas and downstream areas. The ecosystem for a long time will be continuously, positively affected in diversifying, enriching fauna and flora in the sub-project area.

Completion of the works of the Sub-project will stabilize the water table in 7 reservoirs. The water level of the reservoirs will be higher than the water level in the downstream areas, thereby after the reservoirs operate, the downstream underground water level maintains year round to be able to meet the demand for water for daily life and cultivation of local people.

During the implementation, the Subproject will affect the ecosystems around the reservoirs, however, the impacts are small and can recover in a short time. Impacts and mitigation measures are analyzed and detailed in the next section in this report.

Selection of construction solutions

In addition to the socio-economic and environmental benefits provided for the comparison in the case of non-implementation and implementation of the subproject, the construction option for the items requested in the bidding documents should be selected to minimize impacts on the natural and social environment during an implementation as follows:

Soil excavation and transportation: Using a combination of 1.25m^3 excavator, trucks 5-7 tons to transport soil to dump sites at the prescribed locations. It will minimize noise, dust generated and limit traffic accidents, damage to local roads.

The dam filling complies with the regulations in TCVN8297: 2009: "*Irrigation Works – Soil Dams - Technical requirements in compaction method*". The main construction method is using 1.25m^3 excavators, trucks of 5T to buy and transport filling material from mines to the construction sites of 15 to 25 km; using 110cv bulldozers to level the soil layers; using compactors to compact soil; in tight locations where compactors cannot reach, tampers are instead; within 1 meter of a soil filling work, rich soil or clay without gravel or other impurities are compacted by tampers or by hand to minimize noise and dust generation.

Concrete work: Mix concrete by 250 liters mixer and 500 liters, pouring concrete by hand.

Paving the upstream slope: cast-in-place concrete slabs are used to limit vehicle traffic and traffic safety issues in transportation.

Grassing on the downstream slope: Grass to be planted to protect slopes is harvested in the vicinity of the works. Grass with solid roots must be chosen, which can live strongly and suffer drought and have a low body. The grass is hedged to the planting sites and is firmly attached to the slopes. The position and size of each grass plot must comply with the provisions in the design documents, which will help to restore the indigenous ecosystem, protect the surface of the dam against erosion when it rains when the construction phase has just completed.

Paving: Mainly use manual method to limit the impact of machinery to the surrounding environment and to be suitable with the local construction conditions.

Formwork: Formwork installation is manual. Most steel formworks can be used for convenient installation and dismantling to ensure labor safety and saving construction costs.

Reinforcement work: Reinforcement steel is assembled and processed mainly in warehouses in the construction sites and transported to the site for installation. At the site, small parts are mainly processed by steel and auxiliary works in order to save time, cost and minimize the impact on the surrounding environment due to the construction conditions in the area. The dam site is not wide.

Other tasks: Mainly are manual to reduce the impact of mobilizing vehicle and machinery to the site and suitable for each construction item in the condition of each area of the reservoirs.

The option of non-interruption of water during the construction process: The choice of diversion and non-interruption during the construction process ensures the irrigation downstream for the agricultural production activities of the people. With the lakes serving an

irrigated area for a few tens of hectares of rice and cropland, the issue of adequate water supply is an important issue, ensuring the stability of people's lives and reducing conflicts with the residential community. This is the optimal construction plan compared to having to water interruption.

Local labors: This is an option that suits the wishes of the people in the consultation process, and it also helps to minimize risks of security and order, conflicts of customs and familiar practices with local workers and workers from other places coming. This option also helps to minimize the impacts on domestic waste and domestic wastewater from the activities of workers' camps.

Material transport routes: Will use the existing and not open roads new. This plan has a negative side that there is a risk of damage to existing roads due to a large increase. On the other hand, the roads leading to the lake are now dirt roads and have been degraded. However, it will reduce losses in land acquisition when opening new routes, while limiting the volume of earthwork, dumping and reverting to the current state after construction.

Usual drilling solution: To make waterproof for the dams under the project, it is necessary to apply the solution to meet the following needs: (1) The bottom of the structures can be penetrated without affecting the structure; (2) It is possible to create a waterproofing curtain at the bottom of the base, and at the same time, it is required to fill holes in the foundation; The depth of treatment must cut through sedimentary layers deep in the bottom of the structure; (3) being able to construct in difficult conditions, narrow spaces, fast execution time without affecting reservoir operation (No need to drain all water in the lake), (4) Having a reasonable cost.

In order to meet these requirements, only the plan of seal-off drilling and the jet-grouting method can meet the requirements. While the plan for non-jet drilling, which uses inclined walls and blankets, requires withdrawal water in the reservoir, it has a long construction period, affects agricultural production. At the same time, it needs a large land mine and has to demolish completely the protection layer of the existing upstream slope. The option of jet grouting has a higher cost than the traditional grouting option. From the above points and based on local practical conditions, the dam body waterproofing solution is a seal-off grouting method.

CHAPTER VII. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Objectives

- Complying with the World Bank's regulations as well as Vietnam's legal system, standards, and guidelines applied at the provincial and national levels.
- Ensuring that sufficient resources are allocated based on the subproject budget to carry out the activities related to the ESMP.
- Ensuring that the environmental and social risks of the Subproject are adequately predicted and managed.
- Ensuring specific and feasible response plans with unforeseen environmental issues in the subproject's environmental impact assessment.
- Creating an effective feedback mechanism for further improving environmental protection results.
- Outlining mitigation, monitoring and institutional measures that will be implemented during the development and operation of the Subproject to avoid or control adverse impacts on the environment, society and outlines the actions required to implement mitigation measures. The ESMP creates a useful link between adverse impact and mitigation measures and ensures that such measures are implemented.
- Imposing responsibilities for the implementation, monitoring, time and cost for the proposed mitigation measures. The summary of the Subproject's environmental and social management plans is presented in the following sections.

7.2 Mitigation measures

7.2.1 Mitigation measures during the preparation phase

(1) Land acquisition

The main issue in this period is the compensation, assistance and resettlement for affected people whose land, houses, income and assets are affected. The compensation for site clearance will follow the updated resettlement plan of the subproject. The estimated cost of for implementing the RAP for the Subproject works is VND 1,036,132,218.0, which includes the cost of compensation/assistance for land, works, assets affected by the subproject, income restoration program, transitional support, monitoring and evaluation, management and back-up costs.

Implementation of compensation and assistance for affected households

- The Subproject Owner contracts and coordinates with the District Centers for Land-fund Development, the DoNRE, the DPC, the Divisions of Natural Resources and Environment, the CPC, the concerned organizations, households and individuals whose land and assets attached to land are located in the acquired area to inform and guide the accuracy, public measurement, determination of ownership, asset declaration in order that the compensation, support and resettlement plans are approved the most exactly.
- Disseminate the compensation, support and resettlement plan of the subproject.
- Disseminate the proper implementation of the State's legal obligations and interests.
- Publicize detailed compensation prices of each type of damage to affected households.

- Payment of compensation to the right subjects and on schedule.
- Coordinate with local authorities if any disputes occur to ensure the smooth site clearance.

The cost of compensation, support and other management costs for affected land/property (land, houses, structures and trees) for the Subproject are shown in the table below (For more details, please refer to the RAP report).

Table 47. The Sub-project's cost estimation for compensation and support

No.	Items	Total cost rate exchange 1USD = 23.250 VNĐ	
		VNĐ	USD
I	**Compensation**	**158,224,000**	**6,805**
II	**Compensation for structures**	**63,865,000**	**2,747**
III	**Compensation for crops, trees**	**66,265,000**	**2,850**
IV	**Compensation for public structures**	**235,990,000**	**10,150**
V	**Support**	**399,125,000**	**17,167**
1	Support for a job change and job creation (Decision No.22/2014/QĐ-UBND dated Oct 20,2014)	307,125,000	13,210
2	Support for vulnerable households	92,000,000	3,957
VI	**Sum up I,II,III,IV,V**	**923,469,000**	**39,719**
VII	**Cost for compensation, support (2%)**	**18,469,380**	**794**
VIII	**Back-up amount (10%)**	**94,193,838**	**4,051**
	Total cost for compensation, support (VNĐ)	**1,036,132,218**	**44,564**

(2) Mitigation measures for explosives, filling geological exploration bores

In order to reduce of risks, the sub-project owner will hire a company that has suitable functions and capabilities of landmine clearance (Military Command of Bac Kan Province) to evaluate risks and provide confirmation about landmine safety before construction.

The subproject will hiring a company that has suitable functions and capabilities such as the Center for Landmine and UXO Exploitation under Military Region I, to clear mines and explosives before the construction of all sites of the project components; ensuring a safe distance and warnings for people during the implementation in accordance with QCVN 01:2012/BQP-National technical regulations on clearance of explosive ordnance and QCVN 02: 2008/BCT-National technical standards on safety in transportation, preservation, use and destruction of industrial explosive materials.

After drilling for geological exploration, the design surveyors will fill drilled holes and repair the ground in the areas to minimize washing dirt via drilled holes which may affect the underground water quality.

(3) Measures to manage waste from land clearance and demolition of existing works

Almost all of the products are harvested by people such as rice, vegetables, fruit trees, and timber trees. The structure of architectural objects is not much (one temporary leaf hut, 25 m^2 of the wall, 15 m^2 of the barn). For crops that will be left for people to harvest, luminescent trees can be used for firewood or for sale. Waste from the demolition of existing buildings can also be reused for construction depending on the needs of the local people. The unused portion will be disposed by a hired transportation unit to local dumping ground.

7.2.2 Mitigation measures during construction period

7.2.2.1 Mitigation measures to construction impacts

Mitigation measures are developed based on the World Bank Group's environment, health and safety guidelines and national regulations and standards to minimize construction impacts, in general, which are presented in the ECOP. The ECOP describe the typical requirements implemented by the Project Owner and supervised by the Construction Supervision Consultant during the construction process. The ECOP will be incorporated in the appendices of bidding documents and contract documents. The mitigation measures are identified for the following issues:

- Dust and emissions;
- Vibration and noise;
- Waste management;
- Management of hazardous materials and chemicals;
- Management of camps;
- Biological effect;
- Soil erosion;
- Sedimentation and drainage;
- Stockpile and borrow pits management;
- Traffic safety management;
- Interruption of infrastructure services;
- Accidental discovery;
- Management of labor flow;
- Occupational health and safety;
- Community Health and safety;
- Communication with the local community.

Table 49. Environmental Codes of Practice (ECOP) for addressing generic construction impacts

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
1) Dust and emissions	- The Contractors are responsible for the compliance with the requirements of Vietnamese regulations on ambient air quality - The Contractors must ensure that dust emissions are minimized and will not disturb local people, while implementing dust control measures to maintain a healthy working environment and minimize disturbance to surrounding households. - The Contractors are responsible for the implementation of dust mitigation measures (e.g. use of water sprinklers, covering vehicles for transporting materials ...). - Construction materials such as cement, sand and gravel must be properly covered and secured during transportation to prevent spillage of soil, sand, other materials or dust. - Spoilt and stones and stockpile material must be protected against the effects of wind and the locations of the material stores should be checked for current wind direction and locations of the sensitive works. - Anti-dust masks should be used when dust content is too high. - All transportation and construction vehicles must comply with the Vietnamese regulations on the emission limits.	-TCVN 6438-2005: Road vehicles. Maximum allowable emission -No.35/2005/QDBGTVT on quality control technical, safety and environmental protection; -QCVN 05:2013/BTNMT: National technical regulation on ambient air quality -WBG EHS Guidelines	Contractors	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	- All vehicles must undergo a regular emission test and receive: "certificate of quality, technical safety and environmental protection" under the Decision No.35/2005/QD-BGTVT; - It is important to ensure that no solid waste or construction materials (e.g. wood, rubber, oil dusters, cement bags, paper, plastic, bitumen etc.)			
2. Noise and vibration impacts	- The Contractors are responsible for compliance with the Vietnamese laws regarding noise and vibration. - All vehicles must have the "Certificate of quality control, technical safety and environmental protection" under Decision No.35/2005/QD-BGTVT; to avoid over-noise generation from machinery which is less maintained. - Measures to reduce noise must be applied as follows: + Selection of low noise equipment + Installation of sound muffler for fans + Installation of silencer for exhaust and compressor components + Installation of sound proofing chamber for the equipment cover causing noise + Installation of adjacent sound insulation barriers and the continuous minimum surface	- QCVN 26:2010/BTNMT: National Technical Regulation on noise - QCVN 27:2010/BTNMT: Technical regulation on vibration - WBG EHS Guidelines	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	density is 10 kg/m2 to minimize sound transmission. + The sound insulation barriers should be located near the sound source or the sound transmission source. + Installation of vibration control for mechanical machines + Control of operation time for specific equipment or activities, especially when they work close to residential areas + Moving noise sources to other areas to take advantage of distance and barriers + Installation of fixed equipment as far away from residential areas as possible + Taking advantage of natural terrain in the design to prevent noise + Restriction the use of means of transportation serving the project through residential areas + Establishment of a reception and feedback mechanism			
3) Waste management	**I. General waste** **(a) Wastewater** - The Contractors are responsible for the compliance with the Vietnamese laws regarding the discharge of wastewater into water sources - Consider to hire local workers to limit waste.	- QCVN 14:2008/BTNMT: National Technical Regulation on domestic wastewater quality - QCVN 40: 2011/ BTNMT: National Technical Regulation on	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	- The wastewater treatment system must be provided for the treatment of domestic water or sanitary wastewater in areas without wastewater collection network. Wastewater treatment systems should only be used for the treatment of sanitary wastewater. When the wastewater treatment system being the form of wastewater treatment selected, it is necessary: • Design and installation in accordance with the local regulations and guiding to prevent any risk to public health or the contamination of soil, water or groundwater • Maintaining good performance • Installing in areas with sufficiently permeable soil for the design wastewater percentage • Installing in stable areas at the same level, which are well draining and permeable, with separation between drainage and groundwater or other receiving waters - Wastewater from washing construction machines and equipment must be collected in the settling pond before being discharged into the local sewerage system. - Upon the completion of the construction works, the wastewater tanks and septic tanks must be safely treated or sealed up. (b) **Storm water**	wastewater - Decision Number. 59/2007 / ND-CP Solid waste management; - Decree No. 38/2015 / ND-CP on waste and scrap management; - Circular No. 36/2015 / TT-BTNMT on Hazardous waste management; - WBG EHS Guidelines		

