Initial Environmental Examination for Nam Tong Representative Subproject

Project Number: 50236-002
April 2019

Lao PDR: Sustainable Rural Infrastructure and Watershed Management Sector Project

CURRENCY EQUIVALENTS

(as of 5 April 2019)

Currency Unit	–	Kip (KN)
KN1.00	=	$ 0.000116
$1.00	=	KN8,600

ABBREVIATIONS

ADB	:	Asian Development Bank
AF	:	Additional Financing
CCA	:	climate change adaptation
CIFOR	:	Center for International Forestry Research
COL	:	Concessional OCR lending
DAFO	:	District Agriculture and Forestry Office
DALAM	:	Department of Agricultural Land Management
DDMCC	:	Department of Disaster Management and Climate Change
DMF	:	Design and Monitoring Framework
DRR	:	disaster risk reduction
EIA	:	Environment Impact Assessment
EMP		Environmental Management Plan
ERP	:	Emissions Reduction Program
FAO	:	Food and Agriculture Organization (of the United Nations)
GCF	:	Green Climate Fund
GDP	-	Gross Domestic Product
GIZ	:	Deutsche Gesellschaft für Internationale Zusammenarbeit (German International Cooperation Agency)
GMS	:	Greater Mekong Subregion
IEE	:	Initial Environment Examination
IMT	:	irrigation management transfer
IPM	:	Integrated pest management
ISF	:	irrigation service fee
IUCN	:	International Union for the Conservation of Nature
IWMI	:	International Water Management Institute
LDC	:	least developed country
MAF	:	Ministry of Agriculture and Forestry
MONRE	:	Ministry of Natural Resources and Environment
NGO	:	Non-governmental Organisation
NRI	:	Northern Rural Infrastructure Development Project
NSEDP	:	National Socio-Economic Development Plan
NTFP	:	non-timber forest product
O&M	:	Operations & Maintenance
OCR	:	Ordinary Capital Resources
ODA	:	Overseas Development Assistance
PAFO	:	Provincial Agriculture and Forestry Office
PAM	:	Project Administration Manual
PDR	:	People’s Democratic Republic (of Laos)
PGT	:	Program Governance Team
PLUP	:	participatory land use planning
PPIT	:	Provincial Project Implementation Team
PONRE	:	Provincial Office of Natural Resources and Environment

PRAP	:	Provincial REDD+ Action Plans
PRC	:	People's Republic of China
PRI	:	productive rural infrastructure
PRT	:	pesticide reduction training
RRP	:	Report & Recommendations to the President
RSP	:	representative subproject
SME	:	Small-Medium Enterprises
SRIWSM	:	Sustainable Rural Infrastructure and Watershed Management
TRTA	:	Transaction Technical Assistance
VDF	:	village development fund
WUA	:	water user association
WUG	:	water user group

GLOSSARY

Catchment	In its totality a catchment is equivalent to a watershed, however a watershed may comprise of micro-catchments and sub-catchments. In this document a catchment refers to a subset of the larger watershed.
Watershed	A topographically delineated area from which rainwater drains as surface run-off via a river or stream to a common outlet point (e.g. a large river, lake or the sea).
Watershed management	Securing watershed functions in a sustainable manner. Broadly these functions include: ➢ Ecological function: availability of sufficient good quality water over time, space; erosion control, soil fertility, biodiversity, clean air, carbon sequestration; ➢ Economic function: sufficient natural resource products like food, fuel wood, timber, water, fish, energy required for basic needs of the local population; income generating opportunities; ➢ Social function: maintenance of social structures; protection and development of knowledge and lifestyle arrangements; maintenance and revitalisation of cultural identity and values, recreational facilities.

NOTE(S)

(i) In this report, "$" refers to US dollars unless otherwise stated.

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I. INTRODUCTION

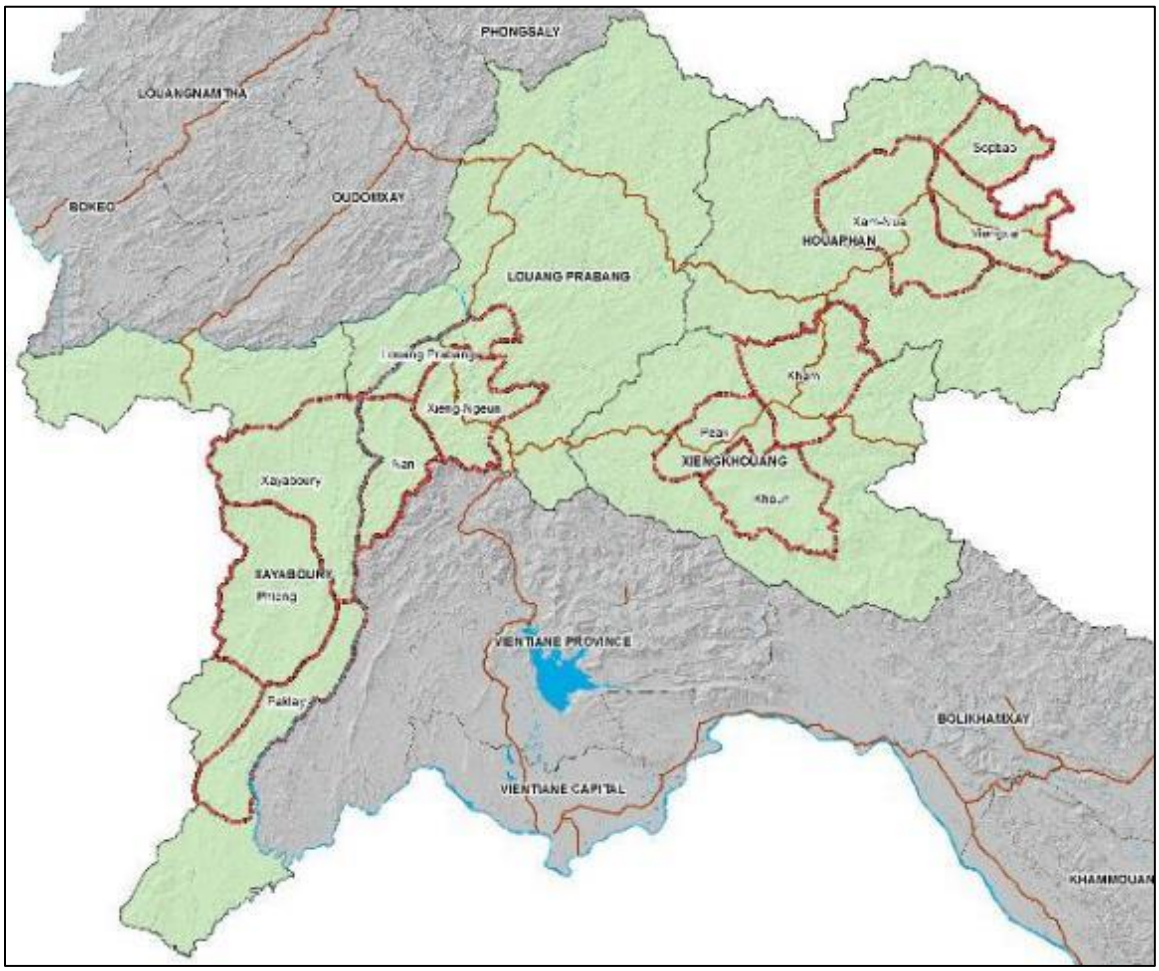
A. Overall Project Area and Scope

1. The geographic scope of the Sustainable Rural Infrastructure and Watershed Management - Sector Project (SRIWSM) includes the provinces of Houaphan, Xieng Khouang, Louang Prabang and Xayaboury. The project will finance subprojects in three agreed districts in each province, see Table 1 and Figure 1.

Table 1: Project Area

Province	**District**
Houaphan	1. Nam Xeua 2. Vengxiay 3. Sop Bao
Xieng Khouang	1. Pek 2. Khoan 3. Kham
Louang Prabang	1. Nan 2. Nguen 3. Louang Prabang
Xayaboury	1. Xayaboury 2. Phiang 3. Paklai

Figure 1: Agreed Project Provinces and Districts



2. The ADB SRIWSM project is part of a wider Government investment into more sustainable intensification and diversification of the agriculture sector. The investment program is being supported by parallel cofinancing from IFAD (for output 1 and output 3 - WUG support) and GIZ for output 2 (with the exception of Xieng Khuoang province). ADB financing will provide irrigation headworks, conveyance systems to the command areas, and water control structures within the command areas along with the provision of improved access. IFAD will support WUGs to intensify and diversify land use during the dry season. GIZ will invest in more sustainable land uses in the upper catchments with the SRIWSM catchments prioritized.

3. For safeguard purposes IFAD have committed to apply ADB safeguard policy whilst GIZ is applying the required WB safeguards from the emission reduction program into which GIZ is investing.

4. Within the IEE, the parallel financed activities are considered as part of associated facilities (see ADB (2012) Environmental Safeguards – A Good Practice Sourcebook. Associated facilities are those “that are not funded as part of a project but whose viability and existence depend exclusively on the Project, or where goods and services are essential for successful operation of the Project.” For these facilities or linkages (see Para 68 bullet 2) the guidance states “Even though the impacts and mitigation measures from the development of associated facilities

do not have to be analyzed in detail in the EIA/IEE of the project financed by ADB, basic information about the main design features, their location, the significance of potential impacts, the required approval process and institutional arrangements need to be outlined in the IEE. Given the timing of the ADB design process and this IEE being in advance of the cofinancing design process the IEE outlines the likely impacts and potential mitigation strategies. Should the cofinancing not eventuate the subproject will apply ADB financing to these mitigation strategies. As such this IEE provides due diligence on the levels of impacts and risks to the environment will recognize the borrower/client's control and influence over the associated investments.

5. The implication is that the subprojects will have a net positive environmental impact. These impacts reflect reduced risk from dry season cropping of the irrigation command areas and the potential increased income leading to both intensification and diversification that absorbs community labor that is often applied to upland shifting cultivation or rotation cropping in the watershed. The project is expected to reduce the pressure on land conversion for upland cropping which is identified as a major driver of forest loss as crops are grown on steep, bare ground subject to high rates of soil erosion in the wet season.

6. The subproject introduces new risks to the environment associated with command area intensification relating to (i) increased use of agrichemicals and fertilizer, and (ii) increased demand for irrigation water during the dry season. The IEE incorporates the requirements to mitigate inappropriate pesticide and herbicide use through the Government Pesticide Reduction Training (PRT) and integrated pesticide management (IPM) training within the IFAD support program. Nutrient management will be incorporated into the IFAD WUG training, farm to farm extension and on-farm demonstrations. For this IEE the risks linked to the "associated facilities" are the risk of intensification of agricultural inputs for the production of high value crops. The subproject will introduce Lao Good Agricultural Practice (GAP) certification and branding for all agricultural production systems in the upgraded command areas.

7. As part of the ADB safeguards and the Lao PDR legislative framework the borrower/client will not use products that fall in World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous) or Class II (moderately hazardous), if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training, equipment, and facilities to handle, store, apply and dispose of these products properly. The good practice requirement will include training in the handling, storage, application and disposal of pesticides in accordance with international good practice such as the Food and Agricultural Organization's International Code of Conduct on the Distribution and Use of Pesticides.

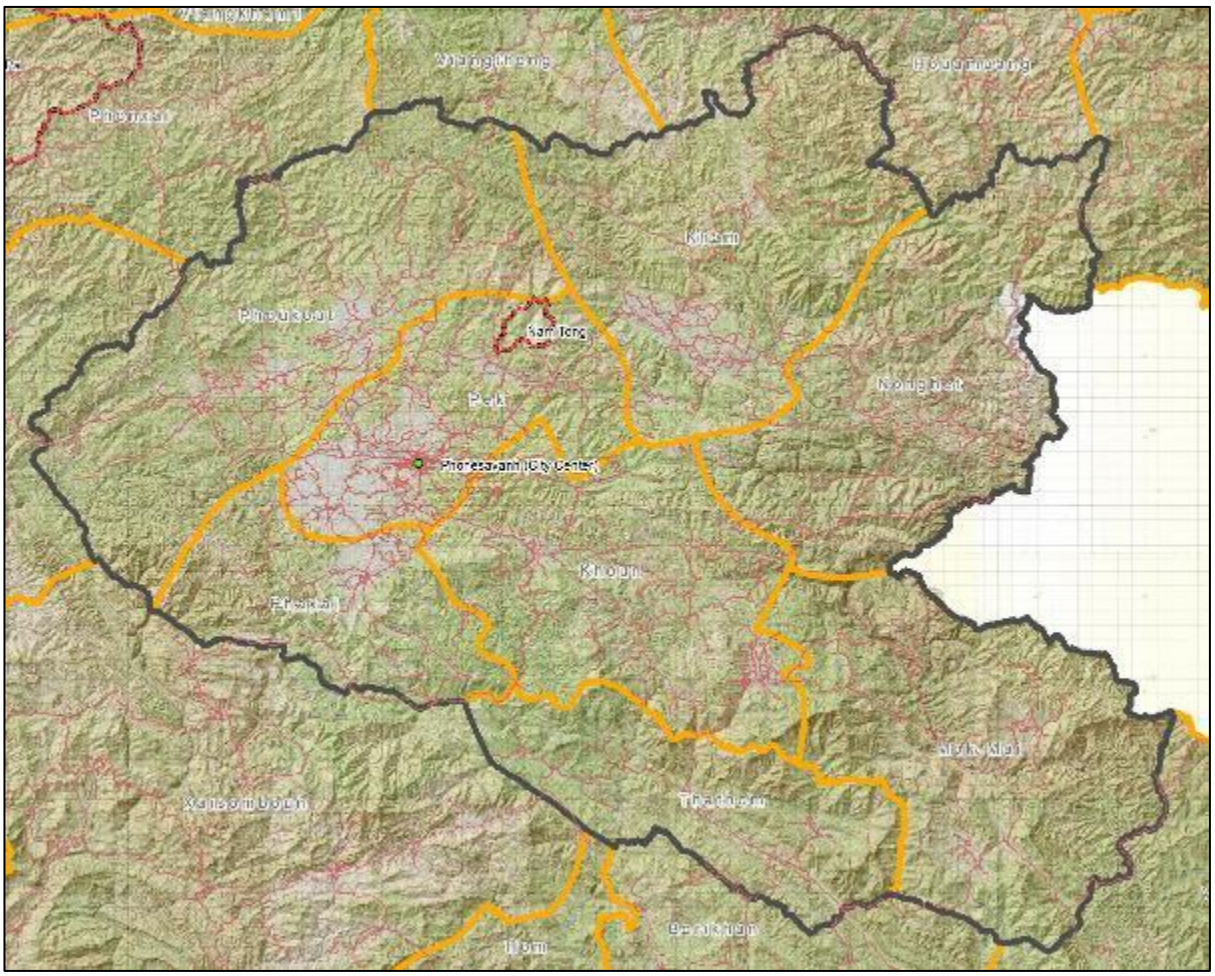
8. Risks to environmental flows are considered within the context of ADB supported facilities and this IEE. These risks are addressed through the requirements for water source gauging stations and flow rate information, flow modelling and estimation, the use of crop water demand planning using CROPWAT software upon which crop planning i.e. sowing dates, crop choice are scheduled within the available water resources. For most cropping options irrigation demand occurs prior to the reported timing of minimum flow in March and April.

B. Location of the Nam Tong Subproject

9. Xieng Khouang lies on the eastern side of Laos, and borders Viet Nam. Pek District occupies the central-western part of the province, and includes the provincial capital, Phonesavanh City. The Nam Tong Subproject lies to the north-east of Phonesavanh, in the northern part of the district. The catchment is bifurcated by two rivers that merge above the Ban

Suan Village to form the Nam Tong river that connects into the wider Mekong. Basin Figure 2 shows this layout.

**Figure 2. Overview Map of Xieng Khouang Province,
Showing the Location of the Nam Tong Catchment in Pek District.**



C. Rationale for the Overall Project

10. The proposed SRIWSM project will increase the profitability of the agriculture, natural resources and rural development sector by enhancing sustainable, market oriented agricultural production together with natural resources management. The project will: (i) enable lowland (irrigated land) and upland farmers to derive increased income from high value crops and livestock; (ii) improve land use management within the productive rural infrastructure (PRI)[1] scheme watersheds; (iii) upgrade PRI to be climate resilient, with efficient and sustainable operation and maintenance; and (iv) improved nutritional status of targeted communities.

11. The project rationale is economic growth through the sustainable use of natural resources by maximising the value of irrigation water to smallholder irrigators and the wider rural

[1] PRI refers to irrigation (pumping stations, weirs, canals, water management, and control structures) and access infrastructure (rural roads/bridges) integral to the functioning of irrigation schemes.

communities of which they are part. Historically, investment in wet season irrigation improvements involved replacing traditional weirs and structures with engineered concrete structures to provide supplemental wet season irrigation. The headworks and distribution canals generally fed water to the highest point of the command area, from where field to field flow was used for distribution.

12. This improved household food security and often provided surplus rice which is sold. As food security based on rice productivity has been achieved the surplus of rice has resulted in declining world and local prices limiting the sustainability of these irrigation systems. Food security investment overlooked dry season cultivation and crop diversification which requires a substantially higher level of investment in the command areas.

13. The government operates a policy of transferring to the users the management of irrigation systems. However, low returns from rice do not currently provide sufficient margin to finance more efficient water management and maintenance of assets through the irrigation service fees that users contribute. As a result, most schemes do not maintain assets or use operational systems that support their command areas, leading to a decline in size and efficiency over time.

14. Dry season crop and livestock systems have vastly higher income opportunities than from irrigated rice. These opportunities require dry season irrigation, when water is less abundant and requires active management in the command area. But without effective control, farmers face insecure or uncertain irrigation outcomes and will not invest in new opportunities. Ensuring control requires more in-command area investment for delivering the right amount of water, at the right time and in sufficient quantity. There is a need to move away from systems of field to field flow with abundant wet season water, to approaches which increase the precision of use of potentially scarce water.

15. Equally important is the recognition that labor is increasingly scarce and valuable, with most irrigators earning less than 50 percent of their income from agriculture. The relative return to irrigated crops per day of labor input determines the household allocation of labor. Once a household is food secure, labor is allocated to the highest return which for the dry season, and increasingly for the wet season, if often casual or contract labor markets in the construction sector, tourism sector and or upland cropping. High value dry season crops are shown to increase returns to labor substantially. This is reflected in the movement of labor out of the district during the dry season to seek higher returns to labor in the construction sector and into neighboring Districts obtaining increased returns to their labor. Xiengkhouang population is one of four Provinces facing declining population levels over the past decade.

16. The efficient and precise use of water is critical because of the impact of climate change and resultant instability within both ecosystems and production cycles. Hence water management is no longer a choice, but has become a necessity. New technologies that increase efficiencies in both water use and labour are the priority to maximise the value of irrigation water. The control of water requires capacity in the Water User Groups to plan and operate their schemes. These operational inputs require financing, which wet season rice is unable to provide – resulting in rice-only irrigation schemes being unsustainable.

17. Dry season irrigation is exposed to upper catchment degradation and loss of watershed environmental services that reduce in-catchment storage and lead to longer periods of low flows during the extended dry season. Managing catchment-based risks to the watershed is a critical success factor for the sustainability of dry season irrigation. Uncertainty of water access or unreliable water quantities make smallholder investment far too risky, so that during the wet

season farming households move their labour into off-farm opportunities. To date, Participatory Land Use Planning has too often been seen as an output to address these risks, when in fact it is an input. The output requires a stronger focus on changing land use behaviours. Planning systems need to identify far more clearly what behaviours need to change, who in these communities are responsible for these behaviours and how can they be supported for change.

18. The efficient allocation of labour and farmer investment into dry season agriculture requires diversified cropping and livestock to generate higher incomes. The increased incomes make the operation of schemes more affordable while providing sufficient incentive to retain labour on the farm. These options however carry substantially more market and business risk than irrigated rice. To manage these risks requires strong and reliable market linkages. Smallholders, and the sector as a whole, need to move from selling outputs to producing for markets through better market connections and strengthened value chains. Agribusiness skills that support Provincial Agriculture and Forestry Office (PAFO) staff and build connections from markets to producers are non-existent, and need to receive additional capacity building. Where such change has already occurred in the northern mountain irrigators report significantly higher wet season rice yields as soil is improved and the residual nutrient and soil biological activity transfers to the wet season rice crop.

19. Business risks are a significant hurdle for most smallholders, as they arise from the need for new technologies, different management skills and more complex sets of inputs and outputs. Extension services in Laos have proven difficult to establish, access, and even more difficult to sustain outside of a project. Options for linking farmers to other farmers, and to access the pool of knowledge and experience that exists in recent past or ongoing development or private sector projects is considered a high priority.

20. The implication of this on the environment of the subproject catchment is intended to have a net positive impact. This is mainly because it will greatly increase the value of low-lying land that can be irrigated and make it easier to derive a reasonable livelihood from it; in turn, this should reduce the pressure on the upland slopes, where forest is widely cleared for shifting cultivation and crops are grown on steep, bare ground subject to high rates of soil erosion in the wet season. Ensuring a good environmental condition of the catchments is also a significant step towards achieving resilience against the effects of climatic fluctuations.

D. Purpose of the Initial Environmental Evaluation

21. This Initial Environmental Evaluation (IEE) has been undertaken in compliance with the specified safeguard requirements of the borrower, the Government of Lao PDR (the government), and the main financing organisation, the Asian Development Bank (ADB).

E. Subproject Rationale

22. The proposed Nam Tong Subproject runs along a relatively contained valley floor and involves four cascaded headworks – see Figure 3. The upstream catchment is relatively small at 28.6 km^2, and the command area comprises of: (i) a new command area upstream of headwork 1, providing 21 ha of irrigated land in Ban Suan village using a pipe and gravity offtake to supplement existing wet season rainfed irrigation as part of a community agreement to cease shifting cultivation; (ii) 50 ha of command area supplied from headwork 2 (a replacement weir); and (iii) 123 ha supplied from headwork 3 (a weir upgrade).

23. Initially the province sought additional support for headwork 1 (on a weir funded by a ADB Community Managed Irrigation Project (CMI) with a command area of 27 ha and a new headwork 1.1, located between headwork 1 and headwork 2, and with a catchment area of 23 ha. Headworks 1 and 1.1 are not expected to support any dry season cropping with irrigators indicating that they simply require more reliability for wet season cropping. The proposed investment is unjustified for these works and were excluded from the subproject. Hence, in total there will be 173 ha of command area that are capable of supporting dry season cropping, including fodder for fattening livestock, and 21 ha in the upper catchment at Ban Suan that could support dry season irrigation.

24. In addition, the project will support the development of up to 15 ha of fish ponds and approximately 2.5 km of road, of which 0.5km is adjacent to Nalam village and the remainder is upstream of the CMI (H1) for improved access through to Ban Suan village using an existing walking and motorcycle track alignment. The road includes an all-weather submersible crossing.

25. Headwork 1 condition is relatively good, but it has been outflanked and the right bank canal is no longer functioning. From the date of the headwork construction the canal on the true right bank only operated for three years.

26. Headwork 2 in the mid reaches of the scheme supports a canal running on the left bank and then along the toe of the slope of the river valley. The previous headwork has been destroyed and is replaced by a temporary sand bag barrier to raise water levels sufficiently to distribute water through the canal.

27. Headwork 3 in the lower reaches of the scheme is in relatively good condition but has potential outflanking on the right-hand side and damage to the first 200 metres of the offtake canals on both sides of the structure. The site needs to be carefully reviewed and a more resilient structure and offtake design will need to be agreed.

28. The overall scheme has four water user groups and one water user association (though none has functioned effectively in the past), based on two villages: (i) Meing Nalam, 88 households and 468 persons, all with paddy; and (ii) Khang Vieng, 136 households supporting 763 people, of which with 80 households (478 persons) have irrigation.

29. The valley is at a relatively high elevation, with the command area at about 1150 metres altitude. This makes it too cold for dry season rice, but also provides considerable residual soil moisture going into the dry season. The scheme is registered for Khoa Koi Noi (little chicken rice) production during the wet season. During the dry season the two upper reaches are mostly used for grazing of cattle and horses with households indicating that they do not want to grow dry season crops due to the high labour requirements. In the lower reaches there are small areas of dry season crops – mostly garlic, onion, and organic vegetables – for which they are unable to supply local demand. The PAFO has formed an organic producer group in Khang Vieng village.

30. Producers in command areas linked to headworks 2 and 3 indicate strong interest in dry season cropping, as well as improved and integrated livestock production through the production of fodder for livestock fattening in the dry season. In addition there is a need to assess side stream inflows, and fish pond development is sought for non-irrigation households. Currently there is about one hectare of fish ponds that have been developed, with a request for up to 15 hectares, mainly at the lowest village, Khang Vieng.

31. The rationale for the subproject is to promote dry season cropping on small cascade systems to take advantage of local markets for high value crops especially organic vegetables, mulch-based high value crops and improved livestock production. Developing water control systems within the command area to support dry season production systems and the management of water for high value use during the dry season are also important.

32. There are no problems reported for access to the command areas for agricultural activities. However, a new 5.5 m wide, 2 km access road is included in the subproject along with a concrete surface on 0.5km adjacent to Nalam village for dust reduction. The new road section is from HW1 to Ban Xouan, thereby providing a considerably shorter and therefore faster route from the village to local schools, social services and markets in the wider Pek District. At present, it takes over one hour to travel from Pek District to Ban Xouan over a very difficult road, whereas the new distance will be only 8 km which can be covered in about 20 minutes. This will facilitate the development of the village through improved access to off-farm employment, markets, health and other essential services.