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	- Rainwater should be separated from the treatment and sanitary sewage to reduce the amount of wastewater to be treated before discharging. - Preventing water surface runoff from construction areas or potential sources of pollution - If this approach is not practical, the amount of wastewater discharged from the treatment and storage area must be separated from the contaminated water stream which is likely to be less polluted. - Reducing water runoff from the areas where there are no potential sources of contamination (e.g. minimizing the impermeable surface area) and reducing the maximum discharge rate (e.g. using aqua cultural ponds) - In case, it is necessary to treat rain water to protect the receiving water quality, priority should be given to managing and treating the first discharge of rainwater, where most pollutants are potential present - When the water quality criteria meets the permission, rainwater must be managed as a natural resource, either for groundwater recharge or for meeting the water need of the facility.			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	- It is essential to install and maintain oil separators and lubricant traps at refueling facilities, workshops, parking areas, fuel depots and storage areas. - Sludge from rainwater tanks or collection and treatment systems may contain high levels of pollutants must be treated in accordance with local requirements. If it is not treated, it must be suitable to the protection of public health and safety and the preservation and long-term sustainability of water and land resources. (c) **Solid waste** - Prior to construction, the Contractors should prepare solid waste control process (storage, garbage bins, cleaning schedules, etc.) and be careful during the construction. - Before construction, the Contractors must ensure that all permits or waste treatment contracts are available. - Measures should be taken to minimize potential waste generation and improper behavior related to waste disposal. At all construction sites, the Contractors must provide garbage bins, containers and waste collection facilities. - Solid wastes may be temporarily stored at site in the designated areas approved by the Contractors, Construction Supervision			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	Consultant and local authorities before being collected and treated through licensed waste collectors. - Waste packaging must be protected against corrosion. - Do not burn, bury or dump solid wastes in place. - Re-usable materials such as wood panels over grooving, steel, scaffolding, packaging materials, etc. will be collected and classified at site from other sources for recycling or for sale. - If not being dismantled on site, solid waste or construction debris will only be disposed at designated locations that are approved by the Construction Supervision Consultant and included in the Solid Waste Plan. In any case, the Contractor shall not dispose of any material in sensitive environmental areas such as natural habitats or water bodies. **II. Hazardous waste** (a) Storage of hazardous waste Hazardous waste must be stored to prevent or control accidental release into the air, soil, and water sources in the area where: - Wastes are stored in a way that prevents any disturbance or contact between incompatible wastes and allows inspection among the tanks			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	to track leaks or spills, e.g. including spaces between compatible areas or physical isolations like walls or barriers. - Store in a tightly closed containers for direct sunlight, wind and rain - Storage should be on a waterproof surface that is easily cleaned, and properly packaged to contain any spill or leakage. The storage area should be covered to prevent rainwater from accumulating - The secondary prevention system must be constructed with appropriate materials for the storage of waste and sufficient to prevent leakage into the environment. - Secondary storage includes wherever liquid waste is stored in volumes greater than 220 litters. The available volume of secondary containment must be at least 110 percent of the largest repository, or 25 percent of total storage whichever is larger) at that particular location. Providing adequate ventilation where volatile materials are stored. (b) Transportation of hazardous waste must implement by the unit, which has licensed Working Certificate on this field.			
4) Soil erosion	- Limitation of construction activities on rainy days	WBG EHS Guidelines	Contractor	PPMU, CSC, Department of

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	- Using geotextile to temporarily cover erosion-prone soil - Covering a layer of soil over the soil surface to help soil absorb water gradually - Building walls around the erosion area to block the flow of water - Stabilizing surface erosion by cultivation or concreting			Natural Resources and Environment, ISC, Local community
5) Drainage and sediment management	- The Contractors should follow the detailed design of the wastewater system in the construction plan to prevent water spills or erosion of hillsides and areas which are not protected from floods, resulting wastewater pollution to local water resource. - Ensuring that the sewage system is not filled with mud and other obstructions. - Maintenance of the status of the areas that are not under construction. - Carrying out reasonable earthwork, excavation and filling, -complying with construction standards, including such measures as installation of wastewater system, planting trees. - In order to avoid waste sediment, that affects the water source, a sediment management system should be installed to slow or divert waste and sediment until the crop is cultivated. A sediment management system	-TCVN 4447:1987: Construction regulations and acceptance - Circular 22/2010/TT-BXD of the Ministry of Construction regulating labor safety in construction work - QCVN 08-MT:2015/BTNMT - National Technical Regulation on surface water quality	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	may include the removal of canal waste, canal banks, waste tank, straw material, post-storm sewerage protection system or barriers. - Draining or supplying water: In case the construction works should be carried out at water sources (e.g. bridges, retaining walls, anti-erosion system), the areas should be drained, ensuring dry conditions for construction. Settling water from the construction site must be discharged into the sediment management system to be treated before flowing into the water source. - Mitigation measures should be implemented for each specific area under the EMP when changing water flows or constructing dykes.			
6) Management of hazardous materials and chemicals	- The use of hazardous materials and chemicals within the subproject must adhere strictly to the manufacturer's instructions. - Using types of chemicals on the list of authorized agencies - Persons exposed to hazardous materials and chemicals should receive intensive training in the risk prevention measures due to exposure to hazardous materials and chemicals. - Persons who are frequently exposed to hazardous materials and chemicals should be	-Decree No. 38/2015/ND-CP on waste and waste management; -Decision No. 23/2006/QD-BTNMT on the list of hazardous wastes; -Circular No.36/2015/TT-BTNMT on management of hazardous waste; -Circular No.03/2016/TT-BNNPTNT on the list of	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	periodically checked health (no less than 6 months) and appropriate rest periods are recommended. **Transportation of hazardous materials and chemicals** - Using accessories, pipe lines and hoses dedicated to the materials in the tanks (for example, all acids use one type of connection, all caustics use different equipment) and maintain procedures to prevent the inaccurate addition of toxic substances to the tanks. - Using compatible transfer device and match the characteristics of the transfer material and design to ensure safe transfer. - Regularly checking, maintaining and repairing accessories, pipes and tubes. - Providing secondary containment, dripping or other spill prevention and containment measures for containers of hazardous materials at possible connection points or spill points. **Overload control** Preparing written procedures for transportation including a checklist of measures	plant protection drugs permitted for use in Vietnam; -Circular No. 21/2015/TT-BNNPTNT on management of plant protection drugs -WBG EHS Guidelines		

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	to be taken during the filling process and use of the trained persons. - Installing the measuring equipment on the tanks to measure the volume inside. - Using water dripping pipes for tank trucks and fixed connections to the tanks. - Providing automatically sealed valves on the tanks to avoid overload. - Using a water tank around the spillway tubes to collect the spillage. - Using pipe connection with automatic overload protection valves (float valves). - Pumping less than the allowed capacity in the tanks or ship by placing less material than its availability. - The case of overload or overpressure of tubes, the load should be controlled down. **Response to fire and explosion prevention** - Storage of incompatible materials (acids, bases, flame retardants, oxidants, chemical reactants) in separate areas, and facilities to separate the material storage areas. - Providing specific material storage for extremely hazardous or reactive materials. - Using flame arresters on vents from flammable containers.			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	- Providing lightning protection for tanks, transfer stations and other equipment used to treat flammable materials. - Selecting compatible building materials with products stored for all parts of the storage and distribution system and avoiding reuse of containers for various products without material interoperability testing. - Storage of hazardous materials in the area of the establishment isolated from the main works. If the tangibility cannot be avoided, physical separation must be made using structures designed to prevent fire, explosions, spills, and other emergencies that affect the operation of the facility. - The storage area should be on a non-absorbent surface and be easily cleaned, properly packaged to avoid any spills or leaks. Storage areas should be covered to prevent accumulated rainwater. - All sources of ignition are prohibited from areas near flammable tanks. **Secondary chamber (liquid)** - Transferring dangerous substance from storage tanks to storage areas where there is sufficiently permeable surface to avoid environmental degradation and sloping down			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	to collection places or storage structures to avoid connecting to wastewater/rain water collection systems. - If no permanent containment structure is provided for transfer activities, one or more other spill prevention forms such as mobile casings (which can be deployed throughout the duration operating hours) of pressure relief valves on rainwater tanks or closing valves in drainage or sewer equipment, in conjunction with oil water separators should be provided. - Storing hazardous materials in tanks capable of equal to or larger than 1,000 litters in the unwater proof surface areas, which are covered or braided to contain at least 25% of total storage amount. - Providing secondary containment to the parts (tanks, pipes) of the hazardous materials storage system, at the feasible extent. - Carrying out routine tank inspections (e.g. daily or weekly), and inspection of visible parts of tank trucks and pipes to avoid leakage. - Using composite or special storage systems and pipelines, especially in the use of underground tanks (USTs) and underground pipelines. If using a dual wall system, there			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	should be a means of detecting leakage between the two walls. **Training - Employees need training in hazardous waste management. The training programs include:** - List of trained staff; - Specific training objectives; - Mechanisms for achieving goals (practical workshops, videos, etc.); - Means of determining whether the training program is effective or not; - Training procedures for new recruits and new courses for existing staff. **Community participation and awareness** - There is general information to the community which is likely to be affected by the scope and extent of the subproject activities and on-site preventive and control measures to ensure that there is no impact on human health. - Potential impacts on human health or the environment caused by incidents or from existing hazardous wastes. - Specific and timely information on the			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	behavior and appropriate safety measures will be adopted in the event of an accident, including practice exercises at high risk locations. - Access to the information needed to understand the nature of the possible impacts of the accidents and the opportunity to contribute effectively to the relevant decisions and to develop emergency preparedness plans. - The Department of Natural Resources and Environment and the Department of Health will be informed in time about any environmental incidents. - Preparation and implementation of remedial measures after the oil spills. In this case, the Contractor must provide a report explaining the reason for the spill, corrective actions, consequence/damage from the spill incident, and corrective action.			
7) Biological effect	- The contractor should establish a management plan for site clearance, vegetation rehabilitation and re-planting in accordance with the relevant regulations for pre-approval by the Engineer. The site clearance plan must be approved by Construction Supervision Consultant and	- Law on Biodiversity No. 20/2008/QH12 - Decree No. 65/2010/ND-CP guiding the Law on Biodiversity	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	Contractor should strictly follow this plan and limit the number of areas that need to be cleared as low as possible. - The site clearance in forest land in mountainous areas requires the permission of the Ministry of Agriculture and Rural Development. - The contractor should release the topsoil of all areas where the topsoil will be affected by the rehabilitation work, including temporary measures such as storage and piling up. Removed topsoil will be concentrated in the areas agreed with the Construction Supervision Consultant for future reforestation and protection. - It is prohibited to use chemicals in the release of vegetation. - Do not cut trees unless getting allowance in the vegetation clearance plan. - Installing temporary protection fences to protect plants that need to be retained if necessary before commencing work at the site. - Do not encroach important ecological resources unless the Construction Supervision Consultant has obtained permission, who should consult with the			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	PPMU and the Independent Environmental Monitoring Consultant (IEMC) and relevant authorities. These include the areas where birds, animals, fish farms, or green protected areas are developed. - The Contractor should ensure that no hunting, trapping and poisoning activities occur.			
8) Traffic management	- The Contractor must strictly comply with the provisions of the Road Traffic Law. - Adopt the best traffic safety measures in all aspects of subproject activities with the aim of preventing traffic accidents and minimizing injuries suffered by sub-project staff and the public. The measures should include: • Emphasizing the safety aspect of the drivers. • Improving driving skills and driving license requirements. • Adoption of travel time limits and arrangement of dashboards to avoid overload. • Avoiding dangerous roads and times of day to reduce the risk of accidents. • Using the speed control equipment on the trucks and remotely tracking the actions	- Law on Transportation No.23/2008/QH12; - Decree No.46/2016/ND-CP on administrative sanctions against traffic and rail safety violations; - Law on Construction 50/2014/QH13; - Circular No.22/2010/TT-BXD, regulating labor safety in construction. - WBG EHS Guidelines	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	of the driver. - Regular maintenance of the vehicles and use of the parts approved by the manufacturers to minimize serious accidents that may occur due to equipment malfunction or premature failure. - Minimizing the interaction of pedestrians with construction vehicles. - Cooperating with local communities and competent agencies to improve the signage, vision and overall safety of roads, especially along strips located near schools or other places where there are children; Working with local communities on traffic education and pedestrian safety (e.g. school education campaigns). - Coordinating with emergency response agencies to ensure that appropriate first aid measures are provided in the event of an accident. - Using locally sourced materials, whenever possible, to minimize transportation distances; Locating associated facilities such as labor camps in the subproject area and arrange transportation of workers by bus to minimize external traffic. - Using safe traffic control measures,			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	including signs and flaggers to warn of hazardous conditions.			
9) Disruption of access to utility services	- Planned and unplanned disruption of water supply, gas, electricity, internet: The Contractors must conduct prior consultation and prepare a contingency plan with the local authorities for the consequences of discontinuance. - Collaborating with relevant utilities to develop appropriate construction plans. - Providing information for affected households on construction time as well as planned service interruption (at least 5 days in advance). - The Contractors plan to provide replacement irrigation water for agriculture for affected people in the event of a long disruption more than one day. - Any damage to the cable lines, power lines, irrigation water ... will be reported to the authorities and repaired immediately.	- Decree No.167/2013/ND-CP on sanctioning administrative violations in the field of security, social order and safety.	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community
10) Management of workers' camps	- Contractors' and workers' camps are built temporarily on the subproject land. - These areas are far enough to accommodate building materials, oil, waste, discharge canals, and sensitive places such as schools, hospitals, churches, temples and other	- Labor law 10/2012/QH13 - WBG EHS Guidelines	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	dangerous areas such as landslides, subsidence or erosion. - Camps should be well-ventilated, sunlight, clean water, garbage collection, septic toilets, mosquito nets, fire extinguishers, first aid kits, and other health protection facilities for workers.			community
11) Managing social issues related to worker flow	- Employment of local workers for simple jobs and limitation of worker increase in the subproject area. - Explanation to the workers about the local customs to avoid conflicts with local people. - The Subproject Owners and the Contractors should cooperate with local agencies to prevent social evils. - Strengthening campaigns to eliminate social evils - Communicating with local organizations to ensure effective management and GRM so that affected local people can rely on. - Temporary workers living in camps and rental housing must register their temporary residency with local authority. - Employees are strictly forbidden to: + Use alcoholic beverages during construction	- Decree - No.167/2013/ND-CP, stipulating administrative sanctions in the field of security, social order and safety; prevention of social evils - WBG EHS Guidelines	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	+ Controversy, fighting + Gambling, social evils such as drug use, prostitution + Littering waste			
12) Chance Finding	If the Contractors discovers archaeological sites, historical relics, remains and antiques, including graveyards and/or individual graves during excavation or construction, the Contractors shall: + Cease construction activities within the scope of discovery; + Delineate location or area of discovery; + Keep the locations safe to protect objects that can be removed from the areas. In the case of detachable antique objects or sensitive objects, it needs to protect them at night until the local authorities or the Department of Culture, Sports and Tourism take over; + Notify the CSC, who will inform the local or national authority responsible for cultural property of Vietnam (within 24 hours or less); +The agency in charge of protection of local or national heritages will be responsible for protecting and preserving these sites before deciding on further procedures. A preliminary assessment report on the	- Amended and supplemented Law on Cultural Heritage No.28/2001/QH10; - Amended and supplemented Law on Cultural Heritage No.32/2009/QH12; - Supplemented and amended Decree No.98/2010/ND-CP	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	detection process is prepared. The meaning and importance of the findings are assessed according to different criteria related to cultural heritage, including aesthetic, historical, scientific, research, social and economic values; + The decision on how to handle the search is made by the agency responsible for protecting local heritages. This may include changes in arrangement (such as when a heritage is found and cannot remove) for conservation, preservation, restoration and recovery; + If cultural monuments, high value heritages and protected conservation areas are recommended by experts and required by the Cultural Relics Agency, the Subproject Owner will need to make necessary changes to meet the requirements and conservation of the area; + Decisions relating to the management of the search for objects will be notified in writing by the competent authority. + The buildings can only be restored after being permitted by local authorities to protect the heritages.			
13) Occupational health and safety	**Overworking** - Training workers in lifting and handling	- Directive No. 02 /2008/CT-BXD on	Contractor	PPMU, CSC, Department of

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	materials in construction and finishing, including the setting of weight limits on which mechanical assistance or two-person lifts, which are required. - Planning work arrangements to minimize the need for manual transportation of heavy loads. - Selecting tools and work points to reduce power requirements and retention time, and promoting improved posture, including workstations that can accommodate users. - Implementing administrative controls on work processes, such as job rotation and rest or break. **Slide and fall** - Implementing good sanitation measures, such as placement and arrangement of loose building materials or debris in designated areas away from pedestrian walkways. - Regular cleaning of waste residue and liquid waste. - Locating electrical wires and connections in common areas and marked corridors. - Using non-slip shoes. **Working at height** - Training and using temporary fall prevention	strengthening measures to ensure occupational safety and health in units in the construction industry - Circular No.22/2010/TT-BXD dated 03/12/2010 of the Ministry of Construction on regulations on labor safety in construction work - QCVN 18: 2014/BXD: National technical regulation on safety in construction - WBG EHS Guidelines		Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	devices such as rails or other fences, which may support a weight of 200 pounds, when workers are working at or above two meters in height or at any height, if the risk involves in falling into the active machinery, into water or other liquids, into the hazardous substance, or through the open area on the work surface. - Training and using personal fall arrest systems such as seat belts and power harnesses which are capable of supporting 2,268 kg (it is also described in the section above), as well as rescue procedures to prevent people from falling to the ground. The connection point of the fall protection system can also support 2,268 kg. - Using control areas and safety monitoring systems to alert workers to the locations near fallacious risk areas as well as to tighten, mark and label lids for openings on floors, roofs or pedestrian surfaces. **Struck by objects** - Using restricted or discharge areas and/or gully to safely move waste from top to bottom. -Sawing, cutting, grinding, sanding, splitting or chiseling with appropriate protection and anchorage when working.			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	-Maintaining clear ways to avoid heavy equipment crossing discarded materials. -Using protective measures when someone or material is dropped from scaffolding and the edges of work surfaces, such as handrails and planks, to prevent material from being shot. -Moving work areas during blasting and use of explosive or deflecting methods to minimize flying stones or demineralization if the work is conducted close to people or structures. -Wearing appropriate personal protective equipment such as safety glasses with side shields, masks, helmets, and safety shoes **Moving machinery** - Planning and isolating traffic locations; operating machinery and walkways; controlling vehicle traffic through one-way lane, speed limits, and on-site personnel; Wearing easy-to-observe jackets or carrying specialized clothing to regulate traffic. - Ensuring visible observation through the use of identifiable coats when working in or walking through heavy equipment operating areas; training workers to check eye contact with operators before reaching the vehicle. - Making sure movable equipment is equipped			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	with alarm system. - Using lifting equipment that is well inspected and maintained for loads, e.g. cranes, and ensuring load when lifting them higher than the required height. **Dust** - Dust minimization techniques such as the use of water or non-toxic chemicals should be implemented to minimize dirt from vehicle movements. - Personal protective equipment such as respirators will be used where dust levels are too high. **Excavation and filling in confined space** - Controlling site specific factors that may contribute to the instability of the slope of the earthworks, e.g. the use of water removal techniques in earthworks, side wall support and adjustment of slope to eliminate or minimize the risk of collapse, trapping, or drowning. - Providing safe facilities to access to and get out of excavated areas such as step slope, grade entry, or stairs and ladders. - Avoiding operating incinerators for long periods in excavation or embankment areas			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	where other workers must enter unless the area is ventilated. **Other site hazards** - Assigning trained staff to identify and eliminate wastes from containers, pots, vats, processing equipment or contaminated soil as the first step in excavation, construction, dismantling or destroying the safety. - Assigning specially trained staff to identify and select the removal of potentially hazardous materials in the construction prior to the demolition, for example, insulators or structures containing asbestos and polychlorinated biphenyls, mercury-containing electrical components. - Using appropriate protective equipment based on occupational health and safety assessment including respirators, protective clothing, gloves, and eye protection.			
14) Community Heath and Safety	**A. Common site hazards** - The Subproject must implement risk management strategies to protect the community from physical, chemical or other hazards associated with construction areas. - Limiting access to construction site via a combination of internal controls and	- Law on road traffic No. 23/2008/QH12 - Circular No. - 22/2010/TT-BXD on regulations on labor safety in construction - QCVN 18:	Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	administrative measures for the high risk structures or areas, depending on specific circumstances, fencing, signage, and communications of the risk to the local community. - Eliminating dangers on construction sites that can not be effectively controlled by restricting access to the site such as covering open areas into shielded spaces, creating paths to the larger openings such as ditches or dug holes or store them around hazardous materials. **B. Disease prevention** *Communicable disease* - It needs to monitor, screen and treat workers. - Preventing diseases among workers, in the local community by: • Providing initiatives to raise awareness on health and education, for example by implementing an information strategy to strengthen individual awareness in order to address systemic factors that may affect fish behavior, which also promotes personal protection and protects others from infection by encouraging the use of condoms.	2014/BXD: Technical regulations on safety in construction - Guiding the environment, health and safety of the World Bank Group		

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	• Training health workers on disease treatment. • Implementing vaccination programs for local community workers to improve health and prevent infection. • Providing health services. • Providing treatment through case management at on-site or community-based health care facilities; Ensuring the access to appropriate medical treatment, confidentiality and care, especially for migrant workers. • Promoting cooperation with local authorities to increase access of families of workers and the community to public health services and promoting vaccination. *Diseases spread by transmission vectors* - Preventing the spread of larvae and pathogens through hygienic measures and removal of habitats and reproduction of larvae of human settlements. - Removing unused water. - Increasing flows of natural and man-made canals. - Considering the application of fencing			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	pesticide residue areas. - Implementing integrated vector control programs. - Promoting the use of chasing drugs, clothing, nets, and other preventive measures to prevent insect bites. - Implementing preventive treatment with non-immune drugs and coordination with health workers to destroy the reservoirs that contain diseases. - Monitoring and treating endemic and migratory populations to prevent the spread of the diseases. - Cooperating and exchanging equipment and machinery with other control programs in the subproject area to maximize benefits. - Training sub-project staff and local people on risk, prevention and treatment. - Monitoring the communities in high risk seasons for the detection and treatment of cases. - Distributing appropriate educational materials. - Following the safety instructions for storing, transporting and using pesticides to minimize the potential for misuse, overexposure, and			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	human exposure to accidents.			
15) Management of warehouse and sand mining	- Measuring based on the ECOP for large pits or piles of soil - All using locations must be pre-designated in accordance with the approved construction standards. - There should be a drain around the collection area to prevent wastewater discharge. - The ground at the collection site will be dug out and then used to return the status quo as initially as possible. - If there is a need for new locations during the construction process, prior approval by the construction engineer is required. - If landowners are affected when their lands are used for digging or piling, they should be included in the Sub-project Resettlement Plan (RAP). - If a connection to the roads is required, which should be considered in the environmental assessment process.		Contractor	PPMU, CSC, Department of Natural Resources and Environment, ISC, Local community
16) Communications with local community	- Maintaining communications with local authorities and communities. The Contractors should cooperate with local authorities (commune-level chairpersons and village heads) on the construction plans	- Decree 167/2013/ NĐ-CP on sanctioning administrative violations in the field of security,	Contractor	PPMU, CSC, Department of Natural Resources and Environment,

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	agreed in the areas near the sensitive areas or in the sensitive times like religious festivals. - Vietnamese copies of ECOP and other relevant environmental safety documents will be provided to the local community and workers in the construction sites. - Amusement park, parking lot is narrowed: Losses in public infrastructure during construction are often an inconvenience to people in sensitive areas. However, surveys on affected populations will provide opportunities for research and implementation of alternative measures. - Disseminate information on the Subproject to the affected parties (e.g. local government, affected businesses and households, etc.) through community meetings before commencement of construction. - Providing public relations contacts for interested parties to collect information on site activities, status and results of the subproject. - Providing information, especially technical findings in understandable language to the public and useful form to elected citizens and officials through documentation and dissemination of key findings during the	social order and safety		ISC, Local community

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	subproject phase - Managing the involvement to community and information requirements for subproject implementation. - Responding promptly and accurately to requests by phone and text. - Informing local people about construction plans, service disruptions, roundabouts and bus routes, in case of necessary explosion or destruction. - Limiting construction in the evening. If it is necessary well preparation and notice to everyone is adequately informed to take the necessary measures. - Notifying at least 15 days of disruption of services (electricity, water, telephone, bus, etc.) to the public by posting notice at the place of implementation of the Subproject, bus station and at affected businesses/households. - Providing documentation and technical drawings to local authorities and residents, especially the construction area outline and the ESMP for the construction site. - Bulletin boards should be arranged at all construction sites to provide information on the subproject as well as contact liaison with			

Environmental and Social Impacts	Mitigation measures	Applicable National and International technical Regulations, code, and standards	Responsible agencies	
			Implementation	Monitoring
	the PPMU, environmental staff, safety and health staff, and communications, telephone numbers and other contact information so that any affected people can present their concerns and suggestions.			

The measures of mitigations for gender, sexual abuse and harassment, use of child labor

- *Develop and implement a gender action plan:* A Gender Action Plan (GAP) is necessary to facilitate maximum participation of women in the construction phase of the subproject, providing new opportunities for women to increase their income, but not to increase their burden of life, and to contribute to the women's role and status in the project area. Details of this plan have been presented in the SA Report of the subproject and summarized in Annex 8 of this report.
- Raising awareness for officials, workers on gender equality rights, prohibiting all acts of gender violence, sexual abuse, and harassment against female workers
- PPMU issues sanctions for gender-based violence, sexual abuse, and sexual harassment, and must notify the relevant authorities when handling them.
- For local workers who hired to work for contractors, female workers, male and female workers will be given equal pay for doing the same job.
- In case the contractor hired both male and female employees, let them stay in separate living quarters with toilets should be arranged.
- Prioritize women to do less heavy work, depending on their health conditions.
- All forms of child labor are strictly forbidden. PPMU should issue sanctions for units that intentionally violate.

Measures to minimize impacts due to jet drilling

- Mitigation of the negative impacts caused by waterproofing drills arising such as spillage of drilling fluids into the surrounding environment will be controlled by fully complying with TCVN 8644: 2011.

- Equipment and tools for preparing fluid will be properly managed and sanitized to avoid the penetration of fluid into the soil, surface water, and groundwater environments.
- Shall build temporary sediment manholes in order to collect the solution emanating from the drilling process in the impregnating treatment at the dam body.
- Based on the level of hazard, sediment from the collecting pits will be collected, dried, and further processed or transported to local licensed waste disposal areas after the end of the drilling process according to Government's waste treatment regulations.

7.2.2.2 Mitigation measures for specific impacts

In addition to the general mitigation measures mentioned above, during the implementation of the sub-project in Bac Kan, there are specific impacts on sensitive areas.

Table 50. Mitigation measures for site-specific impacts

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
The Na Leng reservoir - Nghia Binh commune					
1, **The siphon carrying water from a stream running through a household's lake** 	The position running across the surface of The Na Leng reservoir, over the dam and leading down to people's houses	During the process of reinforcing the dam face, drilling bore, mobilizing machines that can break, crack pipe	• Should notify households of about the construction schedule at least 7 days in advance. Therefore, they have a plan for moving water pipes outside the construction area. • In case the pipe is not movable, it is necessary to bar the section of pipe close to the dam and through the dam carefully.	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
2, **The market in Nghia Binh commune** 	Adjacent to Highway 279, the route for materials transporting, about 1.3 km from the lake	Risk of a traffic accident, traffic congestion when there are many vehicles traveling in crowded areas.	• Traffic separation • Assign a staff to guide when passing through this area • Cover car trunks when transporting materials • Comply with traffic rules • Cleaning vehicles before leaving the site	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

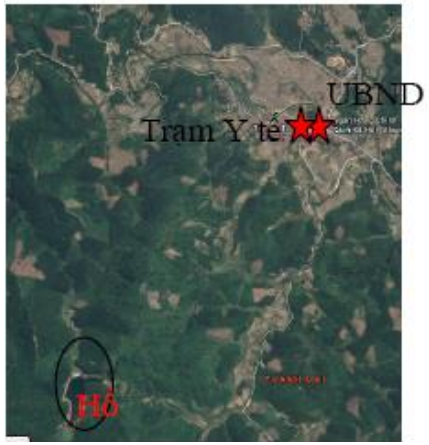
Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
3, The house is next to the dam of the lake 	Located downstream of The Na Leng reservoir, 50-100m away, near the construction area	Located downstream of The Na Leng reservoir, 50-100m away, near the construction area	• Cleaning up spilled material on the road. Cleaning up the construction site every day after construction • Should use trolleys to transport materials from this section to the reservoir • Should have a temporary drainage system • Should manage well about solid waste, hazardous waste, domestic garbage	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
The Coc Thong reservoir - Liem Thuy commune					
1, **The water siphon is located close to the path to the lake** 	Running along the right of the dirt road leading to the lake	During the process of reinforcing the dam face, drilling bore, mobilizing machines that can break, crack pipe.	• Should notify households of about the construction schedule at least 7 days in advance • Making the fence around the pipe leading to the reservoir	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
2, **location of the Liem Thuy commune middle school** 	Location middle school is away from the project area (2.2 km), close to the road, there may be vehicles traveling back and forth	Risk of traffic accidents, traffic congestion maybe occur when there are many vehicles traveling during and after school.	• Assign someone to guide when passing through this area during going-to-school time, or after school • Covering the truck while transporting materials • Comply with traffic rules • Cleaning vehicles before leaving the site	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
3, The house is next to the dam of the lake 	About 20-100 m located downstream of the dam and the lake side. The road to the dam .	Construction and material transportation activities may cause noise and dust. Rainwater can sweep solid waste from affecting people's homes The access road to the lake may be damaged due to many vehicles joining traffic.	*Cleaning up spilled material on the road. *Cleaning up the construction site every day after construction *Should use trolleys to transport materials from this section to the reservoir *Should have a temporary drainage system *Should manage well about solid waste, hazardous waste, domestic garbage	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
The Khuoi Day reservoir – Yen Han commune					

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
1, **Secondary school area** 	High school location is far away from the project area (2.1 km), close to DT256 road, there may be vehicles traveling back and forth.	Risk of traffic accidents, traffic jams maybe occur when there are many vehicles traveling around and after school, or going to school.	• Assign someone to guide when passing through this area during going-to-school time, or after school • Covering the truck while transporting materials • Comply with traffic rules • Cleaning vehicles before leaving the site	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
2, **Market area of Yen Han commune** 	The location of the market area is far from the project area (3.1 km), close to DT256 road, there may be vehicles traveling back and forth.	Risk of traffic accidents, traffic congestion maybe occur when many vehicles are traveling in crowded areas.	• Traffic separation • Assign someone to guide when passing through this area • Covering the truck while transporting materials • Comply with traffic rules • Cleaning vehicles before leaving the site	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