33. The road is designed to be 5.5 m wide, with a 200 mm compacted gravel running surface with surface slope of 4% from the centre line. Embankment batters are 1:1.5 in fill and 1:1.05 in cut. There are some very steep gradients and two river crossings using fords over box or pipe culverts. The PAFO Irrigation Section (PIS) has undertaken to adopt the Provincial Public Works and Transport Department (PWTD) standard which includes guideposts, water tables and cross drainage, which are included in the design; the PWTD have approved the road design.

34. The relationship between the large upland catchment and the small lowland irrigation command area is shown in Figure 3. This highlights the areas of potential impact of the subproject and the differences between the two main locations. The variations are dramatic in terms of both terrain and scale. The key environmental issues relate to the water that passes from one to another, its quality and the way that it is used,

35. The subproject fulfils the eligibility criteria listed in Table 2, which provides further information on the scale and context within which it is to be implemented.

F. Subproject Design

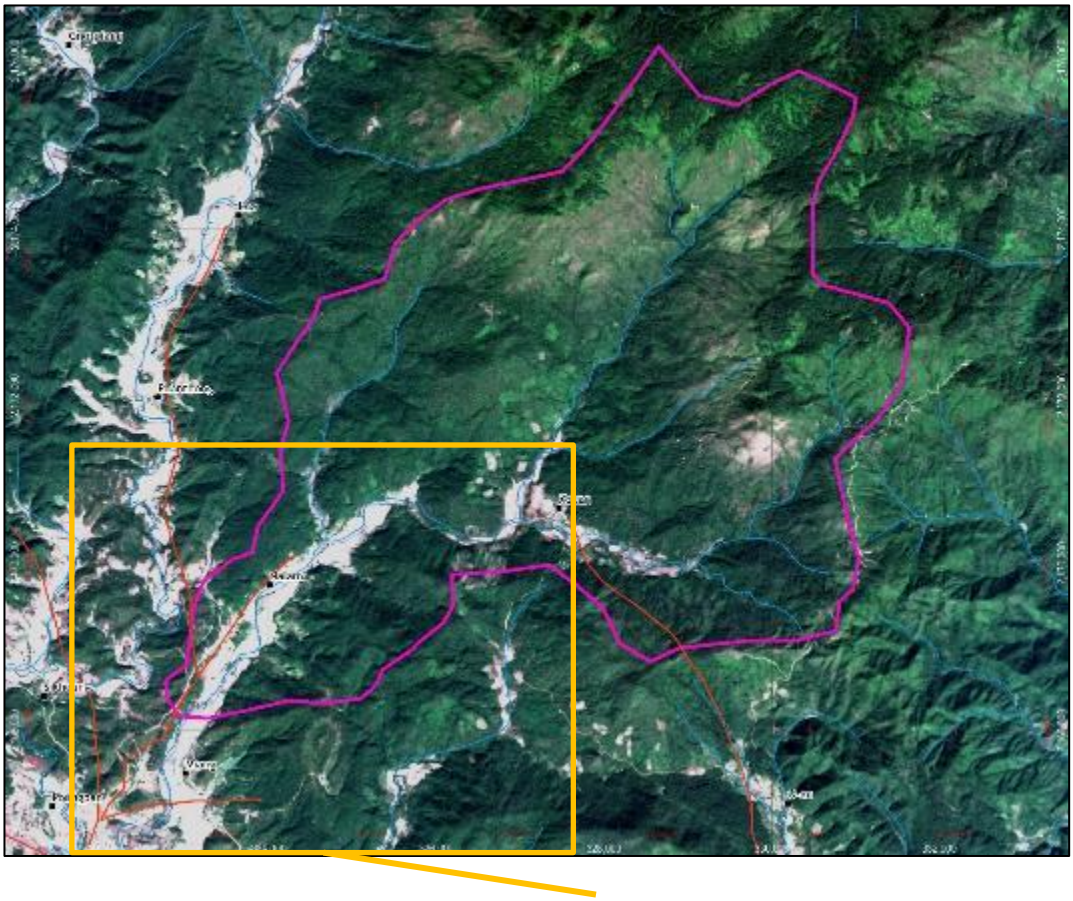
36. The layout of the subproject is shown in Figure 3, which demonstrates the relative locations of the upstream catchment and the downstream command area. It involves the upgrading of an existing wet season irrigation system where there will be future dry season water use. At present the canals contain no flood control measures, so that floods in the river can be transmitted along them and cause damage to both the canal structures. This is especially so for HW 1 however given the investment cost relative to the small command area this investment is unlikely to be justified.

37. The proposed subproject engineering works will consist of the following elements.

(i) Installation of a gabion-protected offtake and piped distribution link to the Ban Suan village.
(ii) Improvement of two headworks, including the installation of fish passes.
(iii) Installation of water control measures to stop floods from the river washing down the canals.
(iv) Repairs and upgrading of the existing canals. These works will include lining in particular.

(v) Construction of 2.5 km of access road along the right bank of the river, above the upper headworks.

Figure 3. Nam Tong Subproject. Top, Water Supply Catchment. Bottom, Distribution Canals and Command Areas.



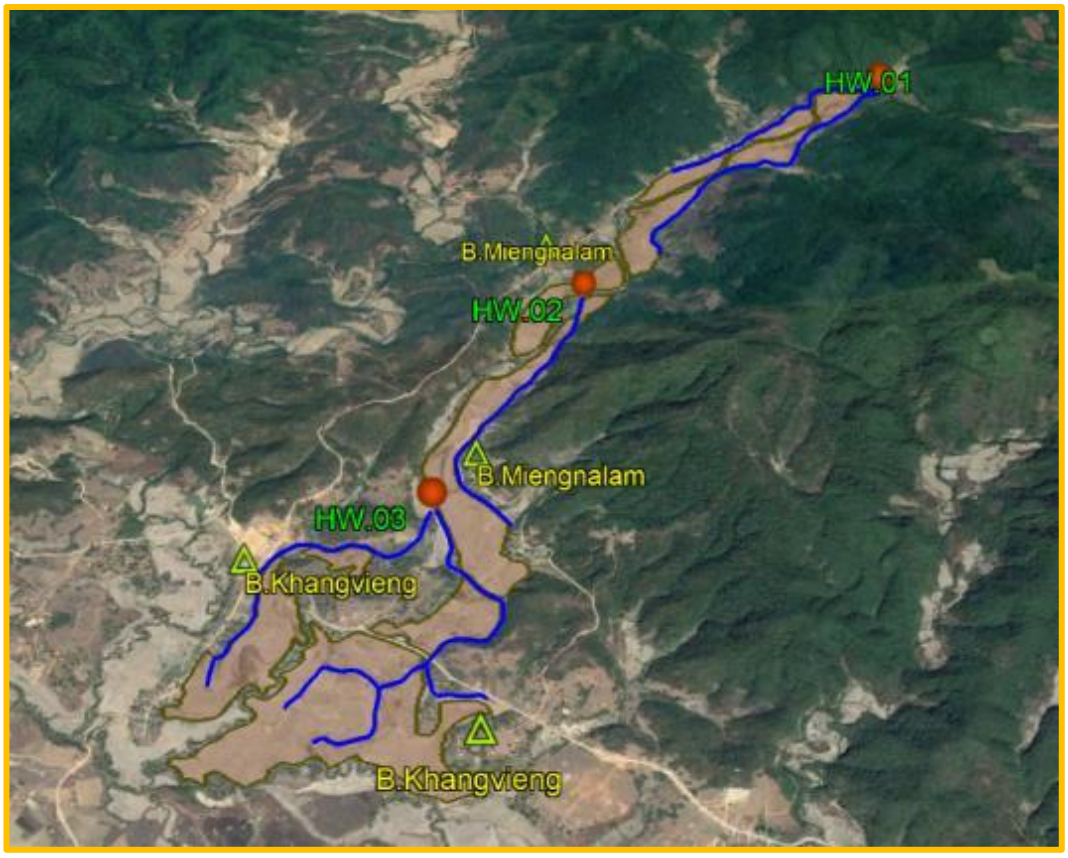

HW.01
B.Mienghalam
HW.02
B.Miengnalam
HW.03
B.Khangvieng
B.Khangvieng

Table 2. Eligibility Check for Nam Tong Subproject

No.	Eligibility Criteria	Nam Tong Subproject
1	**National Strategy.** Be consistent with government strategies and policies.	The subproject supports government agriculture policy.
2	**Socio-economic Relevance.** Be consistent with medium and long-term socio-economic development plans at the provincial and district levels.	The subproject aims to help improve the livelihoods opportunities for the catchment beneficiaries.
3	**Effectiveness.** Have relatively simple and logical designs within one contiguous command area.	It is based on a single distribution system to a command area along one valley.
4	**Safeguards Compliance.** Comply with government and ADB safeguard guidelines and involve a minimum of negative environmental and resettlement impacts, i.e. only MONRE category 1 and ADB safeguard category B or C will be considered. Preference where works are maintained within existing footprint or right of way to minimise land acquisition costs to government.	This IEE confirms that it complies with MONRE category 1 and ADB safeguard category B, and that the anticipated environmental impacts can be satisfactorily mitigated to an acceptable level.
5	**Location 1.** Subprojects must be located in rural areas where the majority of beneficiaries are likely to be dependent upon agriculture for their livelihoods.	The villages of the Nam Tong catchment fit into this category.
6	**Location 2.** Subprojects must not be located in any area where a major development, such as a new hydropower scheme, a mine, major land concession, or a Special Economic Zone, is planned.	No such scheme is known, despite exhaustive enquiries among the government agencies and development partners.
7	**Commitment.** There must be demonstrated local commitment to the subproject with confirmation by beneficiaries (inclusive of women and ethnic groups), participating kumbans[2], and district authorities to that effect, including a confirmed willingness of beneficiaries to contribute land voluntarily for tertiary canals.	This has been expressed verbally and minuted at a number of stakeholder meetings. It will be formalised in signed agreements before the subproject is implemented.
8	**Financial Scale.** The estimated cost of the subprojects must be in the range of $0.7 to $2.0 million (with any exceptions specifically justified).	Detailed costing is not yet available, but the subproject cost is expected to be around the middle of this range.
9	**Productivity.** All proposed subprojects will include more than one type of PRI infrastructure.	Canal improvements and piped distribution are key elements.
10	**Social Conflict.** No significant social conflict in the watershed that will delay investment.	This has not been identified as a constraint during investigations.
10	**No Pumped Schemes.**	No pumping will be involved.

[2] Kumbans are collection of small villages that are aggregated for administrative purposes

No.	Eligibility Criteria	Nam Tong Subproject
11	**Improved Resource Utilisation.** Prioritise the sustainability of assets through WUG or provincial Government to commit to support periodic maintenance through written assurance. Where an existing WUG is operating, the PAFO/DAFO is to obtain written agreement of each stakeholder prior to the field visits.	Options for a sustainable management system have been discussed at a number of stakeholder meetings. The agreed mechanism will be formalised in a signed agreement before the subproject is implemented.

G. Implementation Arrangements

38. The executing agency of the SRIWSM is MAF, with support from the IA - Department of Irrigation (DOI). Implementation is decentralised to the Provincial Agriculture and Forestry Offices (PAFO) where implementation activities will be assigned to the respective sections of PAFO, co-ordinated into a Provincial Project Implementation Team (PPIT) for the management of the SRIWSM Project.

39. The executing agency (i.e. MAF) and IA (i.e. DOI) will establish a Program Governance Team (PGT) that would be responsible for: (i) establishing the operational procedures to be used by the PPIT, including planning, budgeting, financial management, procurement, disbursement, contract management, safeguard monitoring and compliance monitoring; (ii) ensuring both government and donor audit requirements are met; (iii) providing capacity building at the provincial level for both PPIT staff and potential contractors; and (iv) providing technical support for advanced engineering designs and project management teams, including the provision of skill mentoring and technical assistance input to procurement and contract management.

40. Government staff are therefore involved in environmental management and monitoring at a number of levels and in two main ministries: MAF for both management and monitoring; and MONRE as delegated to PONRE for monitoring. The capabilities required of staff varies depending on the phase of the subproject, and their level and remit, but the common thread required by all is a sound understanding of the environment and society in the rural hill catchments of the northern provinces, and a particular understanding of current issues in both upland and irrigated agriculture. PONRE staff have the underlying environmental knowledge but often lack the technical expertise to address specific issues. DONRE staff are far less experienced and qualified. The Loan Implementation Consultants – both international and National will provide (i) Project awareness training, (ii) technical training with respect to environmental monitoring systems and techniques that will apply to their specific subproject (most PONRE have only 3 subprojects to monitor), (iii) PONRE staff receive budgetary support for their additional costs on an output basis ie PAFO will pay for monitoring reports received. In addition, PONRE and DONRE monitoring staff will be supported for regular site visits by the construction supervision staff of PAFO.

41. During the project implementation period, which effectively involves subproject design and construction phases, safeguards are the responsibility of the Vice Governor Office represented by PAFO with support from the PGT within the Department of Irrigation. Environmental safeguards will be assigned through a Memorandum of Understanding (MoU) between the Vice Governor Office, Director of PAFO and Director of PONRE. Additional support is provided by the environmental safeguard consultants in the LIC. The LIC consultants will generate the IEE/EMP or Code of Conduct documentation for approval. PAFO Project management staff, will work with

the construction supervision staff, PONRE and DONRE staff to provide the monthly, quarterly safeguard reports that will be submitted to the Vice Governor, and the EA via the PGT in DOI.