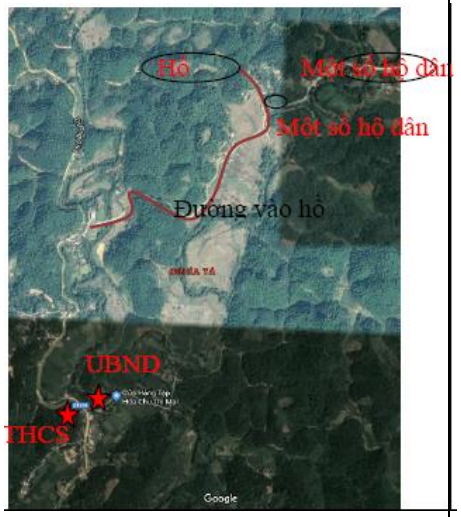
Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
3. Road to the reservoir	Earth road	The access road to the lake may be damaged due to many vehicles joining traffic.	• Using small truck • Don't transport materials over allowable weight limit • Cleaning up spilled materials on the roads while transporting	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
The Khuoi Sung reservoir – Yen Han commune					
1, Yen Han High School 	High school location is far away from the project area (1.5 km), close to DT256 road, there may be vehicles traveling back and forth.	Risk of traffic accidents, traffic jams maybe occur when there are many vehicles traveling between and after school or going to school.	• Assign someone to guide when passing through this area during going-to-school time, or after school • Covering the truck while transporting materials • Comply with traffic rules • Cleaning vehicles before leaving the site	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
2, The location of Yen Han commune market 	Location of the market area is far away from the project area (1.9 km), close to DT256 road, there may be vehicles traveling back and forth.	Risk of traffic accidents, traffic congestion maybe occur when many vehicles are traveling in crowded areas.	• Traffic separation • Assign someone to guide when passing through this area • Covering the truck while transporting materials • Comply with traffic rules • Cleaning vehicles before leaving the site	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
3. Road to the reservoir	Earth road	The access road to the lake may be damaged due to many vehicles joining traffic.	• Using small truck • Don't transport materials over allowable weight limit • Cleaning up spilled materials on the roads while transporting	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
The Khuoi Dang reservoir – Thanh Mai commune					

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
The lake is isolated, around 3km there are no specific structures The access road to the lake is earth. 	The location of the lake is 3km from the People's Committee, along the road to the lake is about 2.5km without any houses.	The access road to the lake may be damaged due to many vehicles joining traffic.	• Using small truck • Don't transport materials over allowable weight limit • Cleaning up spilled materials on the roads while transporting	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
The May Day reservoir – Dong Xa commune					

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
The lake is isolated, the road to the lake is 3.3 km. Downstream from the lake from 500-1km, there are a few households scattered. Also no other works The access road to the lake is earth 	The location of the lake is 3km from the People's Committee, isolated	The unique route into the lake, and the people from the inside to the center of the commune, so during the construction process, when the increase in the number of vehicles can damage roads, traffic jams cause difficulties for people to travel. Especially on rainy days, it will be more difficult to move.	• Using small truck • Don't transport materials over allowable weight limit • Cleaning up spilled materials on the roads while transporting • Arranging construction time suitably • Should notify households of about the construction schedule in advance • Assign someone to guide when passing in and out of the reservoir	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community
Na Kien reservoir – Nghia Ta commune					

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
1, The house is located close to the road to the lake 	The road leading to the lake has 3 households located close to the road leading to the lake, about 250m away.	Construction and material transportation activities may cause noise and dust. Rainwater can sweep solid waste from affecting people's homes.	• Cleaning up spilled material on the road. Cleaning up the construction site every day after construction • Should use trolleys to transport materials from this section to the reservoir • Should have a temporary drainage system • Should manage well about solid waste, hazardous waste, domestic garbage	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

Works	Location/ Description	Potential impacts	Mitigations	Responsibility for implementation	Responsibility for Monitoring
The lake area is relatively isolated, 2.4 km from the People's Committee, the secondary school, but the road to the lake is a unique route to the CPC, so the households inside this route may have difficulty moving when mobilizing vehicles during the construction.  		The road to the lake is a unique route to the CPC, so the households inside this route may have difficulty moving when mobilizing vehicles during the construction.	• Using small truck • Don't transport materials over allowable weight limit • Cleaning up spilled materials on the roads while transporting • Arranging construction time suitably • Should notify households of about the construction schedule in advance • Assign someone to guide when passing in and out of the reservoir	Contractor	Project Owner, CSC, ISC, Department of Natural Resources and Environment, Local community

7.2.3 Mitigation measures in operation phase

After the completion of the construction works, the reservoirs will ensure the water capacity according to the designs and ensure irrigation planning for downstream agricultural cultivation. The solutions related to the safety and operation of reservoirs are discussed further in the "Dam Safety Report" of the same subproject

Table 51.General mitigation measures for impacts during operation phase

Impact	Mitigation measures	Responsibility for implementation	Responsibility for Monitoring
Risk of drowning	- Equipping warning signs and installation of dangerous warning system on the dam areas. - Disseminating drowning risk to the community along the reservoirs.	Reservoir owner	PMU (for the first year operation), DARD, and Bac Kan Irrigation Works Management One-Member Co. Ltd
Domestic waste from activities of reservoir operators and tourists	- Limiting the activities that generate solid waste and wastewater. - No littering. - Waste must be collected and transported to the local landfill. - Waste water must be collected into the settling pits before being discharged into the environment. - If the reservoir operators are regularly present on reservoirs, the septic tanks should be built.	Reservoir owner	PMU (for the first year operation), DARD, and Bac Kan Irrigation Works Management One-Member Co. Ltd
Repair and maintenance	- Informing the downstream people about the annual repair and maintenance plans. - Performing periodic maintenance and repairs during the shortest period of time and at the time of the lowest water demand. - Performing measures to maintain water supply during repair to ensure there is no disruption in water supply.	Reservoir owner	PMU (for the first year operation), DARD, and Bac Kan Irrigation Works Management One-Member Co. Ltd
Regulation of reservoirs and flood	- Preparing an emergency preparedness plan as part of the dam safety report.	Reservoir owner	PMU (for the first year operation),

Impact	Mitigation measures	Responsibility for implementation	Responsibility for Monitoring
discharges in case of big floods affecting downstream	- The Management and Operation Unit should timely and accurately inform the flood discharge plan for the community. - At risky times like in rainy season, it is necessary to appoint persons to regularly monitor, to ensure proper regulation of water sources. - Building safety corridors for flood discharge on the basis of impact scenarios. The specific solutions are detailed in the dam safety reports and emergency response plans. - Some measures to rescue dam faults: *Before causing the emergency case:* + Repairing houses and warehouses to make stability, cutting down branches of big trees near the house, near power lines. Move immediately the warehouses located in the area expected flood diversion, key areas, critical areas. + To prepare forces and means to proactively protect dikes and rescue people and properties; prepared materials such as bamboo, guadua bamboo, leaves, oil paper, nylon, canvas ... to set up camps in the place of evacuation; prepare dry food during evacuation days. + Propagate, maintain a hygienic lifestyle, perform cooked food, drink boiled water; don't eat raw vegetables, don't drink plain water; wash hands before eating; actively kill flies, mosquitoes, mice. + Maintenance of dam systems and ancillary equipment to be ready to cope with floods. Check the drainage, anti-landslide, erosion to		DARD, and Bac Kan Irrigation Works Management One-Member Co. Ltd

Impact	Mitigation measures	Responsibility for implementation	Responsibility for Monitoring
	protect dams *<u>When happening the emergency case:</u>* + In case of an incident such as a dam failure is very unlikely, but the plan for preventing and rescuing the incident is still in place to proactively cope with reality. + When an incident occurs, announce an emergency situation to focus on all capabilities, forces, human resources, and physical forces on the spot to rescue the lives of people in the downstream area. + In flooded areas, unable to move in time, organize task forces to give food and medicines; + Mobilizing forces of the army, police, organizations, enterprises, militia forces to gather strength and means to protect, life and property of the people, maintain order, security and deal with the truth. Strictly take advantage of this difficult time to steal and disrupt; + Providing food, clothing, medicine ... resolutely struggles with the unfair subjects in difficult times for seeking dishonest profits for themselves, especially in evacuation points, places where vehicles are yoke occlusion in the affected areas; + Mobilizing the armed forces together with the police forces to coordinate and assist localities in the relief work; + Coordinate with Flood Prevention Committee to control flood discharge. + Self-consciousness to eat		

Impact	Mitigation measures	Responsibility for implementation	Responsibility for Monitoring
	cooked, drink boiled water, do not drink field water, do not drink un-boiled water, do not eat raw vegetables, do not eat rancid foods, do not eat sick animals, die of illness. *The days after the storm*: + Storms, floods or water washed away feces, garbage, dead animals, poultry ... seriously polluting water sources and the environment, if not handled in time, it will adversely affect health. Therefore, as soon as the water starts to recede, it is necessary to concentrate its efforts on overcoming the consequences, so that where water is drained down, carry out total hygiene right there. + Urgently prepare food, medicine, roofing plates... to support people in stabilizing their life when the water recedes. Deploying local forces in situ to smoothly restore traffic routes, electricity, communications ... to restore people's production and life.		
Disaster risks to cause unsafe situation	- The Management Units of Reservoirs have to monitor frequently the safety of the dams and reservoirs. - Strictly follow the operating procedures to ensure the safety of the reservoir. - The Management Units of Reservoirs closely coordinates with the Commune People's Committees and the local people to promptly report the risks associated with dam safety in order to take timely corrective measures.. - Local people and local authorities	Reservoir owner	PMU (for the first year operation), DARD, and Bac Kan Irrigation Works Management One-Member Co. Ltd

Impact	Mitigation measures	Responsibility for implementation	Responsibility for Monitoring
	take initiative in community-based coping strategies. - Developing scenarios for predicting the extent of dam breakage effects, options for human evacuation, solutions for life and community property in emergency situations, etc.. Details are included in the Dam Safety Report and the Emergency Preparedness Plan of the Subproject.		

7.3 Organization of implementation

7.3.1 Project management

Central level

The MARD is responsible for implementing and managing the entire project. The provinces carrying out the rehabilitation and improvement of the dam safety under Component 1 and MARD will coordinate the activities with the MoIT and the MONRE under Component 2. The CPO under MARD is responsible for coordinating and monitoring the overall project. The improvement and preparation of dam safety plans, including protection and authorization, are focused on the provincial governments. The PPC is the provincial chairmen. The PPMUs are responsible for managing and supervising the works with the support from the CPO.

The CPO will assist the project implementation via an Environmental and Social Technical Assistance Agency. In addition, the CPO will hire an independent consultant to evaluate the implementation of the Environmental Safety Policy for the entire subproject, once every 6 months. This agency is selected through a competitive process to provide support and quality assurance for the central level during the project implementation. This includes the support to the CPO in reviewing, refining when necessary and re-implementing the development framework during the project implementation, which can provide a general framework for the national programs. This process will be considered in accordance with the context of Decree 114/2018/NĐ-CP to assist MARD in establishing necessary systems for the implementation of the National Dam Safety Program.

Provincial level

The People's Committee of Bac Kan province assigned the PMU to carry out the subproject in the area, set up the WB8 Project Management Unit (PPMU) to implement the bidding, supervision of construction, resettlement action plan, environmental and social action plan, and these actions must be in line with the overall framework of the overall project. The PPMU will be supported by the CPO in term of technical assistance, environmental and social consultation. The project implementation organization is outlined in the following diagram.

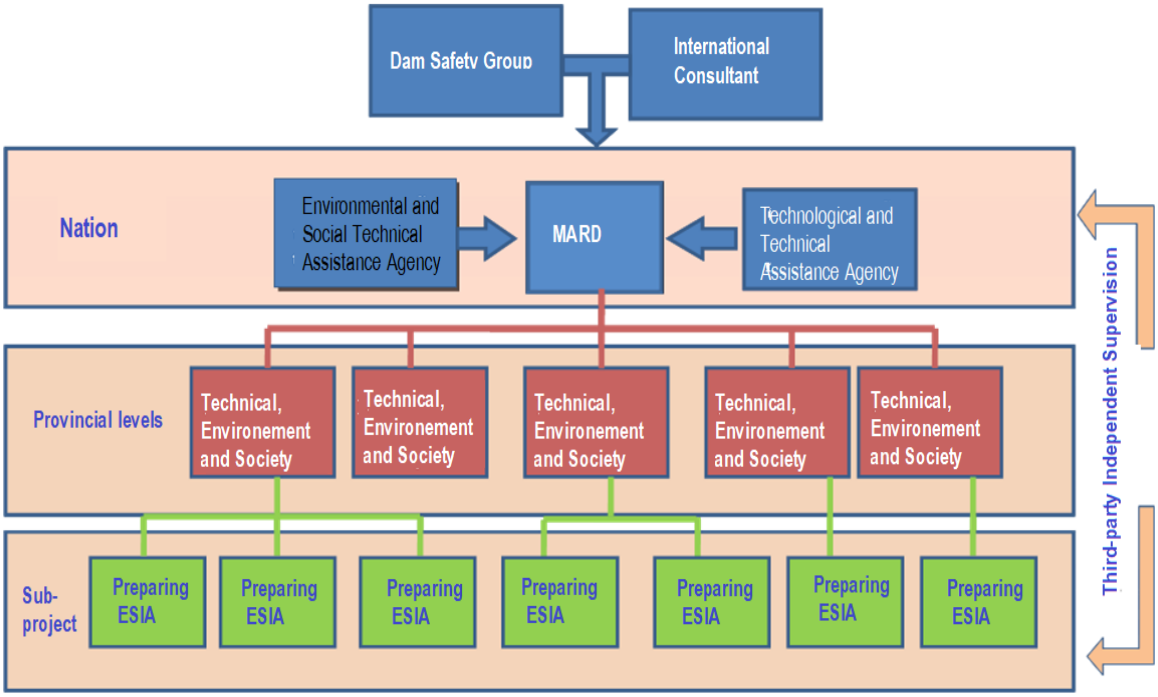


Figure 21. Implementation organization of the project

(Source: DRSIP Framework, 2015)

7.3.2 Roles and responsibilities for environmental and social safety management

In terms of the regular investment monitoring activities, the CPO will carry out the monitoring with the coordination of the local environmental authority to determine whether the subproject implementation meets all requirements of the local ESMF, SEIA reports and EMPs or not. The agency will also visit the site at various stages of the project to confirm that the ESMPs and the environmental and social monitoring plans are being implemented in full. A monitoring report including environmental and social management issues will be included in the overall field report. The designated environmental and social experts are responsible for preparing quarterly and annual reports on major project implementation steps, outputs and results of environmental management actions to be made for all investments throughout the subproject cycle.

The CPO requests the PPMU to include their corresponding environmental component in their investments, which include important mitigation activities and environmental incidents. The PPMU must integrate the environmental component in all reports prepared for the World Bank.

The Stakeholders should be fully aware of the ESMP implementation mechanism in the subproject investments. This will be very important in supporting and evaluating their roles in the environmental monitoring and the monitoring and evaluation of the subproject activities. The organization diagram during the ESMP implementation is outlined in this figure.

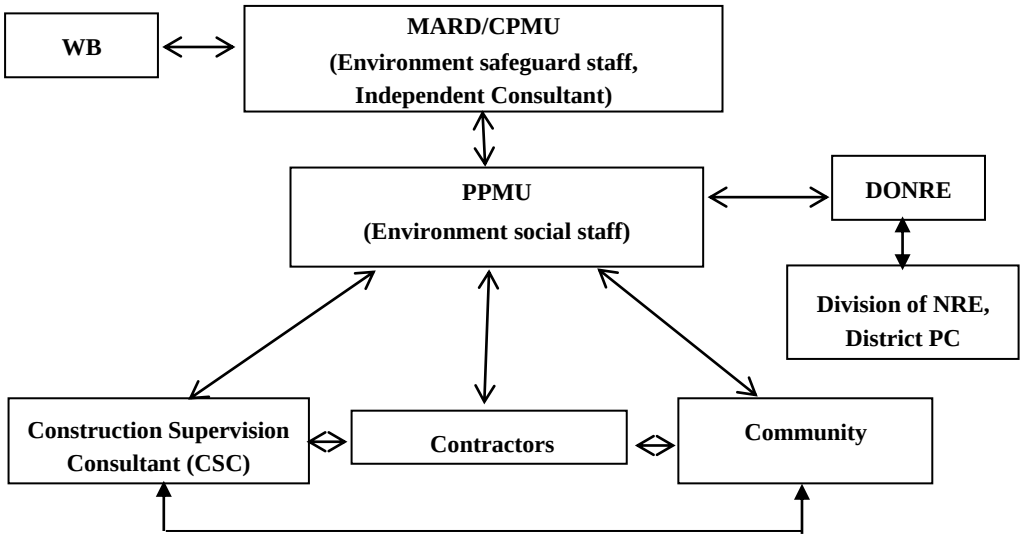


Figure 22. Organization chart of the Environmental Safety policy of the sub-project

The details of the roles and responsibilities of the stakeholders involved in the environmental and social management during the subproject implementation are presented in Table below.