42. At the provincial level, a PAFO will assign overall project management to an existing PAFO Deputy Director General and will implement subprojects. Within each PAFO, the technical staff will be assigned to the PPIT must be able to monitor the implementation of works programs with the supervision role also maintaining both social and environmental checklists for site visits. The submission of safeguard reports to the Vice Governor and to the PGT will trigger a consolidation report from the PGT that will be submitted to ADB twice yearly for review and approval.

43. The division of the responsibilities for environmental safeguards is listed in Table 6.

Table 6. Responsibilities Regarding the Environment and Related Safeguards

Project organisation	Management Roles and Responsibilities
Ministry of Agriculture and Forestry (Executing Agency)	• The EA will constitute a national steering committee with representatives of MAF, Vice-governors of Participating Provinces (4), MOF, MPI and MONRE.
National Steering Committee	• Provide guidance to the IAs and EAs in terms of project scope of work, expected performance standards, remedial action. • Confirm annual performance.
Department of Irrigation (Implementing Agency)	• Support and operate the Program Governance Team. • Provide technical support on irrigation technical and institutional issues. • Consolidation of reports
Department of Planning and Finance (within the MAF)	• Define and validate the project management systems to be applied across the programme to ensure that government and ADB requirements are met. • Verify all subproject draft procurement (including safeguard) documentation prior to be submitted to ADB or publicly advertised. • Undertake a quality control and verification of the quarterly and annual reports that will have document quality control procedures and a sign-off page
Program Governance Team (within the DOI)	• Overall programme management and coordination of separate project investment within the programme. • Define the programme code of conduct including accountability of individuals, authority and levels of delegated authority, jurisdiction and mandate limits. • Produce a project management procedure manual, and the supporting templates, guidelines for planning, budgeting, financial accounts, disbursement, procurement, contract management, reporting, safeguards and audit. • Technical support for setting up project management systems and templates in the Provincial project management units and the required capability to operate these systems • Ensure safeguard frameworks are being applied in the design of subprojects with each safeguard plan (i.e. the

Project organisation	Management Roles and Responsibilities
	Resettlement and Ethnic Minority Development Plan or REMDP and IEE / EMP) at the subproject level, to be reviewed and commented on within 30 working days. • Monitor the safeguard implementation of the REMDP and IEE / EMP during subproject implementation. • Facilitate the development of provincial contractor awareness and capability. • Will ensure that all subproject detailed engineering designs include a first step that confirms dry season water availability for a minimum of 50 percent of the wet season command area and that the social environmental safeguard screening is confirmed as category B under ADB safeguard provisions.
Provincial Steering Committee	• Each Participating Province will establish a Provincial Steering Committee chaired by the Vice-governor, Participating District Governors, Directors General of PAFO, Finance, Planning and Investment, and PONRE. • Review annual work plans and provide guidance on project scope and performance standards.
Provincial Project Implementation Team (within the PAFO / PIS)	• Each provincial government will form a Project Implementation Team under the Provincial Agriculture and Forestry Office (PAFO), aligned to the Provincial Irrigation Section (PIS) within the PAFO. The PAFO will identify implementation focal points in DALAM and DOF to be seconded into the project management structure of the PIT to support activities relating to land use planning, catchment management and land registration administration. • Establish operational systems with staff assigned and with the capacity to maintain the project administration and management systems • Establish and maintain subproject monitoring and impact assessment using the RSP irrigation modernization as a wider learning site • Coordinate the ADB-financed activities and integrate these with the activities of other donor-financed programmes working on watershed management. • Provide quarterly and annual reports according to the templates specified by the Program Governance Team • For the Representative Subproject • Obtain final approval from the Director General of the PAFO in accordance with the Irrigation Law 2014 - (Article 38). • With support of the Program Governance Team identify local contractors and conduct awareness and capacity building programmes to increase the inclusiveness of local contracting companies. • Complete land acquisition and compensation programme as per the REGDP. • Contract management during implementation

Project organisation	Management Roles and Responsibilities
	• Ensure implementation of the Environmental Management and Monitoring Plan. • Ensure implementation of the REGDP action plan. • Safeguard monitoring as per the LARP and REGDP subproject documents. • On project completion as confirmed by the construction supervision consultant (Program Governance Team) the Project Director (PAFO) shall conduct a site inspection in accordance with the Public Work and Irrigation Law. On confirmation of contract completion the PAFO will transfer the operation and maintenance of the asset to the water user group. • For Water User Groups: • Provide awareness and capacity building on project activities, water user group implementation roles and procurement modalities. • Monitor and mentor water user group contracting of in-command area works.
PONRE Land Registration Department	• Conduct land registration. • Issue land title and demarcation.
PONRE Environmental Management Department	• Conduct regular environmental monitoring of subprojects. • Undertake a general programme of monitoring environmental parameters (e.g. water quality) at strategic sample locations throughout the province. • Provide Quarterly monitoring reports to PAFO
MAF – DALAM	• Agricultural land use planning guidelines and verification.
PAFO – DALAM	• Agricultural land registration survey. • Consultation of land users in command areas • Land registration proposal for agricultural land
MAF - Department of Forestry	• Forest Land Use Guidelines and quality verification.
PAFO - Department of Forestry	• Forest Land use zonation and survey demarcation. • Supervision of forestry activities funded by ADB.

44. During the infrastructure operation period, following construction and commissioning, the subproject infrastructure is operated by the Water User Groups. The subproject infrastructure will be handed over to the Water Users' Group at the time of commissioning with government agency only responsible for supporting a general overview role.

45. The environmental monitoring portfolio of the PONRE means that its staff are responsible for ensuring compliance with environmental safeguards under all activities of the subprojects supported by the SRIWSM, and during the subsequent infrastructure operational period, which is indefinite. This role includes review of submitted reports, analysis of the information provided and occasional field visits to verify findings. These staff are responsible for ensuring that the project's environmental impacts really are effectively mitigated, and for flagging up shortcomings in its

strategy if this does not appear to be the case. This takes place both through the PONRE, and at national level, through the ministry itself.

46. Reforms of government to separate the environmental portfolio from agriculture and forestry started in 2017 and are not yet complete. Capacity in this respect is therefore still being developed, particularly at the provincial and district levels. Early in the subproject, the loan implementation consultants will therefore be expected to help improve capacity and assist the government to improve its staff skills and knowledge in this respect. This should include support to PONRE and DONRE staff in their capabilities for environmental monitoring.

a. Water User Groups

47. The subproject WUG becomes the owner of the infrastructure at the time it is commissioned. It then has the responsibility for managing and maintaining it, and ensuring environmental mitigation during the operational period of the infrastructure – which in effect means throughout the lifetime of the engineering works created under the subproject. During the design period, the WUG must be given the support required by its members to understand and commit to implementing operational mitigation measures during their use of the subproject facilities.[3] Further support is required during the later construction period, in the run-up to the handover of the infrastructure. It is likely that the WUG members' capacity will need to be enhanced in order to be able to undertake some aspects of these obligations.

b. Loan Implementation Consultant

48. The project implementation consultant will assist the executing agency (i.e. the PGT within DOI), the implementing agency (i.e. PAFO) and the other project stakeholders in the design and construction of the subproject. For this reason, the Program Governance Team will contract a Loan Implementation Consultant with two environmental specialists- See PAM for detailed ToRs to support subproject designs and the preparation of IEE and for the supporting and monitoring of the EMP during subproject implementation.

49. The LIC environmental specialists work with the WUG, PAFO and DAFO and the contractors for the subproject, to ensure the IEE and EMP are properly implemented, with the required environmental mitigation measures incorporated into the final engineering designs and administrative arrangements in every case. During the construction period, they must work with the subproject implementation partners to ensure that all of the environmental management and mitigation measures are fully complied with, as agreed in each IEE and as outlined in every EMP.

c. Contractors and Subcontractors

50. All contract documents must include an environment section in the terms of reference for bidders, and environmental contract clauses for contractors that include special conditions for the protection of the physical, biological and socio-economic environments. These will underpin the obligations towards the environment that must be upheld by all contractors. There is a need to ensure that contractors, as the stakeholders with the shortest-term involvement in the subproject, do not give rise to long term liabilities for the subproject owners and other stakeholders through reckless practices.

[3] The proposed IFAD project will support WUG capacity strengthening

51. While the contractors themselves must fulfil their environmental responsibilities, in most cases success in this respect requires strict management and supervision of the contractor during site works: this is the responsibility of PAFO. Because of the competitive bidding process and the emphasis on engineering works, there is often a tendency for environmental safeguards to be delayed by contractors in the hope that costs can be saved, and overlooked by management staff as being of lower importance than the primary functional infrastructure. This must not be allowed to happen, or it will mean that the subproject and therefore the overall SRIWSM is non-compliant with respect to both government and ADB safeguards.

52. Additional attention must be paid to subcontractors. It must be made clear to the main contractor at all times that they are fully responsible for the actions of his subcontractors, and that retention money is at risk if there is not full compliance with this plan. The contractor should be encouraged to start this process with an orientation for each subcontractor before they start work, and sub-contractual conditions to ensure that the subcontractor complies. The project implementation consultant should be able to assist the contractor in this process.

d. Summary of Institutional Arrangements

53. The PGT will appoint a qualified environmental safeguards officer to supervise and co-ordinate implementation of environmental safeguard requirements with support of the LIC International and National Environment Specialists. The PGT Project Director will be responsible for submitting environmental safeguard reports to ADB for clearance and disclosure. They will also carry out regular monitoring during implementation and prepare a summary of progress of EMP and GRM implementation for the quarterly project progress reports. They will participate in ADB loan review missions, ensure that semi-annual environmental safeguards monitoring reports are submitted to ADB on time and follow-up on agreed actions.

54. Each PPIT will nominate an environmental safeguards focal point to support LIC Environment Specialists and PGT with co-ordination at the province level. The PPIT environmental safeguards focal point will undertake joint site visits with subproject Supervision Staff and Contractors to review implementation of EMP and GRM and report issues to PGT and LIC. PPIT will co-ordinate environmental quality monitoring with PONRE and invite PONRE to join site visits and ADB loan review missions.

55. The LIC Environmental Specialists (LIC ES) will provide safeguards capacity development training for PGT, PPIT, LIC, Contractors and GRM focal points on EMP mitigation and monitoring measures, Contractor EMP preparation, templates for environmental monitoring and report. LIC ES will screen and assess additional subprojects proposed under Output 3 and any other infrastructure requiring civil works under other outputs and prepare the environmental safeguards reports and ensure that RSP environmental safeguard reports are updated based on detailed engineering design.

56. The Contractor will be required to develop a site-specific Construction Environmental Management Plan (CEMP) in accordance with the IEE/EMP and designate an environmental health and safety (EHS) Officer to supervise and train workers on occupational and community health and safety practices and to monitor and report on implementation of EMP/CEMP and corrective actions. A GRM focal point/community liaison officer should also be designated to ensure public disclosure of planned construction to affected persons and monitoring and reporting on GRM. Each works Contractor EHS Officer will prepare a monthly report on EMP/CEMP and GRM implementation for submission to PPIT, PGT and LIC.

57. The construction supervision staff (CSC) will ensure a CEMP is prepared for each Category B subproject and an Environmental Code of Conduct for each Category C subproject. The CSC will be responsible for day to day monitoring of implementation of health and safety and EMP/Code of Conduct requirements and issuing instructions for corrective actions, as needed.

58. ADB will visit project sites and review project performance against the EMPs and legal agreements and as documented in periodic environment monitoring reports submitted by the PGT. If any of the safeguard requirements that are covenanted in the legal agreements are found not to be satisfactorily met, ADB will require the PGT to develop and implement an appropriate corrective action plan (CAP) agreed upon with ADB. If unanticipated environmental impacts become apparent during project implementation, ADB will require the PGT with support of LIC ES to (i) assess the significance of such unanticipated impacts; (ii) evaluate the options available to address them; and (iii) prepare or update the IEE and EMPs.

H. Analysis of Alternatives

59. During the technical assistance inception period, a large number of possible subprojects were assessed for suitability. In Xieng Khouang Province, as elsewhere, subprojects were proposed by the PAFO for consideration. The consultants used an agreed screening process, which was defined in the technical assistance Inception Report. This led to six subprojects being selected for a short list: these are shown in Table 3. Although these may be funded later as SRIWSM subprojects, at this stage they remain alternatives compared with the subproject that is the subject of this IEE.

Table 3: Subproject Short List – Xieng Khouang Province

District	Subproject	Command Area (ha)		Catchment Area	Villages	House-holds
		Wet Season	Dry Season	(km^2)	(no.)	(no.)
Pek	Nam Tong (1,2,3)	223	105	40	2	624
Pek	Nam Pieng (1,2,3)	87	28	57	3	95
Pek	Nam Kha (1,2,3)	95	33	46	3	90
Khoun	Nam Thot	74	18	x	1	61
Khoun	Nam Ngiew	215	61	92	4	355
Kham	Mouang Kham Floodplain headworks			1,524		
Total		**663**	**245**	**1,759**	**13**	**1,225**

60. The Mouang Kham floodplain headworks potential subproject involves around 300 headworks, of which 40 have been improved.

61. From the short list, one representative subproject was selected for each province. This secondary selection process focused on several parameters. Overall the types of subproject selected were considered in terms of how they reflect those in the wider programme. In addition, they were selected on their ability to demonstrate and pilot aspects of modernised irrigation,

irrigation management, and overall development impact. As such, the Nam Tong subproject will be used in project implementation strategies as a demonstration or pilot site. The site will be used to monitor water use and dry season diversification such that lessons learned can be captured and integrated into Provincial and Project planning.

62. Alternative technical options were reviewed with a preference to use existing infrastructure to the maximum extent possible. As such no additional canals or landtake is required. Headworks weirs will be improved from the environmental perspective by the construction of fish passes. There were no logical alternatives to these options, and so none were given serious consideration.

II. LEGAL AND POLICY FRAMEWORK OF THE IEE

A. Lao PDR Environmental Law and Policy

63. Government policy on environmental protection is expressed in the eighth National Socio-economic Development Plan (SEDP), for the period 2016 to 2020. This builds on the achievements in previous planning periods, including the regularisation of environmental assessment procedures through the widespread use of IEE and EIA, greater use of environmental monitoring and the establishment of five environmental laboratories, including a national laboratory certified to ISO standards. In the eighth SEDP, environmental protection, climate risk and disaster preparedness are effectively mainstreamed by placing them as the third of three major outcomes, albeit behind overall economic growth and the development of human capital. This raising of the profile of environmental issues means that all forms of natural resources development should be sustainable during the plan period, with greater emphasis given to management plans and monitoring, and reinforcing of the "polluter pays" principle through increased taxes of large scale resource users and fines against abusers.

64. Specific policy for environmental management of investment projects is provided in the objectives for the Decree on Environmental Impact Assessment, April 2010, which states that all investment projects may create adverse environmental and social impacts, are to be designed with the correct and appropriate environmental and social impact prevention and mitigation measures or environmental management and monitoring plans (EMMP[4]) and social management and monitoring plans (SMMP).

65. The law governing the protection of the environment, including the assessment and management of projects, is the Environmental Protection Law (EPL) 1999, which is further elaborated on by the Decree on the Implementation of the EPL of 2002. Responsibilities and procedures for environmental assessment, together with requirements for environmental monitoring of projects, were revised and are set out in a new Decree on Environmental Impact Assessment (EIA Decree), dated April 2010.

66. The EIA Decree sets out the principal institutional arrangements, assigning primary responsibility for undertaking environmental assessment of projects to the project developer, which may be an individual or private sector entity as well as a Government Department. In the case of development projects, the relevant line Ministry is responsible to review and assess draft environmental assessments and issue its own approval before submission to the MONRE – formerly the Water Resource and Environment Administration (WREA) – and local

[4] The Government of Lao Environmental assessment requires an EMMP, however the ADB requires an Environment Management Plan (EMP) that is more broadly specified. For this IEE both are covered by the EMP.

administrations, as appropriate. The MONRE is responsible for the review and approval of environmental assessment reports, co-ordination of monitoring and evaluation, and issuance of compliance certificates, acting through the head office in Vientiane or through its provincial departments. Public participation and discussion with local administrations is required throughout the environmental assessment process.

67. The MONRE was created in 2011 by merging the WREA with departments of the National Land Management Authority (NLMA) and portfolios of other ministries including the Geology Department, and the Forest Conservation and Divisions within the Ministry of Agriculture and Forestry (MAF). The MONRE houses the Department of Environment, which hosts the Climate Change Office that acts as the Designated National Authority or national focal point for the UNFCCC. The Department of Forest Resource Management (DFRM) was formed within the MONRE in 2012.

68. Investment projects are categorised according to a schedule to the EIA Decree as follows.

(i) Category 1: small scale investment projects with minor environmental and social impacts, for which initial environmental examination is required;
(ii) Category 2: large scale investment projects which are complicated or create significant environmental and social impacts, for which environmental impact assessment is required.

69. For irrigation projects, those with a command area of between 100 and 2,000 hectares are in category 1, and those with a command area greater than 2,000 hectares are in category 2. The implication is that an irrigation project with a command area less than 100 hectares and with negligible environmental impacts would not qualify as either. In the EIA Decree, where a project is of a type that is not in either category, an investment application is submitted to MONRE for screening. However, because of the nature of the subproject, involving changes in water use and agriculture for the command area where there are identified potential environmental impacts, a discretionary approach has been used in this case, placing it into category 1. The corresponding category in the ADB's classification system is B, which, similarly, requires an IEE (see below).

70. Lao PDR is signatory to the following international environmental agreements. Provisions under these conventions and agreements must therefore be followed in all development activities.

(i) ASEAN Agreement on the Conservation of Nature and Natural Resources.
(ii) Convention for the Protection of the World Cultural and Natural Heritage.
(iii) Agreement on the Cooperation for Sustainable Development of Mekong River Basin.
(iv) United Nations Convention to Combat Desertification.
(v) United Nations Framework Convention for Climate Change.
(vi) Convention on Biological Diversity.
(vii) Montreal Protocol on Substances that Deplete the Ozone Layer.
(viii) Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer.
(ix) Millennium Declaration.
(x) Convention on International Trade in Endangered Species of Wild Fauna and Flora.
(xi) Stockholm Convention on Persistent Organic Pollutants.
(xii) Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention).

(xiii) Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.

71. Several laws and regulatory decrees and directives underpin the national adherence to these international conventions. Examples of these include the following, although this is not an exhaustive list.

(i) Decree on Compensation and Resettlement Management in Development Projects, No. 84, dated 5 April 2016
(ii) Directive on the Prohibition of Hunting and Trading Wildlife and Aquatic Animals, Nationally and Internationally, and of Providing Passage to 3rd Countries, No. 76/MAF, dated 2 June 2002
(iii) Law on Chemical Management No. 07/NA, dated 10 November 2016
(iv) Decree on Pesticide Management, No. 258 /GOV, dated 24 August 2017
(v) Regulation on Control of Pesticides in Lao PDR, No. 2860/MAF, dated 11 June 2010

72. The EIA Decree sets out in detail the procedures, rights and responsibilities for the preparation and approval of IEE, and the preparation, approval, implementation and verification of EMP.

B. ADB Environmental Policy

73. ADB's environmental policy is described in its Environment Safeguards: a Good Practice Sourcebook – Draft Working Document, dated December 2012. This provides guidance for implementation of the Environmental Assessment Guidelines (2003)[5]. In turn, these go into considerable detail on a number of issues which must be incorporated into the EARF and IEE documents. Key among them is the initial screening of projects, which leads to the following three categories.

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works.

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts are less adverse than those of Category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects.

Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.

C. Categorisation of the Nam Tong Subproject

74. The Nam Tong Subproject was screened using the criteria summarised in Table 4a, with the results shown in Table 4b, which forms part of the review process described in the EARF. The screening resulted in classification of the subproject as MONRE category 1 and ADB

[5] See Paragraph 6, ADB Environment Safeguards: a Good Practice Sourcebook – Draft Working Document, dated December 2012

category B. The irrigated command area is less than 2000 hectares. There will be environmental impacts of a number of types, but the likely impacts are expected to be reversible and can be mitigated. This means that an IEE is required for the subproject, and this document has been duly prepared.

D. Environmental Standards

75. The government published its National Environmental Standards in 2017 superceding the 2010 standards. The SRIWSM will apply the Lao Ambient standards. These cover air quality, water quality, noise and vibration in considerable detail. The project uses these standards as appropriate as part of its safeguarding programme, and they are incorporated into this subproject IEE.

76. Standards are not yet defined by government for a number of practical environmental management measures. To ensure that each subproject maintains best environmental practices, a number of additional guidelines have been defined. These are listed in the accompanying EMP. They cover a wide range of construction site management issues to help ensure compliance by contractors and are to be used throughout the subproject to underpin the environmental mitigation measures adopted in the EMP.

77. The World Bank Group Environment, Health and Safety General Guidelines (2007) also provide indicative standards designed for use in an international setting where national standards are not fully developed. Elements of these have been adopted in the project-specific guidelines listed in the EMP.

Table 4a: Environmental Appraisal Categorisation Checklist

Screening issue	Outcome
1. Will the subproject involve an irrigation command area of more than 2000 hectares?	• If "yes", then it qualifies as MONRE category 2 (ADB category A) and cannot be supported. • If no, then address all of the questions below.
2. Will the subproject involve an irrigation command area of more than 100 hectares? 3. Might the siting of the subproject cause the removal of native trees and shrubs? 4. Might the site of the subproject be affected by climate conditions including extreme weather-related events such as floods, droughts, storms or landslides? 5. Will the subproject cause alteration of surface water hydrology that might result in increased sediment in streams? 6. Will there be bare surface at the construction site that might give rise to soil erosion? 7. Might silt and waste runoff from construction lead to a deterioration of surface water quality?	• If the answer to any one of these questions is "yes" **and** the potential adverse impacts are likely to be significant, irreversible, diverse or unprecedented, then it qualifies as MONRE category 2 (ADB category A) and cannot be supported.
8. Might there be increased air pollution due to subproject construction and operation? 9. Might there be increased noise and vibration due to subproject construction and operation? 10. Might the subproject or its construction generate solid waste or hazardous waste? 11. Might chemicals or fuels be stored and used for the subproject or its construction? 12. Might wastewater be produced during subproject construction or operation? 13. Might there be construction dust and erosion from earthworks?	• If the answer to any one of these questions is "yes", but the likely impacts are reversible and can be mitigated, then it qualifies as MONRE category 1 (ADB category B) and requires an IEE (see Environmental Assessment and Review Framework).
14. Might there be any loss of habitat or micro-habitat for local biodiversity? 15. Might there be changes to local drainage? 16. Might the subproject involve an excessive use of local water resources? 17. Might the subproject lead to water use conflicts? 18. Might the subproject cause cumulative impacts on limited water resources? 19. Might the construction and use of access roads be close to and affect residences, waterways or other facilities due to dust, noise or runoff? 20. For agricultural components, might there be transport, storage, handling and use of materials, and inputs of seeds, seedlings, fertilisers and pesticides? 21. Might there be increased residues of plastics, including mulch materials, in soil and water?	• If the answer to all of these questions is "no", then it does not fall into a MONRE category (but fits ADB category C), it requires an investment application that must be covered by the Environmental Code of Conduct (see Environmental Assessment and Review Framework).

22. Will soil conservation and management risks be increased or important for the sustainability of the infrastructure 23. Will the subproject increase the use of pesticides? 24. Will fertiliser use increase with the diversification and intensification of irrigated cropping? 25. Will there be a change greenhouse gas emissions? 26. Will there be increased risks to occupational safety and health from physical, chemical hazards including UXO? 27. Will there be changes to the Community Safety and Health risk arising from traffic and vehicle movement, in-migration of labor, and chemical use?	