Table 52. Roles and responsibilities of stakeholders

Unit	Responsibilities
Central Project Office (CPO)	-The CPO, on behalf of the Project Owner, MARD will be responsible for monitoring the overall implementation of the subproject, including the compliance with the subproject's environmental and social safeguard policy. -Responsible for reporting the implementation of the subproject environmental protection policy to the MONRE and the World Bank. -The CPO will be assisted in the overall implementation of the Subproject by the Technical Consultant (TA), which will develop a system to properly monitor the social and safety aspects during the subproject implementation. -The independent monitoring of the third party will carry out regular independent evaluation of the subproject activities. This agency will also assess the compliance with the policy application and the implementation of safety instruments, including EMPs/environment code of practices, RPF/RAP, EMDP and GAP.
Provincial Project Management Unit (PPMU)	- The PPMU will be responsible for monitoring the implementation of the subproject, including the compliance with the subproject's environmental policy. The PPMU will be the final agency responsible for the ESIA implementation and the implementation of the environmental activities of the subproject during the construction and operation phases. - Specifically, the PPMU will: (i) work closely with the local authorities on the community consultation during the project preparation and implementation phases; (ii) monitor the implementation of the ESIA,

	including the incorporation of ESMP into detailed engineering designs, tender documents and contract documents; (iii) ensure that the environmental management system is well established and functions; (iv) responsible for reporting on the implementation of the ESIA to the CPO, the DoNRE and the World Bank.
PPMU environmental and social staff (ES)	- The PPMU's ES is responsible for monitoring the implementation of the World Bank's social and environmental safeguard policies at all subproject stages and during the subproject implementation. Specifically, the environmental staff will be responsible for: (i) assisting the PPMU to integrate ESMP into detailed engineering designs, civil engineering tender documents and contracts; (ii) assisting the PPMU to monitor ESMP and RAP in accordance with the ToR, bidding documents and contract documents for CSC, if needed; iii) providing relevant inputs for the consultancy selection process; (iv) reviewing reports submitted by the CSC and the safeguard consultant; (v) conducting periodic field surveys; (vi) supporting the PPMU with the measures to address the social and resettlement issues of the subproject; and vii) developing social and environmental implementation contents in line with the progress and the Review reports to submit to the CPO and the World Bank.
Construction Supervision Consultant (CSC)	-The Construction Supervision Consultant will entrust the Environmental and Social Officers to maintain regular monitoring of all construction activities and ensure that the Contractors comply with the contract requirements and the ECOPs. The CSC will arrange sufficient number of qualified staff (e.g. Environmental Engineers) with full knowledge of environmental protection and construction project management to perform the required tasks and supervise the Contractors' activities. -The Construction Supervision Consultant will also assist the PPMU in (i) reporting and maintaining close coordination with local communities, and (ii) strengthening the capacity of safety protection for the construction Contractors.
Bidders	Bidders will submit the following additional documents to the bidding documents: **Code of Conduct (ESHS)** • The Contractor will submit a Code of Conduct that will be applied to employees and subcontractors to ensure the compliance with the contractual environmental, social, health and safety obligations (ESHS). • In addition, the Contractor will make details on how this Code will be implemented. This will include: how it will be incorporated into the conditions of employment/participation, training to be provided, how it will be monitored and how the Contractor proposes to deal with any violation. **Management Strategies and Implementation Plans (MSIP) for Risk**

	Management (ESHS) • The Contractor shall submit Management Strategies and Implementation Plans (MSIPs) to manage the following major Environmental, Social, Health and Safety (ESHS) risks: + Traffic management plan to ensure the safety of local communities from construction traffic; + Water resources protection plan to prevent drinking water pollution; + Strategic marking and boundary protection for mobilization and construction to prevent adverse externalities; + Strategies to obtain consent/permits prior to commencement of related work such as opening a quarry or mine.
Contractors	- The Contractors will appoint Environment Safeguard Monitoring Officer to implement the proposed environmental and social mitigation measures in the ESMP. -The Contractor shall submit to the PPMU/CSC for approval, and then to implement, the Contractor's Environmental and Social Management Plan (C-ESMP)[2], must be in accordance with the Specific Conditions of the Terms of Contract 16.2, including the agreed Management Strategy and Implementation Plan. -The Contractors are required to appoint competent individuals who are Site Environmental Safeguard Officers (SSEO), who will be responsible for monitoring the compliance with the Code of Conduct and Management Strategies and Implementation Plans (MSIP) for Risk Management (ESHS). -Take action to minimize any potential negative impact that is consistent with the objective described in the C-ESMP. -Actively discuss with local people and propose actions to prevent disturbance during construction.

[2] The Contractor shall not commence any Works, including mobilization and/or pre-construction activities (e.g. limited clearance for haul roads, site accesses and work site establishment, geotechnical investigations or investigations to select ancillary features such as quarries and borrow pits), unless the Project Manager is satisfied that appropriate measures are in place to address environmental, social, health and safety risks and impacts. At a minimum, the Contractor shall apply the Management Strategies and Implementation Plans and Code of Conduct, submitted as part of the Bid and agreed as part of the Contract. The Contractor shall submit, on a continuing basis, for the Project Manager's prior approval, such supplementary Management Strategies and Implementation Plans as are necessary to manage the ESHS risks and impacts of ongoing works. These Management Strategies and Implementation Plans collectively comprise the Contractor's Environmental and Social Management Plan (C-ESMP). The CESMP shall be approved prior to the commencement of construction activities (e.g. excavation, earth works, bridge and structure works, stream and road diversions, quarrying or extraction of materials, concrete batching and asphalt manufacture). The approved C-ESMP shall be reviewed, periodically (but not less than every six (6) months), and updated in a timely manner, as required, by the Contractor to ensure that it contains measures appropriate to the Works activities to be undertaken. The updated C-ESMP shall be subject to prior approval by the Project Manager.

	-Ensure that all employees and workers to understand their procedures and tasks in the environmental management program. -Report to the PPMU and the Construction Supervision Consultant about any problems and solutions. -Report to local authorities and PPMU and Construction Supervision Consultant in the event of environmental incidents and coordinate with the agencies and the stakeholders to address these issues.
Local government, local community	-The local community monitoring boards are set up under the Prime Minister's Decision No.80/2005/QD-CP dated April 18,2005, on the "Regulation on Community Investment Supervision Mechanism". The commune community supervision committees have the power and responsibility to supervise construction activities, environment negative impacts caused by construction activities, and the potential negative impact mitigation measures. Ensure that the potential negative mitigation measures are effectively implemented by the Contractors. In case of environmental problems affecting the community, they will inform the CSC and/or the PPMU.
PPC, DoNRE	-Supervise the implementation of the environmental protection of the Subproject's construction components, ensuring the compliance with the Government's policies and regulations. The DoNRE and MONRE in the districts monitor the compliance with the Government's environmental requirements.

7.4 The compliance with the Environment framework

The duties of the Contractor, Social and Environment Safety Officer (SSEO) and CSC here which are not mentioned in the SPD are required to be included in the Subproject Owner Request (Section 7 of the SPD).

7.4.1 Contractor's environmental duties[3]

Firstly, the Contractor must comply to mitigate potential impacts of construction activities of the Subproject. Secondly, the Contractor must apply the mitigation measures within the framework of the ESMP to prevent damage and disturbance for local communities and the environment due to impacts during the construction and operation phases.

The Contractor is required to submit for approval and then implement the Contractor's ESMP in accordance with the SCC Clause 16.2, including the Management Strategies and Plan Implementation.

The remedial actions that cannot be carried out during the construction process must be carried out at the completion of the construction (and before the acceptance of the completion of a work). The tasks of the Contractor include, but are not limited to:

- The compliance with the legal requirements relating to the environment, safety and public health.
- Working within the scope of contract requirements and other bidding conditions.
- Establishment of representatives of construction teams that participate in the joint inspections conducted by the Environmental Safety Officers of the PPMU and the CSC.
- Coordinating with the functional units which are responsible for conducting periodic environmental monitoring according to the ESIA.
- Coordinating with the PPMU to conduct training and dissemination of social and environmental safety policies for officials and workers on site.
- Carrying out any corrective actions as directed by the Environmental Officers of the PPMU and the CSC.
- If there is a case of non-compliance or falsification, the investigation and submission of options on mitigating measures should be carried out and measures are taken to minimize environment impacts.

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[3]If the Contractor was, or is, failing to perform any ESHS obligations or work under the Contract, the value of this work orobligation, as determined by the Project Manager, may be withheld until the work or obligation has been performed, and/or thecost of rectification or replacement, as determined by the Project Manager, may be withheld until rectification or replacement hasbeen completed. Failure to perform includes, but is not limited to the following:

- failure to comply with any ESHS obligations or work described in the Works' Requirements which may include: working outside site boundaries, excessive dust, failure to keep public roads in a safe usable condition, damage to offsite vegetation, pollution of water courses from oils or sedimentation, contamination of land e.g. from oils, human
  waste, damage to archeology or cultural heritage features, air pollution as a result of unauthorized and/or inefficient combustion;
- failure to regularly review C-ESMP and/or update it in a timely manner to address emerging ESHS issues, or anticipated risks or impacts;
- Failure to implement the C-ESMP;
- Failing to have appropriate consents/permits prior to undertaking Works or related activities;
- Failure to submit ESHS report/s (as described in Appendix C of SPDs), or failure to submit such reports in a timely manner
- Failure to implement remediation as instructed by the Engineer within the specified timeframe (e.g. remediation addressing non-compliance/s).

- Stopping obstructing construction activities when receiving instructions from the Environmental Safety Officers of the PPMU and the CSC; proposing and implementing remedial measures and alternative construction methods to minimize environment impacts. If the Contractor fails to comply with the above requirements, the Contractor will be suspended from work or receive penalties until the matter is resolved and approvals are obtained from ES of the PPMU and CSC.

7.4.2 The Contractor's Safety, Social and Environmental Officers

The Contractor is required appointing competent staff, including the Safety, Social and Environmental Officers (SSEO). The SSEOs must be adequately trained in environmental management and provided with necessary skills to transfer environmental management knowledge to all staff involved into the contract. The SSEOs will be responsible for monitoring the Contractor's compliance with the ESMP requirements and the environmental requirements. The assignments of the SSEOs will include but is not limited to the following:

- Organizing the inspection of the environment current state to assess and inspect the status of the Contractor's construction site, Contractor's equipment and construction methods related to pollution control and mitigation measures to environmental impacts, which is fully realized or not;
- Monitoring the compliance with environmental protection measures, pollution prevention and control measures and contract requirements;
- Assisting the functional units to periodically monitor the environment according to the ESIA content;
- Monitoring the implementation of environmental mitigation measures;
- Investigating complaints and proposing corrective measures;
- Advising the Contractor on environmental improvement, awareness and measures to prevent immediate pollution;
- Proposing appropriate mitigation measures for the Contractor in case of non-compliance; Implementing additional monitoring of non-compliance under the instructions of the PPMU environmental officers and the CSC;
- Notifying the Contractor and environmental staff (PPMU and CSC staff) of environmental issues; submitting the Contractor's ESMP to the environmental staff of PPMU and CSC, and other concerned agencies, if necessary;
- Maintaining detailed records of all site activities related to the environment.

7.4.3 Environmental and social monitoring during construction

During the construction process, the CSC who are able to report to the PPMU will carry out the environmental and social monitoring. The CSC will assign environmental and social staff who will be responsible for monitoring and supervising all construction activities to ensure that the mitigation measures selected in the ESMP are properly implemented and the negative environmental and social impacts caused by the Subproject are minimized. The CSC will hire environmental and social monitoring engineers with knowledge of project management, construction and environmental and social management to perform the required responsibilities and supervise the implementation of the Contractor. In particular, the CSC's environmental and social staff will:

- On behalf of the PPMU, review and evaluate if the construction design meets the CESMP's requirements for mitigation and management measures;
- Supervise the Contractor's environmental and social management at the site including the implementation, experience and ability to address environmental and social issues on site and providing guidance on correction;
- Review the Contractor's CESMP, verifying and confirming the environmental and social monitoring procedures, parameters, monitoring sites, equipment and results;
- Report on the implementation of the CESMP to the PPMU and preparation of environmental and social monitoring reports during construction phase.

7.4.4 Compliance with contract and legal requirements

The construction activities not only comply with the environmental protection and pollution control requirements of the contracts but also comply with the Law on Environmental Protection and Pollution Control of the Vietnamese Government.

All Contractors' reports on construction methods submitted to the CSC and the PPMU for approval must provide with adequate measures to control pollution and protect the environment.

The CSC and the PPMU will also review the progress and program of the works to verify that the relevant environmental laws are violated and to possibly prevent any one who manage to break the law.

The Contractors must copy the documents related to the SSEO and the ES of the CSC and the PPMU. The documents must at least include updated work progress reports, updated construction methods, and other licensing applications under the Environmental Protection Law and all valid permits/licenses. The Environmental and social staff of the CSC and the PPMU will also have right to access to the website logbook upon request.

After reviewing the documents, the environmental and social staff of the CSC and the PPMU will advise the PPMU and the Contractor on any non-compliance with the contractual and legal requirements relating to the environmental protection and pollution control so that they can continue the next actions. If the environmental and social staff of the CSC and the PPMU conclude that the status of the permit application and any environmental protection and pollution control activities may not be consistent with the works or may lead to violations of environmental protection and pollution control requirements, they will promptly notify the Contractor and the PPMU.

7.4.5 Reporting mechanism

In addition to the progress reports, the Contractor shall also provide reports on the Environmental, Social, Health and Safety (ESHS) data set out in Appendix B to the Standard Bidding Document (SPD). In addition to the reports in Appendix B, the Contractor shall immediately notify the PPMU of any incidents in the following groups. Full details of these incidents will be provided to the PPMU within the time agreed upon with the PPMU.

- Confirmation or any act which is likely to violate law or any international –
- Any death or serious injury (time damage);
- Significant adverse effects or damage to personal property (e.g. car accidents, damage caused by flying stones, working outside the boundaries)

- Severe pollution of groundwater or damage to or destruction of habitats or endangering rare species (including protected areas); or
- Any allegations of sexual harassment or sex offenses, child abuse, defamation, or other violations related to the child

Table 53. Reporting requirements

No.	Reported by	Submitted by	Report frequency
1	Contractors	CSC	Immediately reporting specific issues and monthly issues with wider violation issues
2	Construction Supervision Consultant	PPMU	Immediately for serious accidents and/or environment Monthly for usual issue
4	Community monitoring boards	PPMU	When the community has any complaints about the implementation of the subproject safety policy
5	PPMU	Provincial DONRE and CPO	Immediately for serious accidents and/or environment Once every six months in compliance with the Government's environmental regulatory requirements

7.5 Grievance redress mechanism

All complaints related to any subproject issues will be resolved through negotiations to reach consensus. The complaints will go through three stages in CPC , district and provincial levels before appealing to the courts. The agencies in charge (PPMU) of complaint settlement will pay all administrative and legal fees related to the acceptance of complaints. This cost is included in the Subproject budget.

The procedure for lodging and settling complaints will be as follows:

7.5.1 Procedures for complaints and settlement

i) The People's Committees at commune levels (CPCs): The affected people can bring their complaints to any members of the CPCs through the village heads or directly to the CPCs in writing or orally. The members of the CPCs or the village heads will inform the CPCs of the complaints. The CPCs will work directly with the affected people who complains and decide on the reconciliation/settlement within 5 days of receiving the complaints (about 15 days for the mountains and remote areas). The secretaries of the CPCs are responsible for filing and archiving documentation of all complaints that the CPCs handle.

After decisions are made by the CPCs , the concerned households can make complaints against within 30 days. In the case of the second decisions made by the CPCs, if the households are still unsatisfied with the decisions, they can appeal to the superior people's committees in accordance with the complaint procedure stipulated in the Law on Complaint in 2011 and related documents.

ii) The District People's Committees (DPCs): When there are complaints, the DPCs will have a period of 15 days (or 30 days for mountains and remote areas) to resolve them. The DPCs are responsible for filing and archiving documentation of all complaints that they handle.

When the DPCs issued decisions, the complainants can appeal again within 30 days. In the case of the second decisions made by the DPCs, if the households are still unsatisfied with the decisions, they can appeal to the provincial people's committee in accordance with the complaint procedure stipulated in the Law on Complaint in 2011 and related documents.

iii) The Provincial People's Committee (PPC): The PPC has a period of 30 days (or 45 days for mountains and remote areas) from the date of receipt of the complaints to settle. The PPC is responsible for filing and archiving documentation of all complaints that it handles.

After the PPC issued decisions, the complainants can appeal again within 45 days. In the case of the second decisions made by the PPC, if the households are still unsatisfied with the decisions, they can appeal to the court within 45 days. The PPC will have to pay compensation costs to an account.

iv) The Provincial Court. When the complainants take their cases to the provincial court and the rules of the court are favorable to the complainants, the provincial authorities will increase the compensation to a level that the court can approve. In the case that the court judgments are favorable to the PPC, the complainants will be reimbursed the charges they paid to the court.

The complaint decisions must be sent to the complainants and the involved parties and publicly posted up at the offices of the people's committees of the competent levels. The complainants will receive the judgments three days at the commune level and seven (07) days at the district or provincial levels after there are decisions on the settlement of their complaints.

To minimize the number of complaints at the provincial level, the PPMU will coordinate with Song Lo, Lap Thach, Tam Dao and Phuc Yen District Compensation Committees to organize the consultations on the complaint settlement. Its role and capacity is to provide compensation, assistance and resettlement to affected households and displaced persons.

Personnel: The environmental and resettlement staff selected by the PPMU will design and maintain a database on the subproject complaints from affected households, including information like the nature of the complaints, the sources and dates of receipt of the complaints, the names and addresses of the complainants, the action plans, and the current status.

For verbal complaints, the agency that settle complaints will record these requests in a complaint form at the first meeting with the affected households.

7.5.2 Contractors and Construction Supervision Consultant

During the construction process, the grievance redress mechanism will be managed by the Contractors under the supervision of the CSC. The Contractors will inform affected communities the availability of the grievance redress mechanism to resolve grievances and concerns regarding to the Subproject. This will be done through a community consultation and disclosure process whereby the Contractors will regularly communicate with affected communities and relevant agencies. The meetings will be held quarterly, monthly at least.

The subproject information flyers will be announced. The announcements will be made on the local media and announcements that the upcoming activities will be posted ...

All complaints and actions taken by the Contractors will be recorded in the subproject monitoring reports. Complaints and claims for damages may be made in the following forms:

By word of mouth: directly to the CSC and/or the Contractor's security guards or regional office representatives.

In writing: by hand or by posts to specific addresses.

By telephone, fax, e-mail: to CSC, security guards or Contractor's representative.

When a complaint is received, the CSC and Contractor's safeguard officers or representatives will file the complaint and record incidents subsequent to the complaint until it is settled. Immediately after receiving complaint, it is necessary to make 04 copies. The original will be kept in the file, 01 copy will be kept by the Contractor's safeguard officer, 01 copy will be sent to the CSC and 01 copy will be sent to the PPMU within 24 hours of receipt of the complaint.

The complaint information recorded will include:

- Dates and hours of complaints.
- Names, addresses and contact details of complainants.
- Brief descriptions of complaints.
- The actions taken to resolve complaints, including contact persons and findings at each stage of complaint settlement process.
- Dates and hours when complainants are contacted during the resolution process.
- Final decisions about complaints.
- Dates, times and how complainants were informed.
- Signatures of complainants when making decisions.

Small-scale claims will be resolved within a week. Within two weeks (and every week thereafter), the written response will be sent to the complainants (manual, post, fax, e-mail) which states the procedures to be followed and the process by date.

The main objective is to solve the problem as quickly as possible by the simplest means, involving as few persons as possible and at the lowest possible level. Only if the problem cannot be solved at the simplest level and/or within 15 days, other functional agencies will participate. Such situations may arise, for example, where damages are claimed, the volume of claims cannot be resolved, or the causes of damages are determined.

7.5.3 The World Bank's Grievance Redress Mechanism

The World Bank Grievance Redress Mechanism: Individuals and communities can believe that if a subproject funded by the World Bank adversely affects their lives, they may file complaints to that subproject grievance mechanism or the World Bank's grievance redress committee. The World Bank's grievance redress committee ensures that complaints are addressed in a timely manner related to the subproject. Individuals or organizations affected by the subproject may file complaints with the World Bank Inspectorate to determine if any damage occurs or may occur, as a result of failing to complying with the World Bank policies and procedures. Complaints may be made at any time when the matter is of concern to the World Bank, the PPMU will have responsibility to answer. For more

information on how to file a complaint with the WB's grievance redress committee, please visit www.worldbank.org/grs. For more information on how to file a complaint with the World Bank Inspectorate, please visit www.inspectionpanel.org.

7.6 ESMP implementation plan

7.6.1 Contractor's Social and Environmental Management Plan

As soon as the contracts are signed, based on the ESIA report, the subproject construction methodology, the construction plans which are approved by the CSC and the PPMU, the Contractors prepare the ESMP of their packages and submit to the PPMU for review and approval.

Once the ESMPs are approved, the Contractors will implement measures to minimize environmental and social impacts on site.

The ESMP information will be posted at the workers' camps and workplaces to disseminate information about mitigation measures for workers.

The Contractors post information of mitigation measures at the entrances of the sites, including the addresses, representatives, phone numbers of the parties involved for the local community to follow and contact as necessary.

Assign staff responsible for environment safety; train knowledge on environment safety and workers' health.

Survey, check the environmental status at site, report to CSC/PPMU if there are significant differences compared to the environment.

Sign contracts with authorized units for treatment of daily-life wastes, hazardous wastes, and supply of clean water.

Manage workers and construction equipment and issue new certificates in case of expiration.

Implement the ESMP and update, submit to the CSC/PPMU for approval if changes are made prior to application.

Collaborate with the CSC/PPMU to resolve complaints from people about environmental issues and the safety of the packages in a timely manner.

Report on the implementation of the monthly ESMP.

7.6.2 Start up the sub-project and personnel

The Contractor's Environmental Safety Officers must be trained in the relevant regulations, have certificates of occupational health and safety, and are full-time employees on site.

The provision of training on occupational health and safety for workers and the regular inspection of the health and safety service on site must be implemented.

7.7 Capacity building and training

7.7.1 Training on safeguard policy

PMU is an experienced unit in the field of construction in general and in the field of irrigation and agriculture in particular. However, due to the fact that the PMU has not yet implemented the projects that financed by World Bank, there is a lack of experience on the donor's environmental and social safeguard requirements.

The PPMU has appointed an officer to be responsible for the environmental safety of the Subproject. This environmental officer has participated in some safety training courses organized by the World Bank and the CPMU at the early stage of the subproject implementation. Training and capacity development, however, is required annually through technical assistance of the World Bank's Safeguard Policy Officers addressing new safeguard policy requirements. Because the new environmental, social, health and safety (MXSA) requirements are set out in the standard bidding documents, the training in the MXSA requirements will be provided by the World Bank's Safeguard Policy Officers to the environmental and social staff of the PPMU, the CSC and the environmental and social staff of the Contractors as soon as they are mobilized. The PPMU will be responsible for organizing the training compatible with the World Bank's Safeguard Policy Officers.

Such training courses will be held at the beginning of the Subproject to ensure that the ESMP is properly integrated into the bidding documents (subsequently are the contracts). Technical assistance should be provided by experienced staff and the skills of construction supervision consultants in accordance with the terms of reference which encompass specific references to the development of the items of the request of the Subproject Owner on the standard tender documents.

7.7.2 Training on occupational safety and health

The provisions will be made to provide occupational safety and health training for all new employees to ensure that they are informed of the site's basic workplace conditions and work practices to protect personal and prevent injuries to their colleagues.

The training will include perceptions on basic hazards, specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disasters, which must be practice properly. Any specific hazards or color codes to be used will be considered thoroughly as part of the training orientation.

7.7.3 Orientation of visitors

If visitors are allowed accessing to the areas with hazardous conditions or substance presence, visitor orientation and control program will be established to ensure that they do not enter dangerous areas without the accompanying persons.

7.7.4 Training contractors and new workers

The PPMU will ensure that workers and contractors, before undertaking new jobs, receive adequate training and information so that they can understand the hazards at work and protect themselves from the hazards which may occur. The training will include:

- Understanding about materials, equipment and tools
- Understanding about the hazards of operation and how to control them
- Potential risks to health
- Alerts to prevent exposure
- Sanitary requirements
- Wearing and using protective clothing and equipment
- Actions to severe operating conditions, incidents and accidents

7.7.5 Training on basic occupational health and safety

A basic training program and intensive courses will be deployed as needed to ensure that workers are oriented towards the specific hazards of individual work tasks. The training will

generally be provided to managers, supervisors, workers, and occasional visitors to risk and hazardous areas.

Workers with first aid and rescue obligations receive special training not to exacerbate the exposure and health hazards to themselves and their colleagues. Training will include the risk of transmitting diseases through blood due to contact with body tissues and body fluids.

Through appropriate contractual terms and monitoring, the PPMU will ensure that service providers as well as contractual workers and sub contractual workers are adequately trained before commencement of their works.

The PPMU will be responsible for coordinating with the construction supervision consultants and the contractor's social environment officers to organize the training courses mentioned above.

7.8 Environmental monitoring plan

7.8.1 Monitoring the compliance with mitigation measures

The PPMU and the CSC will monitor the compliance of the standards. The PPMU and the CSC will monitor the Contractors' activities in accordance with the agreed mitigation measures. The results are summarized in the monthly reports.

Local authorities and communities in 7 reservoir areas will perform monitoring tasks in accordance with the Government's regulations, the Law on Environmental Protection 2014 and Decree No.80/2005/ND-CP regarding the regulations on investment community monitoring.

In addition, the Contractors' environmental safety staff will be responsible for day-to-day monitoring of labor safety and environmental sanitation and reporting to the CSC.

The detailed monitoring plans will be prepared during the detailed design phase. Expenditures for the monitoring program will be included in the cost of the ESMP implementation.

7.8.2 Monitoring environment quality

(a) Periodic monitoring

An environmental monitoring program for the air quality, soil and water supply information can be used to assess the effectiveness of pollution management strategies. A systematic planning process is recommended to ensure that the collected data is appropriate to their intended purpose (and to avoid unnecessary data collection). This process, sometimes referred to as the process of data quality objectives, determines the purpose of data collection, decisions based on data and consequences of making wrong decisions, time and place boundaries, quality and data required to make a correct decision. The environmental monitoring program will consider the following factors:

- Monitoring parameters: The selected monitoring parameters should reflect disturbing pollutants related to the subproject processes.
- Basic calculations: Prior to the construction of the Subproject, monitoring the environment quality in the ambient and in the subproject area should be carried out to assess the contamination level of the main pollutants to distinguish between the conditions of the current surrounding environment and impacts related to the Subproject.
- Type and frequency of monitoring: The ambient environmental quality data generated through monitoring program should represent contaminated pollutants caused by the Subproject by time. The time and monitoring frequency can also be arranged from

continuous to infrequent, monthly, quarterly or yearly occurrence.

- Monitoring locations: Monitoring the ambient environmental quality may be external or within the subproject area by the Subproject Owner, DONRE, or by the cooperation among the parties. The locations of the monitoring stations should be established based on the results of scientific methods and mathematical models to estimate potential impacts on the receptors from emission sources, taking into account such aspects as the locations of the communities which are likely affected.
- Sampling and analysis methods: The monitoring programs should use national or international methods for sample collection and analysis, such as those published by the International Organization for Standardization (ISO). The sampling must be conducted by or under the supervision of the trained staff. The analysis will be by authorized or certified entities for this purpose. The quality control plans (QA/QC) should be documented to ensure that the quality of data is consistent with the intended use of the data (for example, the method limits detection to less than the level of interest). The monitoring reports should include QA/QC documents.

The noise monitoring programs can be useful for the purpose of setting the ambient noise level, which is present in the proposed subproject area or useful for checking the noise level at the operation phase. The noise monitoring programs should be designed and implemented by trained professionals. Typical monitoring cycles should be sufficient for statistical analysis and may last up 48 hours in parallel with the noise monitoring devices to able to record continuous data during this time period, or by hour, or more often, if appropriate (or include different time periods for several days, including weekdays and weekends). Sound indicator types are recorded depending on the types of noise, which is being tracked and are determined by the noise specialists. The equipment should be placed about 1.5m from the ground and not closer than 3m to any reflective surfaces (e.g. walls). In general, the level of ambient noise or the level of baseline noise limits the noise level in the absence of the noise source, which is being investigated.