Table 4b: Environmental Appraisal Categorisation Checklist Completed for Nam Tong

Screening issue	Finding
1. Will the subproject involve an irrigation command area of more than 2000 hectares?	• No.
2. Will the subproject involve an irrigation command area of more than 100 hectares?	• Yes, it involves the rehabilitation of two headworks, together supplying existing command areas totalling 173 ha.
3. Might the siting of the subproject cause the removal of native trees and shrubs?	• Not anticipated.
4. Might the site of the subproject be affected by climate conditions including extreme weather-related events such as floods, droughts, storms or landslides?	• Yes. This aspect is covered in detail in the project's CRVA, with appropriate climate resilience measures put in place.
5. Will the subproject cause alteration of surface water hydrology that might result in increased sediment in streams?	• No.
6. Will there be bare surfaces at the construction site that might give rise to soil erosion?	• Yes, but this will be carefully controlled through the EMP.
7. Might silt and waste runoff from construction lead to a deterioration of surface water quality?	• Yes, but this will be carefully controlled through the EMP.
8. Might there be increased air pollution due to subproject construction and operation?	• Yes, but this will be carefully controlled through the EMP.
9. Might there be increased noise and vibration due to subproject construction and operation?	• Yes, but this will be carefully controlled through the EMP.
10. Might the subproject or its construction generate solid waste or hazardous waste?	• Yes, but this will be carefully controlled through the EMP.
11. Might chemicals or fuels be stored and used for the subproject or its construction?	• Yes, but this will be carefully controlled through the EMP.
12. Might wastewater be produced during subproject construction or operation?	• Yes, but this will be carefully controlled through the EMP.
13. Might there be construction dust and erosion from earthworks?	• Yes, but this will be carefully controlled through the EMP.
14. Might there be any loss of habitat or micro-habitat for local biodiversity?	• No biodiversity habitat of significance will be affected.
15. Might there be changes to local drainage?	• Only on the irrigated land, which will be managed carefully. The drainage along the 2.5 km of road will be carefully designed.
16. Might the subproject involve an excessive use of local water resources?	• Unlikely, as there is currently adequate water for all known uses.
17. Might the subproject lead to water use conflicts?	• Unlikely, as there is currently adequate water for all known uses.
18. Might the subproject cause cumulative impacts on limited water resources?	• Unlikely, as there is currently adequate water for all known uses.
19. Might the construction and use of access roads be close to and affect residences, waterways or other facilities due to dust, noise or runoff?	• Yes, there will be a road close to the Nam Tong, connecting a village to the highway. The drainage will be carefully designed.
20. For agricultural components, might there be transport, storage, handling and use of	• Yes, but it is expected that this will be better controlled through

materials, and inputs of seeds, seedlings, fertilisers and pesticides?	additional capacity building of PAFO staff.
21. Might there be increased residues of plastics, including mulch materials, in soil and water?	• Not expected
22. Will Soil Conservation and Management risks be increased	• No – substantial gains are likely
23. Will the subproject increase the use of pesticides	• Command area pesticide use is likely to increase although the crop type and chemical used may change
24. Will fertiliser use increase	• Based on expected cropping the fertiliser use will increase during the dry season
25. Will there be a change in greenhouse gases	• Unknown likely to be minimal, with increased cultivation during the dry season, however improved soil conditions will reduce wet season cultivation
26. Will there be increased risk to occupational safety and health from physical and chemical hazards including UXO	• Occupation risks will increase for areas not previously dry season cropped with additional canal structures, upper catch UXO exposure is however possible and will require prior Provincial certification of UXO clearance
27. Will there be changes to the Community Safety and Health Risks from Traffic and vehicle movement, in-migration and chemical use	• Construction vehicle risks will increase due to local construction, migrant labor risks to community will be low but need to be managed, chemical exposure from agrichemicals from dry season intensification will occur

III. DESCRIPTION OF THE SUBPROJECT ENVIRONMENT

A. Topography and Geology

78. The underlying geology of Xieng Khouang Province is mainly a mixture of ancient igneous and metamorphic rocks with some dominant bands of Silurian and Cambrian rocks set in a strong conformity from north-west to south-east, between bands of younger rocks. It is a complex structure, and although there are no major regional faults, there has been major folding which means that surface-outcropping geology is very variable, particularly across an east-west transect in the central part of the province where the Nam Tong catchment is located. Tectonically it is stable, and the generally rounded hill tops and slopes show more the effects of prolonged weathering rather than those of mass slope movements. Geotechnically, slopes formed in the older rocks should be strong, but there may be weaknesses – and a potential to landsliding – in the limited areas of younger and weaker sedimentary rocks. Major slopes, even in the stronger rock types, might have superficial layers of colluvium that could give rise to shallow slope failures. It should be noted that this area of higher ground is the result of the harder rocks that lie to the north of the main weathered plateau of Xieng Khouang, which occupies much of the southern part of the province.

79. The topography of the Nam Tong catchment is shown in Figure 4. The source of the river is through a series of tributaries that rise in the high ground on the eastern, northern and southern sides of the catchment. Within the upper valley, the terrain is steep, with convex slopes falling to a narrow valley bottom. Lower down, the valley bottom broadens out, giving the flatter lowland that makes irrigated agriculture possible.

Figure 4: Topographic Map of the Nam Tong Catchment. The Grid is at 1 km

B. Soils, Vegetation Cover and Land Utilisation

80. Soils in the area are mostly Acrisols. These are heavily weathered, clay-rich tropical soils that are usually moderately acidic and can have high contents of iron and aluminium, and relatively low fertility. In the lower-lying locations, where soil drainage is limited, soils are subject to waterlogging and therefore have the characteristics of Gleysols (i.e. soils subject to seasonal changes in saturation, and consequently the aeration and oxidising or reducing conditions that strongly dictate the growing conditions for plants. Luvisols also occur in some parts of the landscape, showing heavy leaching and the displacement of clay.

81. A comparison was made of 2010 and 2018 satellite imagery to assess the general land utilisation and the trends over the last eight years. Based on this interpretation, the areas of different land cover were calculated as shown in Table 5, as mapped in Figure 5.

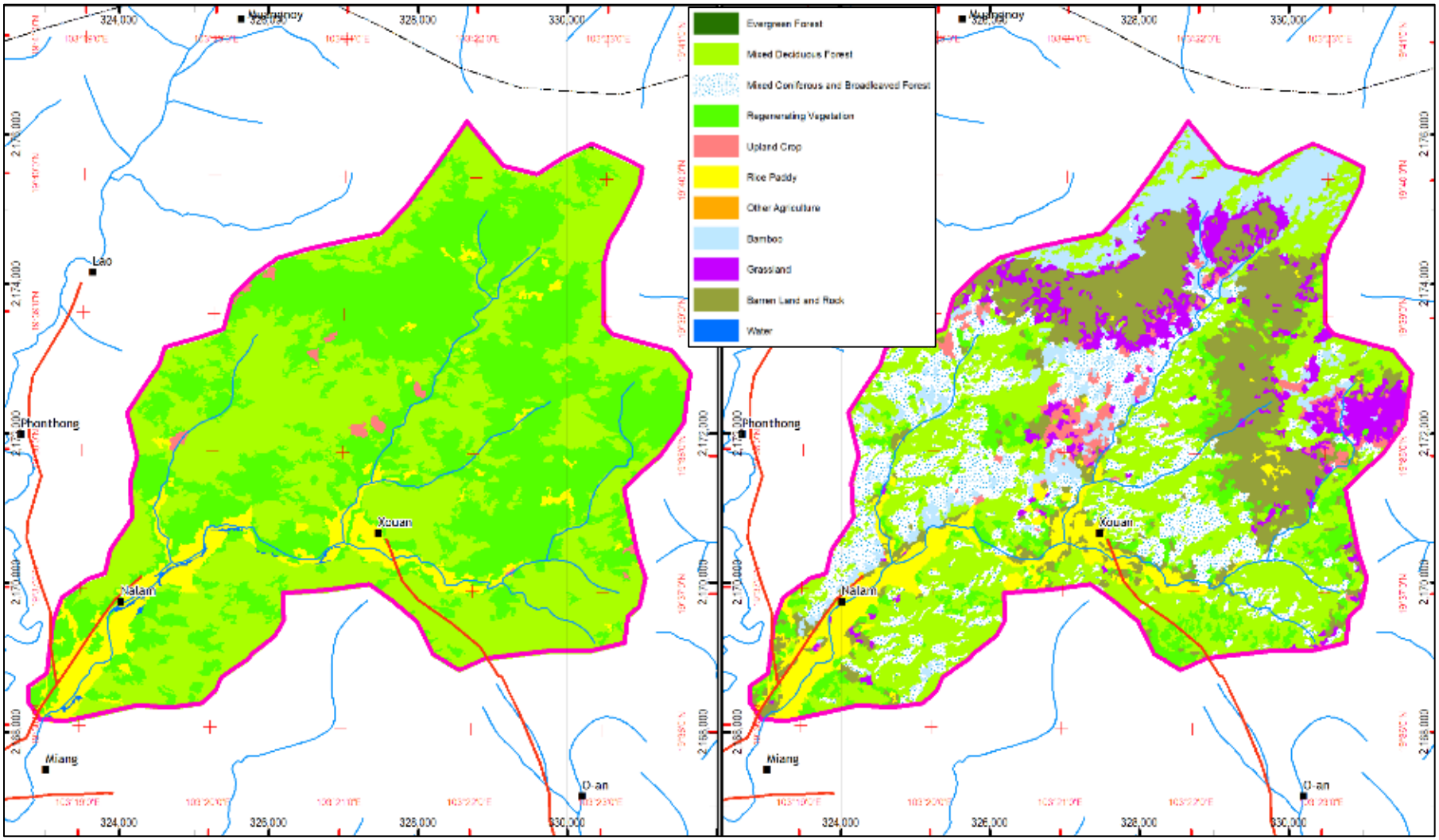
Table 5: Defined Land Use Areas based on Satellite Imagery Interpretation

Land Use	Area 2010 (ha)	Area 2018 (ha)	Variation (ha)
Mixed deciduous forest	1,918	1,321	-597
Mixed coniferous and broadleaved forest	0	702	702
Bamboo	0	358	358
Regenerating vegetation	1,771	298	-1,473
Grassland	0	275	275
Upland agricultural cropping	22	95	73
Rice paddy	271	272	1
Barren land and rock	0	709	709
Water	9	0	-9
Total catchment area	3,991		

82. The catchment had been subject to heavy use before 2010, with nearly half of the mixed deciduous forest already cleared and replaced by regenerating vegetation. Interpretation of the mapping suggests that, between 2010 and 2018, the following changes appear to have occurred in the Nam Tong catchment.

- There seems to have been very little upland cropping active in 2010, and at 95 hectares in 2018, this still amounted to only just over 2 percent of the catchment.
- Poor image quality in 2010 means that the interpretation and detail are not as good as for 2018. Almost half (48 percent) of the catchment was classified as mixed deciduous forest in 2010. From the 2018 imagery, it was possible to distinguish between two forest types, and perhaps some of the regenerating areas could now be classified as forest. By 2018, a little more of the catchment (51 percent) was classified as forest.
- The 2018 imagery shows some 709 hectares of the catchment to be bare ground. Most of this is actually grassland in effect, but with considerable presence of *Eupatorium* and *Pteridium* that presumably give a different spectral signature to the areas shown as grassland. Also, in the central-eastern part of the catchment are two high mountain tops, at about 2000 metres, which include some exposed rock and other naturally bare ground, which for some reason did not show up in the 2010 interpretation. The area of land that can be grazed by cattle is probably about 900 hectares, with the remaining areas classed as bare ground being around 80 hectares, mostly recently cleared for cultivation.
- In 2010, about 1770 hectares was classed as fallow or regenerating vegetation. By 2018, this had been reduced by almost half, but is now reclassified as grassland, bamboo and regenerating vegetation.
- The area of paddy remains unchanged at 272 hectares, which at 7 percent is a relatively large proportion of a hill catchment and reflects the broad, flat valley bottom.

Figure 5. Interpretation of Land Utilisation in the Nam Tong Catchment: left, 2010; right, 2018.



C. Climatic Conditions

83. There are no weather data specifically for the Nam Tong catchment, so climate must be considered at the provincial scale. Xieng Khouang as a whole has a humid tropical climate, being situated between 19.5 and 21.0 degrees north of the equator. Average temperatures are generally in the range of 15 to 30 degrees centigrade throughout the year in the lower valleys. Temperature declines with elevation, to the extent that the higher elevation of even the lowland command area of the Nam Tong would be a few degrees cooler than this – typically in the range of 12 to 26 degrees. The upland at the head of the mountain catchment has a temperature regime about five degrees cooler than the valley bottom, so perhaps typically in the range of 8 to 22 degrees. The subproject area might therefore be considered to have an altitude-induced subtropical climate.

84. Moisture is dominated by seasonal air movements, with most rainfall coming with the south-west monsoon during June to October. Simply put, the northward migration of the sun draws warm, moist maritime air from the Indian Ocean across the land masses of south and south-east Asia. Rainfall varies across Laos, but Xieng Khouang is in a moderate rainfall belt. The one weather station in the Province, at Thonghaihin, shows an average annual rainfall of 1,470 mm over a data period of 35 years. The range of annual totals recorded over the same period shows variations between 1,000 and 1,900 mm. This is a considerable variation, being about 30 percent either side of the mean. Monthly and annual rainfall figures are given in Figure 6.

85. The pattern is for increasing rain as pre-monsoon warming gives rise to convective cells that produce thundery downpours through March, April and May. The monsoon arrives in June, typically without an increase in that month as it gets established. The rainfall is highest – typically 280 to 300 mm per month – in July and August. The monsoon weakens in September and dissipates through October, with the last substantial rain clearing usually in that month. This leads into the pronounced dry season from November to February. However, this pattern can be altered in any year by the passage of tropical cyclones, usually affecting Laos from the South China Sea: these are discussed below.

86. The annual spread of rainfall can be seen by the data on the number of rainy days per month, given for the same weather station in Figure 7. These data cover only six years, and so cannot be relied on to give a very clear view of the situation, but nevertheless show the general pattern. Although it is rare for there to be no rain in a month, periods can be seen where there is very little: for example, with rain on only two days, there was only 22 mm in the 90-day period from 1 January to 31 March 2014, presumably giving a significant drought. By contrast, it is rare for there to be rain on less than half the days from May to September inclusive, and quite common for there to be only five dry days in some months between June and August.