The details are shown in the table below:

Table 54. Environmental monitoring plan during the construction process and the first-year operation

No.	Name of reservoir	Components of environment	Location	Sign	Coordinates	
					E	N
Construction period: frequency, every 3 months (Duration 2 years)						
1	The May Day reservoir	Air, noise	Main dam	KK1	106º02’02”	22º02’40”
			Material yards and disposal sites	KK2	106º02’25”	22º02’46”
		Water	Water of reservoir in the area where the main dam is built	NM1	106º02’01”	22º02’35”
			Water in the channel from the reservoir	NM2	106º02’11”	22º02’39”

No.	Name of reservoir	Components of environment	Location	Sign	Coordinates	
					E	N
2	The Coc Thong reservoir	Air, noise	Main dam	KK3	106º03’28”	21º57’22”
			Material yards and disposal sites	KK4	106º03’31”	21º57’21”
		Water	Water of reservoir in the area where the main dam is built	NM3	106º03’27”	21º57’22”
			Water in the channel from the reservoir	NM4	106º03’29”	21º57’25”
3	Na Kien reservoir	Air, noise	Main dam	KK5	105º31’26”	22º04’05”
			Material yards and disposal sites	KK6	105º31’29”	22º04’20”
		Water	Water of reservoir in the area where the main dam is built	NM5	105º31’18”	22º04’17”
			Water in the channel from the reservoir	NM6	105º31’21”	22º04’19”
4	The Khuoi Sung reservoir	Air, noise	Main dam	KK7	105º55’44”	21º56’05”
			Material yards and disposal sites	KK8	105º55’46”	21º56’09”
		Water	Water of reservoir in the area where the main dam is built	NM7	105º55’40”	21º56’02”
			Water in the channel from the reservoir	NM8	105º55’42”	21º56’07”
5	The Khuoi Day reservoir	Air, noise	Main dam of The Khuoi Day reservoir	KK9	105º55’45”	21º56’00”
			Material yards	KK10	105º55’49”	21º56’03”
		Water	Water of The Khuoi Day reservoir near the main dam	NM9	105º55’44”	21º56’00”
			Water in the channel from The Khuoi Day reservoir	NM10	105º55’47”	21º56’02”
6	The Khuoi Dang reservoir	Air, noise	Main dam	KK11	105º45’23”	22º01’26”
			Material yards and disposal sites	KK12	105º45’25”	22º01’28”
		Water	Water of reservoir in the area where the main dam is built	NM11	105º45’23”	22º01’26”

No.	Name of reservoir	Components of environment	Location	Sign	Coordinates	
					E	N
			Water in the channel from the reservoir	NM12	105º45’21”	22º01’25”
7	The Na Leng reservoir	Air, noise	Main dam	KK13	105º55’10”	22º16’58”
			Material yards and disposal sites	KK14	105º55’13”	22º16’54”
		Water	Water of reservoir in the area where the main dam is built	NM13	105º55’11”	22º16’59”
			Water in the channel from the reservoir	NM14	105º55’15”	22º16’61”
Operating the first year (every 6 months)						
1	Water environment	The same as the position in the construction phase				
2	Water level observation	The Khuoi Sung reservoir, May Day, Coc Thong, Na Leng, Khuoi Dang, Khuoi Day				
3	Seepage observation	The Khuoi Sung reservoir, May Day, Coc Thong, Na Leng, Khuoi Dang, Khuoi Day				
Next operating years						
1	Water level observation	At the points in The Khuoi Sung reservoir, May Day, Coc Thong, Na Leng, Khuoi Dang, Khuoi Day				
2	Seepage observation	The Khuoi Sung reservoir, May Day, Coc Thong, Na Leng, Khuoi Dang, Khuoi Day				

(b) Incident monitoring

The purpose of this monitoring is to assess the soil and water pollution levels caused by sudden discharge like discharge of wastewater and oil into nearby water and soil sources and to make timely pollution control decisions to reduce environmental risk.

An incident monitoring plan will be developed by the CSC in the initial stage of the subproject implementation and submitted to the PPMU for approval. This plan identifies the potential environmental risks associated with the discharge of waste, like waste oil and wastewater, into nearby water bodies. The plan also identifies resources to monitor this issue, such as personnel, equipment, location and monitoring parameters, analytical methods, dedicated laboratories, and cost estimates.

7.8.3 Dam safety monitoring

Once the water is accumulated and the dams start operating, the dam owners are responsible for monitoring the dam safety. This task is done by qualified independent specialists who are not involved in the investigation, design, construction or operation of the dams. After the dams are in normal operation, the regular inspection stages take place, including safety inspection of the dams before and after annual flood season in accordance with Government Decree No. 114/2018/NĐ-CP - on Dam Safety Management.

7.9 Estimated cost

The estimated cost for the ESMP monitoring is given in the table below. The cost for implementing mitigation measures will be included in the construction costs.

Table 55. Estimated costs for ESMP implementation monitoring and training

No.	Items	Cost(VNĐ)
1	Monitoring of ESMP implementation during construction and the first-year operation (see the Annex 2 for more information)	329,500,000
2	Capacity Strengthening (see the Annex 1for detailed)	320,000,000
3	**Total**	**649,500,000**

The community involvement in the ESIA implementation is voluntary for the benefit of the community and people themselves. Therefore, people participating in the CESMP monitoring will not be paid. However in order to encourage the community participation, the cost of materials and tools should be allocated to the monitoring activities to support selected community members to participate in the monitoring. According to Decision No.80/2005/QD-TTg dated 18/4/2005 by the Prime Minister on the Regulation on Investment Community Supervision and the Joint Circular guiding the implementation of Decision No.80/2005/QD-TTg: "The cost of investment community supervision in the communes/wards is included in the estimated cost of the budget of the Fatherland Front at the commune level and deducted from the commune/district budget and financial support for dissemination, training courses, guidelines, preliminary and final reports. the provincial and district levels will reimburse from the cost estimate of the Front Fatherland at the provincial/district levels, which is deducted from the provincial budget".

The table below summaries the funding flow for the environmental quality monitoring and capacity building during the implementation of Bac Kan Subproject.

Table 56. Funding for ESMP monitoring

Contents	Costs	Funding sources
(a) Minimization during construction	Part of the construction contract	WB
(b) Control of safeguard policy during construction	Part of the cost of the Construction Supervision Consultant (CSC)	WB
(c) PPMU in charge of environmental safeguard policy	Part of the cost of the PPMU	Counterpart
(d) Monitoring environmental quality	Cost of renting environmental monitoring	WB
(e) Capacity building program on safety policy	Training cost	WB

Table 57. Summary of mitigation measures

Phase	Environmental and Social Issues	Mitigation Measures	Location	Applied Standards	Mitigation Costs	Implementing Agency	Monitoring Agency in charge
Pre-construction phase							
	Clearing vegetation on temporarily and permanently acquired land	- Only clearing the vegetation on the defined area. - Utilizing plant waste as a raw material or fuel - Collecting unused plant waste and transporting to a local landfill. - Repopulating the vegetation as soon as possible to maintain the landscape, microclimate and local habitats.	Sub-project area		Compensation and site clearance cost	Affected households	PPC, DPCs, CPCs
	Land acquisition: The subproject implementation will permanently recover 9,255 m^2 of land from 41 households. In addition, the subproject also temporarily	Compensation, assistance and resettlement for people affected by damage to land, housing, income, property. Compensation for site clearance will follow the updated resettlement plan of the subproject	The entire sub-project area to be affected	Land Law No. 45/2013/QH13, relevant decrees and circulars	4,463,585,280 VNĐ	DPCs, CPCs	PPMU and local communities

Phase	Environmental and Social Issues	Mitigation Measures	Location	Applied Standards	Mitigation Costs	Implementing Agency	Monitoring Agency in charge
	affects 37,132 m^2 of land managed by CPCs						
	Risks from landmines	Ensuring the safe distance and warnings for people during the implementation in accordance with QCV 01: 2012/BQP- National technical regulation on clearance of explosive ordnance and QCVN 02: 2008/BCT- National regulation on safety in transporting, preserving, using and destroying industrial explosive materials.	The entire sub-project area to be affected	QCVN 01:2012/BQP QCVN 02:2008/BCT Circular No. 146/2007/TT-BQP	Demining cost	The military unit under Military Zone I	PPMU
	Groundwater contamination due to geological drilling	After drilling for geological exploration, the design surveyor will refill drill holes to minimize the effect of rinsing dirt into the boreholes that affects the quality of underground water.	The entire sub-project area to be affected	National regulation QCVN 09-MT: 2015	Cost for preparing the FS	Consultant preparing the FS	PPMU
Construction phase							

Phase	Environmental and Social Issues	Mitigation Measures	Location	Applied Standards	Mitigation Costs	Implementing Agency	Monitoring Agency in charge
	The general environmental and social negative impacts are related to construction activities and specific impacts	- Environmental Codes of Practice (ECOP) - Measures to mitigate specific impacts	The entire sub-project area to be affected including construction site, transportation route, quarries	Laws, decrees, circulars and current national technical regulations Guiding to the Environment, Health and Safety of the World Bank Group	Included in the construction costs	Contractor	PPPMU, CSC, independent monitoring consultant of the CPO, Provincial DoNRE, local communities,
Operation phase							
	Risk of drowning	- Equipping warning signs and dangerous warning systems on dams and reservoirs. - Disseminating risk of drowning to the community along the reservoirs.	Reservoir area	Official Letter No.5675/BGDĐT-GDTC dated 30 November 2017	Operating costs of the reservoirs	Dam owners	Operation agency, DARD
	Domestic waste from activities of reservoir operators and visitors	-Limiting activities that generate solid waste and wastewater - No littering - Waste must be collected and transported to the local landfill - Waste water must be	Reservoir area	Decree No. 38/2015/NĐ-CP	Operating costs of the reservoirs	Dam owners	Operation agency, DARD

Phase	Environmental and Social Issues	Mitigation Measures	Location	Applied Standards	Mitigation Costs	Implementing Agency	Monitoring Agency in charge
		collected into the settling pit before being discharged into the external environment - If the reservoir operator is present, the septic tanks should be built					
	Repair and maintenance can lead to reduction of downstream water	- Informing downstream people of the annual repair and maintenance plan - Performing periodic maintenance and repairs during the shortest period of time and at the time of the lowest water demand -Implementing measures to maintain water supply during repair to ensure there is no disruption in water supply.	Reservoir area and downstream	Decree No. 114/2018/NĐ-CP	Operating costs of the reservoirs	Dam owners	Operation agency, DARD
	Operating reservoirs and discharging flood in case of big floods affecting downstream	- Preparing an emergency response plan as part of the dam safety report. -The management and operation units should promptly and accurately	Reservoir area and downstream	Decree No. 114/2018/NĐ-CP	Operating costs of the reservoirs	Dam owners	Operation agency, DARD

Phase	Environmental and Social Issues	Mitigation Measures	Location	Applied Standards	Mitigation Costs	Implementing Agency	Monitoring Agency in charge
		announce the flood discharge plans so that the communities may take initiative in grasping and responding. -In times of insecurity such as the rainy season, people should be regularly arranged to monitor to ensure proper water regulation. -Building a safety corridor for flood discharging, on the basis of impact scenarios; Specific solutions are detailed in the Dam Safety Report and Emergency Response Plan.					
	Disaster risk causes insecurity	- The management units of the reservoirs regularly to check the reservoir safety -Properly performing the operation procedures to ensure the safety of the reservoir. -The management units of	Reservoir area and downstream	Decree No. 114/2018/NĐ-CP	Operating costs of the reservoirs	Dam owners	Operation agency, DARD

Phase	Environmental and Social Issues	Mitigation Measures	Location	Applied Standards	Mitigation Costs	Implementing Agency	Monitoring Agency in charge
		the reservoirs work closely with the Commune People's Committee and the local people to promptly report on dam-related risks so that timely remedial actions are taken. -People and local authorities take initiative in community-based disaster preparedness planning -Developing scenarios for predicting the extent of dam breakage effects, options for migration, solutions for evacuation and community property in emergencies, etc. The details are in the Dam Safety Report and Subproject Emergency Response Plan.					

CHAPTER VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

8.1 Purpose and method of consultation

In the process of ESIA, the community consultation and information disclosure is required to ensure consensus among local authorities, local NGOs and affected communities in the subproject area. The community participation is one of the basic conditions to ensure the support of local authorities and communities to the Subproject and take their views into the report. Through community consultation, potential negative environmental impacts are comprehensively identified and mitigation measures would be adequately proposed and included in the ESIA. In fact, if the community commented early in the subproject preparation process, the relationship between the community and the subproject staff became more intimate. Based on that, the community can contribute valuable opinions to the Subproject.

81.1 Purpose of public consultation

The consultation with local authorities and affected people in the subproject area at the stage of preparation and implementation of Environment and Social Impact Assessment will provide necessary information to better understand the Subproject, impacts of the implementation, and possible preventive and mitigation measures to the community and the surrounding environment, specifically:

- Clarify the issues discussed at the beginning of the Subproject;
- Notify benefits to be gained when the Subproject is implemented;
- Point out responsibilities and awareness of the parties, beneficiary people in the subproject area during the implementation;
- Encourage the community participation in identifying environmental impacts of the Subproject;
- Gather information about the needs and responses of local people and local authorities regarding the subproject construction and proposals to mitigate its environmental impacts or to consider adjustments during the technical design;
- The World Bank's policy (OP/BP 4.01) on Environmental Assessment requires that affected groups and local governments must receive notification and consultation during the preparation of the social and environmental impact assessment.

The community consultation during the preparation of the ESIA report of DRSIP in Bac Kan Province meets the World Bank's safeguard policy requirements and the requirements of Decree No.18/2015/ND-CP dated Feb 14, 2015 of the Government and Circular No.27/2015/TT-BTNMT dated May 29, 2015 of the MoNRE on strategic environmental assessment, environment impact assessment and environmental protection plan.

The community consultation provides opportunities for affected people to participate in all subproject implementation stages. Feedback from the consultations will be considered and incorporated into the design of construction measures and mitigation measures of the Subproject. The consultation will be conducted during the implementation process as a necessary condition to address arising issues in the subproject implementation such as environmental and social impacts. The community consultation includes the following groups:

- Representatives of villages/villages which may be affected;
- Representatives of affected households, communities living near the construction site which may be affected;
- Representatives of People's Committees at all levels;
- Representatives of mass organizations, Women's Unions, Farmers' Unions ...

8.1.2 Principles of community consultation

Facilitate the participation of affected people and local authorities in the subproject area as soon as possible.

The project owner cooperates with the Consultant to conduct community consultations in the project implementation areas with the participation of local authorities, the Fatherland Front Committee of the localities, communities, and households affected by the project. The use of these methods and techniques is to enhance the reliability and effectiveness of the feedback from the subproject stakeholders, especially affected local people and ensure that (i) the affected people receive full information on the subproject; and (ii) affected people are involved in the free consultation process, advance notice and providing sufficient information during the preparation and implementation process.

8.2 Consultation process

The DRSIP in Bac Kan Province, according to the World Bank's policies (OP/BP 4.01) on environmental impact assessment, requires 02 times of community consultations. The Environmental Consultant has worked closely with the PPMU, local authorities and communities in the affected area to conduct community consultation to meet the WB requirements.

According to the preliminary design report of the Subproject, there are 10 reservoirs located at 4 districts: Cho Moi, Cho Don, Na Ri and Bach Thong. Prior to the consultations in each commune and residential area, the PPMU organized joint meetings in the province and districts to introduce and collect comments from DARD, DOC, DONRE, DPI, ... and the specialized departments of districts Cho Moi, Cho Don, Na Ri and Bach Thong about the Subproject.

At the consultation meeting in each commune, the Consultant introduced an overview of the Subproject, identified residential areas/groups in the subproject area, collected information on local environmental sanitation, discussed potential environmental impacts and mitigation measures, developed and coordinated with the local authorities in the consultation in the subproject areas. At the same time, the Consultant send written requests for consultations with concerned agencies.

The effective participatory plan of consultation process was developed and implemented with the participation of all affected people and stakeholders, which is an important part of the Subproject. This process identified beneficiary and affected people. The Consultant applied professional works and directly participated at site to collect information about community feedback on the proposed subproject components during the implementation and monitoring. During this period, community consultation meetings were held in 6 communes (Dong Xa, Liem Thuy, Nghia Ta, Yen Han, Thanh Mai, Sy Binh) with the participation of the following stakeholders:

- Representatives of local authorities from 6 communes/towns in the subproject area;
- Departments and unions: Father Front, Women's Union, Youth's Union, Farmer's Union ...
- Representatives of households in the subproject area, including those whose land is possibly acquired and beneficiaries.

The contents which were consulted and exchanged:

(i) Introduction about the subproject items and components;

(ii) Review of local socio-economic status;

(iii) Current status of technical and social infrastructure in residential areas: electricity, roads, schools, health stations; irrigation canal system, ...

(iv) Screening/evaluating potential impacts which likely occur in the subproject preparation, construction and operation phases which may affect the environment, society, culture of local people;

(v) Community consultation on mitigation measures.

The direct consultation process at the community and in the commune/town people's committees was held from 02-09/07/2018 and from 15-17/02/2019. The letters issued by PPMU were sent for local authorities regarding the community consultation for the preparation of the social and environmental impact assessment report.

During the process of completion of the DRSI Subproject's the ESIA Report in Bac Kan, the PPMU sent letters to the CPCs to consult with the local authorities, the Fatherland Front, mass organizations and local communities on the content of the ESIA.

8.2.1 Brief description of consultation process at commune/town level and mass organizations

In the implementation of the WB's Environmental Safeguard Policy, the Government's Law on Environmental Protection in 2014 and Circular No.27/2015/TT-BTNMT dated May 29, 2015, the representatives of Bac Kan WB8 PPMU sent letters about the public consultation during the preparation and appraisal of the Subproject's social and environmental impact assessment report. The direct consultation meetings were conducted from 02-09/07/2018 and from 15-17/02/2019 with the participation of 20-30 individuals and local governments.

Table 58. List of local consultations

No.	Name of locality	District	Reservoir
1	Dong Xa commune	Na Ri	May Day
2	Liem Thuy commune		Coc Thong
3	Nghia Ta commune	Cho Don	Na Kien
4	Yen Han commune	Cho Moi	Khuoi Sung
5	Yen Han commune		Khuoi Day
6	Thanh Mai commune		Khuoi Dang

7	Nghia Binh commune	Bach Thong	Na Leng

Participating in the consultations were representatives of local government and mass organizations (Farmers' Union, Women's Union, Father Front, Youth's Union), PPMU and environmental and technical consultants, AHHs in the project area.

The main contents of the consultation are: Introduction about the Subproject such as objectives, locations, scale and plan of subproject implementation, technical design plans, and policies related to environmental protection, compensation, assistance and land acquisition/resettlement by the GoV, the WB and the Subproject.

Bac Kan PPMU with the support of the Environmental, Resettlement Consultant consulted on mitigation measures to the environment, the compensation and resettlement with the stakeholders, including staff from the commune/town people's committees, leaders of the population groups and local people in the affected area.

After the survey and consultancy, the Consultant Team had meeting with local authorities to report all survey results. At the same time, the Consultant's experts collected relevant information, advantages and disadvantages, lessons learned and proposed measures for the resettlement plan and set up monitoring indicators and continued implementation at the next stage.

The follow-up consultation was conducted during the completion of the Subproject's ESIA Report. The PPMU sent letters to the People's Committees of the communes/towns to ask for opinions of local authorities, mass organizations and local communities on the ESMP content. The report includes the designs of the works, the construction items, the scale, possible social and environmental impacts as well as mitigation measures during the preparation, construction and operation phases of 7 reservoir areas. After reading the ESMP report, the representatives of local governments sent written response to the PPMU, highlighting the opinions of the local authorities, unions and community about the impacts and measures relating to the environment and society.

8.2.2 Summary of consultations with community directly affected by Subproject

After working with the People's Committees and the mass organizations at the commune/town level relating to the community consultation, the People's Committees coordinated to convene community-based consultation meetings for the people who are directly affected by the Subproject. The participants in the meetings were as follows:

+Representatives of local authorities

+Representative of local Fatherland Front.

+Representatives of communities, households affected by the Subproject

+The representative of the Subproject Owner or consultancy agencies.

The community consultation meetings were conducted in the following order: the Subproject Owner read the contents of the letters which were sent; present brief description of the Subproject and its environmental and social impacts, including activities and proposed mitigation measures during implementation; then the participants discussed and responded to questions and comments from representatives of local authorities and local community on the issues related to the Subproject; the community is consulted and actively participates in discussions about the need for development as well as the sense and responsibility for the subproject objectives, they are advised on negative impacts and measures to mitigate

negative impacts and improve benefits; also local authorities and riverside residents are advised on the agreement and commitment to the implementation of the resettlement policy.

In addition to the consultation meetings, the Consultant undertook field surveys and exchanged directly with people living around the reservoirs to collect information and consult their comments on the issues related to environmental and social aspects during the subproject implementation.

8.3 Consultation results

8.3.1 Comments from Ward/Commune People's Committees and local Organizations

a. Consultation and introduction about Subproject, impacts on natural and socio-economic environment, proposed mitigation measures during subproject implementation.

The outcomes of the consultation meetings are summarized below (*the details are presented in the consultation minutes in the appendix 3*):

- The local authorities and the mass unions strongly support the subproject implementation and wish it to be implemented soon. In all 6 communes, the authorities remind paying attention to the loading of vehicles and construction machines when they are transported through inter-village roads to the works; and requesting the construction units to use small trucks to avoid affecting the quality of local infrastructure and to commit to return the initial status of infrastructure after their completion of the construction of the sub-project.
- All communes requested the construction companies to set up and announce the construction plans, signage, safety belts and lighting in the worksites to ensure traffic safety in the region.
- The local authorities desire that the Contractors should pay attention to the time of the harvest crops to minimize losses to farmers.
- The local authorities and the mass organizations want the Contractors to inform the construction plan and construction progress in order that affected people will be informed to arrange trees and livestock accordingly.
- The local authorities request the Contractors to send the construction schedule and plan before the construction to help farmers arrange reasonable farming schedule.
- Regarding the downstream aquaculture The Khuoi Dang reservoir Thanh Mai commune; The Khuoi Sung reservoir, Khuoi Day Yen Han commune, The Coc Thong reservoir Liem Thuy commune, the local authorities request the PPMU and the Contractors to send information about 6 months before the construction to help farmers arrange reasonable farming schedule.

- The Contractors minimize any delays in construction progress to avoid direct impacts on household income and daily living.

- Minimize dust and noise when transporting materials collected from the construction sites.

- The Subproject Owner must assign representatives at the construction sites to closely manage the Construction Contractors ‘activities and ensure contact points to help people contact in an emergency.

Table 59. Summary of consultation activities carried out

No.	Commune	Time	Location	Participants	Number of participants		
					Total	EM	Female
1	Yen Han	7/2018 - 2/2019	Meeting Hall of CPC, culture house	Representatives of CPC, mass organizations, affected households, beneficiaries	**39**	0	13
2	Thanh Mai	2/2019	Ban Ty village	Representatives of CPC, mass organizations, affected households, beneficiaries	**22**	2	13
3	Dong Xa	7/2018	CPC meeting hall	Representatives of CPC, mass organizations, affected households, beneficiaries	**25**	1	9
4	Liem Thuy	2/2019	Ban Cai village	Representatives of CPC, mass organizations, affected households, beneficiaries	**20**	3	8
5	Sy Binh	2/2019	Na Leng village	Representatives of CPC, mass organizations, affected households, beneficiaries	**21**	1	6
6	Nghia Ta	7/2018	CPC meeting hall	Representatives of CPC, mass organizations, affected households, beneficiaries	**32**	3	14

b. Local consultations via dispatches

The PPMU sent official letters to the CPC in the subproject areas, attached to the ESIA Report. The report clarifies what impacts might happen during the subproject construction to the community and the natural conditions in the subproject area. The feedback from local authorities has been sent, with the majority agreeing on the content of the report on existing social and environmental impacts, which may arise during the subproject implementation, from the preparation, the construction to the operational phases as well as the solutions and measures to minimize environmental and social impacts.

8.3.2 Opinions of local communities

At the community consultation meetings, the representatives of the Subproject Owner read the contents of the dispatches/letters, briefly introduced the Subproject and its

environmental impacts, the subproject activities, forecasted impacts and proposed mitigation measures, then listened to the opinions of the farmers, the households who are directly affected, discussed and responded to the comments, suggestions as well as questions of the community participating in the meetings about the related issues.

The results of the community consultation meetings in the subproject areas show that people actively participated in the expression of ideas and suggestions related to the implementation of the subproject items of works, its environmental and social issues which may happen, and feasible mitigation measures which should be applied. The results of the community consultation meetings in communes/towns in the subproject area are summarized below.

- Local people desired to participate in the construction scheduling because all construction items are related to their irrigation water, therefore during the construction, the Contractors should pay attention to the crop seasons, harvest times to minimize losses of farmers.
- Local people want to receive full information on compensation and support policies in order that they know the compensation options and have the opportunity to choose.
- The community strongly supports the implementation of the project and wishes the project will be implemented soon. In Liem Thuy commune, people have an opinion about the load of vehicles used in construction, because the width of the road is small.
- The construction companies should set up and announce construction plans, signage, lighting at the construction sites, store material to ensure traffic safety. Most of the roads to the dam are the only local roads of each area. Therefore, the Contractors are required to regularly inspect the traffic safety, especially the going-to-school and back-from-the-school time of students.
- Local residents want the Contractors to announce the construction plan before 6 months in order that they can arrange trees and livestock suitably.
- Villagers of Ban Cai village around the Coc Thong reservoir project, Liem Thuy commune gave a note to the design unit about the spillway elevation related to the agricultural area of farmers in the upstream area of the lake; Besides, the issue of leakage and water infiltration at the foot of the dam is also related to the farming efficiency of the agricultural land area immediately downstream of the dam.
- The PPMU and the Contractors should regularly update information on the local construction progress for people in order to arrange their work and daily life to minimize inconvenience during the construction. An appropriate method of construction in section by section should be introduced to avoid rampant construction on the entire sites to reduce influence radius.
- Provide the Community Supervision Boards with the training programs to help them accurately understand their functions and tasks. At the same time, it is of necessity give them funding to maintain and support the members of the Community Monitoring Boards in carrying out their tasks.
- Provide necessary support to households doing business, persons directly or indirectly affected by the construction process.

- Minimize any delays in construction progress to avoid direct impacts on household income and daily living.
- Minimize dust and noise when transporting materials collected from the construction sites.
- The Subproject Owner must assign representatives at the construction sites to closely manage the activities of the Construction Contractors and ensure the contact points in order that people can contact them in case of emergency.
- Provide necessary support for business households who are directly or indirectly affected by the construction process.
- People in the Khuoi Dang reservoir, Thanh Mai commune have opinions asking the construction unit to pay attention to the transportation of raw materials because the road section is mostly earth road, likely to settle down when it rains.

The summary of the comments and opinions hereafter is based on the minutes of the local community consultation meetings that took place on the same days with the local government consultation meeting. These are what people are most concerned about when the Subproject implements.

8.4 Commitment of the Subproject Owner

After two times of consultations, the opinions of the representatives of the People's Committees, the mass organizations, the local community and Bac Kan PPMU, the Environment Consultant incorporated the opinions in the ESIA report hereafter.

- Regarding the environmental sanitation and public health, the PPMU and the construction companies shall fully implement the mitigation measures stated in the ESIA Report. In addition, the Subproject representatives will collaborate with the local authorities to publicize the activities, impacts and mitigation measures of the Subproject for people to know.
- The punishment in accordance with the terms of contracts and payment for the Contractors that fail to comply with the ESMP commitment to environment and social protection will be fully implemented.
- Relating to the compensation and resettlement and social impacts, the PPMU committed to cooperate with the relevant authorities and agencies at all levels to comply with the laws of Vietnam and the World Bank’s policies during the subproject implementation. The PPMU, the community and the local authorities regularly supervise the implementation and disclosure of information on the mitigation measures implemented by the construction companies.
- Regarding the traffic safety, aiming at minimizing impact of traffic congestion, loss of traffic safety, damage to community facilities caused by the construction and transportation of raw materials, the Contractor is committed to application of mitigation measures in accordance with the SEIA report prepared and approved.
- During the construction, the means of material transport that serve construction must comply with the prescribed load and speeds on each transport road. Material must be covered during transportation.

- PPMU requires the contractor to sign a commitment with the locality when using the transport infrastructure to serve the construction, ensure the quality of the work and return the status quo after the end of the construction and installation item.
- Coordinate closely with local authorities of the communes in the subproject area during the construction to solve problems arising and ensure regional security.
- The PPMU requests all Contractors to take suitable construction solutions so as not to affect the water supply for agriculture and living of the downstream area of the reservoirs.
- Regarding the construction progress: The construction items are conformed to the construction schedule, which was established.
- The PPMU requests the Subproject Design Consultant to make sure the convenience of the people in accessing the community facilities.
- The PPMU and the construction companies will restore the environment after construction, committing to dredge; clear the water flows and restore the environment of the ditches, canals around the dam construction sites, drainage culverts, management roads and embankments.
- The PPMU will direct and supervise the Construction Contractors to implement all measures to mitigate adverse impacts on the environment and the society as committed.

8.5 Information disclosure

The subproject has complied with the World Bank's policy on access to information and the current Government’s environmental assessment regulations.

Namely, information on the subproject's investment items, objectives, funding sources, implementation schedule, environmental and social impacts, and expected mitigation measures of the subproject to people. Project area residents, District and Commune People's Committees, relevant departments and agencies, Irrigation Development Management One-Member Limited Company are widely publicized in all media. Regarding the environmental and social safeguard policy, information disclosure is done as follows

a) The draft ESIA report, the RAP was sent to locally-affected people and local authorities and NGOs for study before public consultation meetings.

b) It is expected that in November 2019, the final ESIA report in Vietnamese language will be disclosed on the project’s website and subproject sites accessible to locally-affected people and local NGOs, and the English version will be disclosed on the Bank’s external website prior to subproject appraisal.

CONCLUSION AND RECOMMENDATIONS

1 Conclusions

(i). The Subproject is classified as Category B as per the results of environmental safety Policy of WB and not located within or adjacent to any environmentally sensitive areas and does not fall into “the exclusion list”;

(ii). The report has identified and adequately assessed the potential impacts in all three phases of preparation, construction and operation. In addition, it has set out the mitigation measures based on consultations with local authorities and affected people including the vulnerable groups;

(iii) The DRSI subproject in Bac Kan may cause negative impacts during the construction phase. However, as the scale of construction works is small, the impacts are considered temporary, localized and can mitigate. Therefore, feasible mitigation measures are introduced and appropriate to the natural and socio-economic conditions and local management and construction conditions in localities;

(iv) The ESMP has been prepared to manage the subproject’s potential negative impacts. The monitoring plan will be applied to monitor and supervise the subproject safeguard compliance. Construction supervision consultant approved by WB will regularly check and prepare monthly Report to submit to PPMU. This report will be independent of the contractor's environmental compliance report and submitted to CPMU.

2 Recommendations

Based on the findings of the environmental impact assessment and the Environment Social Management Plan outlined in this document, it is recommended that:

+ The mitigation measures mentioned in the ESMP will be established as an integral part of the Tender Document. The contractor will separate the workload and set the total cost for the implementation of the mitigation measures. The cost is considered as implementation cost of environmental safeguard policy and will be paid when the mitigation measures are committed to undertake by the contractor effectively;

+ Based on results from the ESIA, the PPMU recommend the competent authority and the World Bank to appraise and approve the ESIA report of the sub-project in order to be as the basis for implementing the next steps and to ensure the implementation progress of the sub-project.

REFERENCES

1. Social safeguard management framework of DRSIP project, 2015;
2. Feasibility study report (FS) of the Dam Rehabilitation and Safety Improvement subproject in Bac Kan province; January 2019.
3. Report on resettlement action plan, Report on SIA of Bac Kan Dam Rehabilitation and safety improvement project; February 2019.
4. Summary report on socio-economic situation of 6 communes in 2018;
5. Google Earth photo source
6. Statistical Yearbook of Bac Kan province, 2017;
7. Report of Current situation of environment in Bac Kan province, period 2011-2015;
8. All types of maps:
9. Map of the project area
10. Status map and land use planning of the project area.

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