87. Rainfall intensity data are scarce, but the maximum 24-hour rainfall totals are given for six years in Figure 8. In general, these show the same pattern of greater amounts during the summer monsoon. The usual feature is that up to half a month's rain can fall in a single 24-hour period. Although the monsoon is the time with the most rain, in most parts of Lao PDR it seems that the really heavy downpours are the result of tropical storms penetrating right across Viet Nam. However, the short data set from Thonghaihin does not show evidence of this. The pattern shown here is for daily rainfall of 60 to 80 mm to be possible in any month, presumably as a result of intense thunderstorms or monsoon downpours. The one value that stands out is the 24-hour rainfall of 138 mm in June 2011, which could have occurred as a result of Typhoon Haima (see below in the section on climate risk assessment).

88. The Climate Risk and Vulnerability Assessment gives a more thorough analysis of the risk and impacts of tropical cyclones, but it is important to consider the key factors in an IEE. The tracks and effects of typhoons across south-east Asia have been well documented over recent decades. There is variability between years, and tropical cyclones can develop into typhoons in every month of the year, with many of these penetrating as far west and inland as Laos. The subproject design needs to be able to accommodate exceptional flows of at least the amounts likely to be derived from these weather systems. The implication is that, if in only six years of data there has been an incidence of almost 140 mm in a 24-hour period, there is a strong possibility that such a figure could be exceeded over a longer time period. This is also only for rainfall collection periods, and obscures possibly greater amounts of rain within 24 hours but split between two daily recording periods. Data are also not sufficient to ascertain cumulative heavy rainfall prolonged over a 48- or 72-hour period, and the effects of this on flood or landslide events. There are no parallel river level data to link with rainfall.

Figure 6: Monthly Rainfall (mm) at Thonghaihin, Xieng Khouang Province

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	5.6	1.1	162.4	158.3	145.9	200.6	105.3	384.8	300.0	26.2	21.9	0.0	1,512.1
1983	37.9	9.7	34.6	78.9	157.5	71.2	225.6	300.4	40.1	74.9	8.6	9.5	1,048.9
1984	0.0	96.7	81.5	136.3	129.0	145.3	210.1	461.3	199.3	85.7	36.8	0.0	1,582.0
1985	21.0	9.8	8.3	107.6	166.8	187.3	330.9	316.3	194.8	89.3	39.0	0.0	1,471.1
1986	0.0	2.5	7.8	144.4	426.6	241.2	328.3	170.8	123.3	15.2	3.3	24.5	1,487.9
1987	0.0	34.5	17.5	180.2	144.4	221.9	191.0	223.4	119.3	48.1	6.5	0.0	1,186.8
1988	0.0	128.0	2.0	181.0	291.4	187.1	155.3	314.6	125.7	102.7	1.1	0.0	1,488.9
1989	4.1	0.0	165.0	151.3	96.7	224.4	308.5	177.3	146.9	128.0	0.8	0.0	1,403.0
1990	0.0	30.0	63.0	92.6	179.3	233.6	387.5	245.8	141.2	45.3	7.4	0.1	1,425.8
1991	3.7	0.0	12.4	233.6	211.2	314.0	278.9	376.8	130.0	42.5	2.6	8.4	1,614.1
1992	42.0	36.1	0.0	83.5	45.9	174.7	222.6	199.2	129.4	29.3	0.0	54.4	1,017.1
1993	0.0	0.6	21.4	92.4	222.7	236.1	338.3	207.8	134.8	25.5	0.4	6.2	1,286.2
1994	0.0	25.3	143.4	135.0	177.9	216.5	269.2	268.2	131.4	139.0	46.1	11.0	1,563.0
1995	0.6	0.0	7.4	127.7	182.4	198.9	455.9	371.7	32.2	60.6	24.6	0.0	1,462.0
1996	0.0	14.8	45.9	199.6	221.6	226.7	264.6	437.1	138.6	52.2	58.2	0.0	1,659.3
1997	14.9	2.8	176.6	330.9	237.8	142.4	280.9	308.0	118.7	121.8	0.3	0.0	1,735.1
1998	0.3	6.4	53.7	154.2	118.2	176.8	194.1	230.7	145.4	25.8	6.1	3.1	1,114.8
1999	4.9	0.0	54.0	116.8	212.2	209.4	147.3	407.4	125.1	46.0	22.9	17.0	1,363.0
2000	0.0	46.8	7.2	206.5	312.8	198.5	337.2	204.9	137.5	96.4	2.1	0.0	1,549.9
2001	0.0	0.0	182.7	65.6	205.3	182.0	286.9	288.1	374.5	173.0	50.5	8.6	1,817.2
2002	45.6	4.6	25.2	167.3	323.6	222.5	418.2	263.3	101.8	18.9	130.0	64.4	1,785.4
2003	8.8	5.8	88.1	119.6	82.9	126.9	211.7	257.0	164.1	24.7	0.0	0.0	1,089.6
2004	17.9	18.9	15.7	183.4	184.9	79.2	272.2	380.8	195.0	0.0	23.9	0.0	1,371.9
2005	0.0	11.7	4.9	96.6	222.9	256.7	381.2	428.9	276.6	8.1	35.7	9.3	1,732.6
2006	0.0	17.1	97.3	134.4	236.1	132.0	302.5	281.8	100.9	108.8	0.0	0.2	1,411.1
2007	0.0	7.8	18.6	81.9	154.7	95.4	122.5	182.4	219.3	122.5	1.4	0.0	1,006.5
2008	22.3	23.8	81.7	264.8	159.7	278.4	372.9	455.4	135.8	34.4	54.5	12.9	1,896.6
2009	0.3	0.0	64.3	77.5	269.2	104.0	455.4	167.1	126.8	53.3	0.0	0.0	1,317.9
2010	75.2	0.0	3.6	89.0	192.6	219.9	319.5	301.2	135.0	24.0	2.2	0.0	1,362.2
2011	1.4	0.8	187.8	108.6	289.0	386.2	284.9	248.9	142.4	23.0	8.8	1.4	1,683.2
2012	6.6	5.7	14.8	183.0	166.6	154.4	290.1	376.0	165.3	78.8	108.0	8.8	1,558.1
2013	9.3	9.2	33.5	133.0	232.1	413.3	386.1	420.0	108.2	22.6	77.8	71.9	1,917.0
2014	0.0	0.0	29.6	282.1	128.4	111.0	345.2	281.0	346.0	64.0	34.7	2.6	1,624.6
2015	30.3	2.0	106.0	184.8	133.9	137.8	312.9	406.6	88.5	126.1	102.9	114.3	1,746.1
2016	107.3	0.6	33.8	70.7	106.6	95.0	154.1	291.5	214.9	80.2	79.5	11.2	1,245.4
2017	12.1	0.0	31.4	137.8	153.4	125.3	379.1	217.1	189.8	82.2	2.0	24.4	1,354.6
Mean	13.1	15.4	57.9	147.0	192.3	192.4	286.9	301.5	158.3	63.9	27.8	12.9	1,469.2
Minimum	0.0	0.0	0.0	65.6	45.9	71.2	105.3	167.1	32.2	0.0	0.0	0.0	1,006.5
Maximum	107.3	128.0	187.8	330.9	426.6	413.3	455.9	461.3	374.5	173.0	130.0	114.3	1,917.0

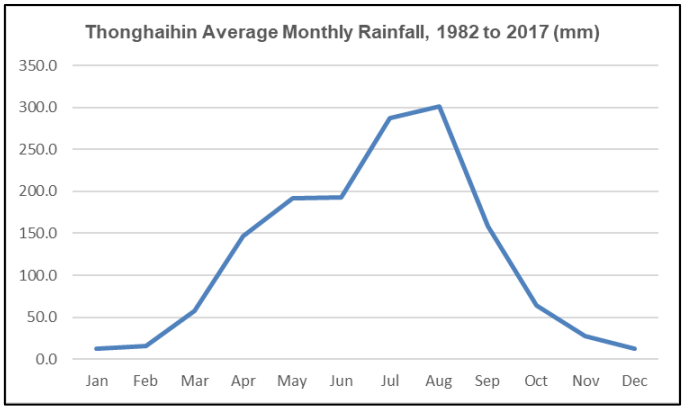

Thonghaihin Average Monthly Rainfall, 1982 to 2017 (mm)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Figure 7: Number of Days with Rain by Month, 2011 to 2017, at Thonghaihin

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2011	2	2	10	17	23	27	20	22	22	5	2	1	153
2012	3	3	4	16	23	21	24	30	15	7	15	2	163
2013	2	1	5	10	19	21	25	26	15	9	7	2	142
2014	0	0	2	23	20	18	27	21	21	8	5	4	149
2015	4	1	5	14	20	17	24	27	21	11	11	8	163
2016	5	3	2	6	16	16	20	20	18	8	7	2	123
2017	*4*	*0*	*7*	*10*	*16*	*18*	*24*	*21*	*22*				*122*
Average	2.7	1.7	4.7	14.3	20.2	20.0	23.3	24.3	18.7	8.0	7.8	3.2	148.8

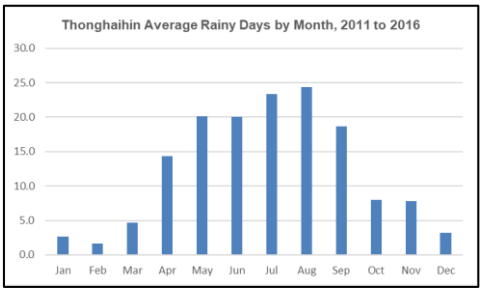
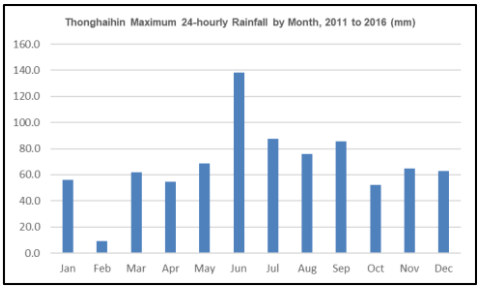


Figure 8: Maximum Daily Rainfall (mm), 2011 to 2017, at Thonghaihin

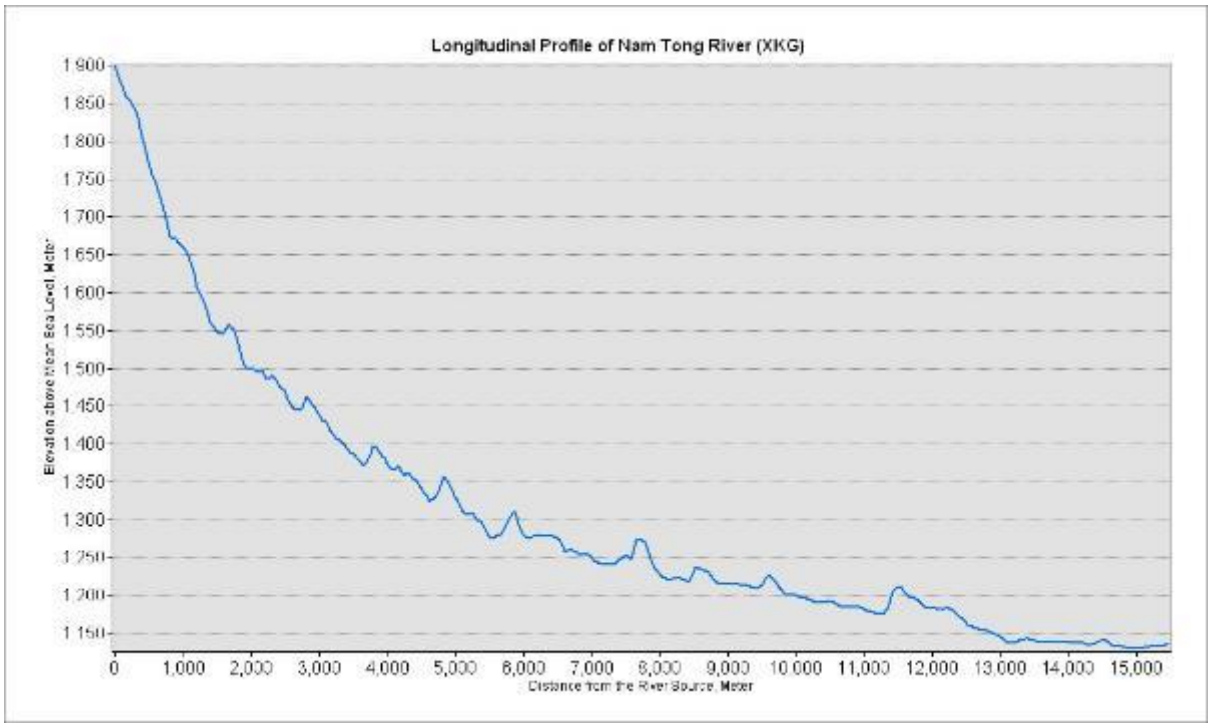
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	1.2	0.7	61.7	28.2	54.7	138.2	49.8	38.0	31.1	8.2	8.6	1.4
2012	4.7	5.3	8.2	52.7	55.3	39.1	49.9	40.0	69.4	52.0	46.0	7.0
2013	7.2	9.2	16.7	54.7	68.9	98.3	87.5	73.3	49.8	8.2	64.8	63
2014	0.0	0.0	21.7	43.4	25.8	37.2	70.6	40.4	85.7	28.6	19.5	1.0
2015	14.1	2.0	54.2	52.9	28.5	26.6	63.5	68.3	16.3	51.4	50.5	53.3
2016	56.2	0.3	31.7	32.8	37.0	24.5	46.3	75.8	74.0	23.1	22.9	8.4
2017	*4.8*	*0*	*14.6*	*27.9*	*37.7*	*33.6*	*79.2*	*35.4*	*46.1*			
Maximum	56.2	9.2	61.7	54.7	68.9	138.2	87.5	75.8	85.7	52.0	64.8	63.0



D. Water Resources

89. The Nam Tong forms a steeply falling hill catchment in its upper reaches – the southern third of the valley – but then the river flattens considerably and has a relatively gentle gradient down the valley. Hence the southern two-thirds of the valley has a slowly dropping thalweg, as shown in Figure 9, but sometimes has steep side slopes. The catchment area above the headworks that will be built by the SRIWSM subproject covers 50 km^2, and this area is to be subject to interventions by the project's watershed management plan.

Figure 9: Longitudinal Profile of the Nam Tong; the Upper Headworks is at about 1200 metres Elevation, around 10 km from the Top of the Catchment



90. The flows in the Nam Tong River follow the rainfall pattern with the mean highest flows being in July and August and lowest flows in late March. There is no flow recording station installed on river.

91. Estimates were made of the flows in the Nam Tong River on 10 February 2018 during a visit by the TRTA team. Flows observed were 1.53 m^3/s at Headwork 1, 1.45 m^3/s at Headwork 2 and 1.31 m^3/s at Headwork 3. Flows were again estimated on 3 April 2018 by the PIS survey team and were 0.38, 0.37 and 0.31 m^3/s respectively. The PIS reported that there had been no significant rain in March, and so this variation over a six-week dry period provides a good indication of the natural recession and lowest flows.

92. The PIS reported that at the time of the surveys, water was being diverted into the canals from Headworks 1 and 2, and that their flow estimates at both Headworks 2 and 3 were net of the upper diversions. Using this data the TRTA assesses there to be sufficient water at each site for the cultivation of mixed field crops over the full command area in the dry season. Peak demands expected are 52 l/s (0.052 m^3/s) in Ban Xuan, 54 l/s (0.054 m^3/s) at Headwork 1, 46 l/s (0.046 m^3/s) at Headwork 1.1, 99 l/s (0.099 m^3/s) at Headwork 2 and 244 l/s (0.244 m^3/s) at Headwork 3. This implies a total demand of 0.495 m^3/s for irrigation.

93. Based on the water demand for a wet season crop of KKN rice, there is sufficient flow to meet the peak irrigation demand and still leave sufficient water in the Nam Tong for environmental purposes. Climate change predictions suggest a potential for increased drought frequency and longer duration which will impact on the recession flows in the rivers and on scheme management. The peak irrigation daily water demand is likely to remain largely unchanged but the duration for peak irrigation demand may be extended. Decreased minimum flows can be expected, but

continuing gains in irrigation efficiencies are expected to be made during implementation. It is expected that efficiency gains will mitigate climate change impacts and prevent having to reduce the cropped areas in the longer term.

94. The highest rainfall recorded in Xieng Khouang in the short period for which 24-hour maximum rainfall records are available (2011 to 2017) was 138 mm on 24-25 June 2011, during Typhoon Haima (Government of Lao PDR, 2011). In Xayaboury, Haima gave rise to 200 mm of rain within a 24-hour period, which is taken to be a 1-in-50-year event (P2%). Extrapolating the known rainfall data for Xieng Khouang, coupled with the record from Haima and using simple probability, the 24-hour rainfall maxima determined for estimating river flows for the P2% and P1% (i.e. 1-in-100-year) events are 198 mm and 222 mm respectively. Based on these, the flood flows for the Nam Tong as estimated using the SOKOLOV empirical method are as shown in Table 6. In addition, the probable maximum flows were also estimated for use as check flows in assessing the headworks for potential inundation and damage areas.

Table 6: Estimated Flood Flows for the Nam Tong

Location	Catchment Area (km^2)	P2% Flood Flow (m^3/s)	P1% Flood Flow (m^3/s)	PMF Flood Flow (m^3/s)
Nam Tong weir 1	28.5	95	126	229
Nam Tong weir 2	39.0	117	156	268
Nam Tong weir 3	41.1	123	164	282

95. The ongoing ADB funded Northern Rural Infrastructure Sector (NRI-AF1) project has adopted the historical P2% flood flow as the design standard for all weirs irrespective of catchment area. To allow for project impacts from climate change, NRI includes a 20% “capacity safety factor” in the key hydraulic capacities of their designs (as stated in the Aide Memoire of the Inception Mission, 20 to 31 October 2017, paragraphs 35 to 37). A preliminary assessment of the impacts from increased rainfall intensities and durations by the TRTA used a comparison with adjustment factors for maximum daily rainfall totals under RCP8.5 Climate Change Scenario Projections for the period 2016 to 2035 relative to the baseline period from 1986 to 2016 for neighboring provinces in Vietnam (source: ADB PPTA 8957). This suggests that a flow adjustment in the range of 35 to 55 percent above the P2% value could in fact be expected, which in effect increases the standard design flow from the P2% values to near the historic P1% values. Therefore it is recommended that the historic P1% flood should be adopted as the new standard for all weirs.

96. The standard flood flow consideration currently adopted for the hydraulic design of head works by the Department of Irrigation are: the 100-year flood flow for dam spillways; the 50-year flood for weirs with catchment areas greater than 100 km^2; the 25-year flood for catchment areas between 50 and 100 km^2; and the 10-year flood for catchment areas smaller than 50 km^2. These return periods represent flood flows of P1%, P2%, P4% and P10% respectively.

97. For the design of spillways for small dams (i.e. those less than 15 metres high) as typically used for small to medium scale irrigation, the TRTA recommends that the standard remains at the P1% capacity but that sufficient freeboard above the reservoir full supply level is included to allow for double (i.e. twice) the P1% flow to pass over the spillway without the main dam embankment being overtopped. This is based on a review of the probable maximum flows (PMF) expected in the watersheds in the northern provinces of Lao PDR which found them to be approximately 75% greater than the P1% flows. This recommendation is in line with findings in other countries where this rule of thumb is applied.

98. In line with the TRTA recommendation to consider the P1% flood flow as the new standard for design of headworks, the capacities of the four Nam Tong headworks structures have been reviewed and confirmed that the design floods are able to be safely passed.

E. Habitat, Ecology and Wildlife

99. Aquatic ecology was not studied scientifically, but local communities were asked for information about fish and other fauna known to be present in the Nam Tong (Appendix 1). This generated the list given in Table 7. All of these species are caught for domestic consumption and were considered to be quite common, but no trading of fish was reported.

Table 7: List of fishes and other fauna known in the Nam Tong

Scientific name	Lao name	English name
Poropuntius laocnsis	Pa Jad	
Puntius aurotaeniatus	Pa Khao	
Osphronemus goramy	Pa Men	
Nemachelidae	Pa Phanh	
Cyprinidae, *Osteochilus lini*	Pa Morm	
Cyprinus carpio	Pa Nai	
Oreochromis niloticus	Pa Nin	
Devario salmonatus	Pa Siew	
Channa striata	Pa Kor	
Claias batrachus	Pa Douk	
Anabas testudineus	Pa Kheng	
Macrobrachium sp.	Kouing	Shrimp
Not known	Kob	Frog

100. Subproject communities report fishing activities and the importance of fish caught within the local diet. From field surveys up to 45 fish species (from 9 families) in the Nam Tong would benefit from improved fish passage along the river. Local villagers interviews catch a high proportion of migratory fish particularly in the early and late wet season. Dry season catches are significantly lower. The proposed fish passage functionality seeks to target the operational range from early-late wet season. The overall goal is to increase fisheries productivity by providing effective fish passes during the peak fish migration periods.

Figure 10: Potential Daily Fish catch reported by Males (kg)

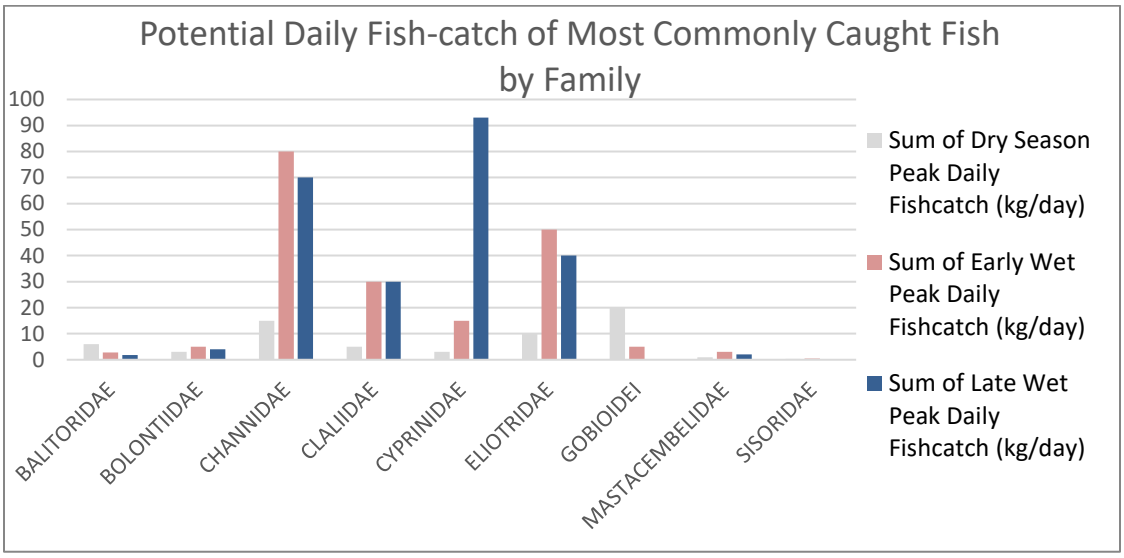
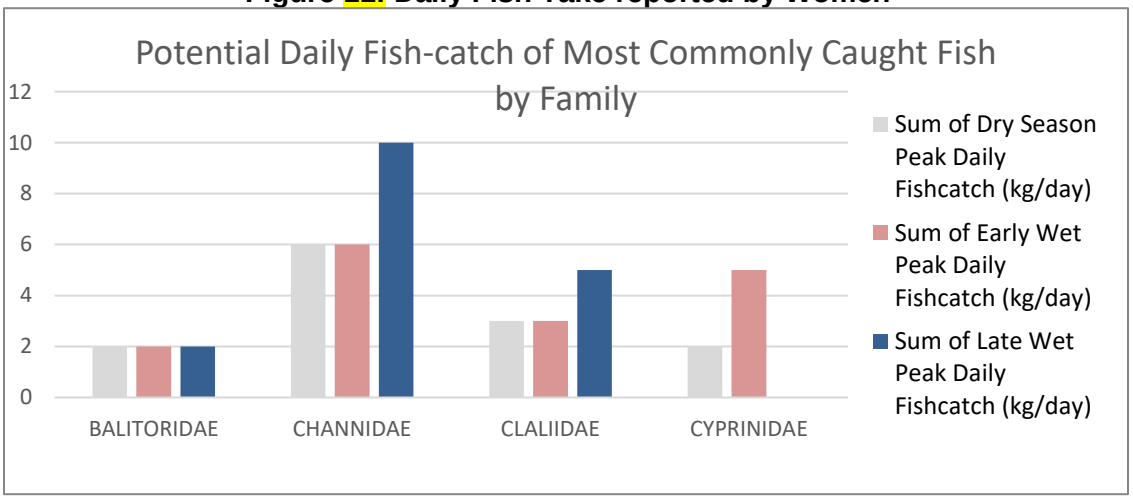


Figure 11: Daily Fish Take reported by Women



101. There is one protected area that straddles the borders of Xieng Khouang, Louang Prabang and Houaphan Provinces. The Phou Loey National Biodiversity Conservation Area covers 1,525 square kilometres and lies adjacent to the Nam Et National Biodiversity Conservation Area to its north. Together these are thought to have the last remaining breeding population of tigers in Indochina, as well as a number of other species that are classified as Critically Endangered, Endangered or Vulnerable on the IUCN Red List. The nearest point is within 50 km from the subproject area. Around 600 square kilometres of Phou Loey is designated a Key Biodiversity Area, which is an international recognition of importance.

102. A biodiversity proximity report was generated for the Nam Tong catchment by ADB using the Integrated Biodiversity Assessment Tool (IBAT). This is available as a separate document that accompanies this IEE. It lists about a thousand species on the IUCN Red List that could be found in the Nam Tong catchment given adequate habitat, of which about half are birds. The

number of those that are threatened – that is quite likely to face extinction – are listed by order in Table 8.

103. In the subproject area, the local consultations included discussions on the biodiversity found in the forested areas of the subproject. Certain tree species are used for small timber in house construction and other local uses. A significant proportion of households appear continue to be involved in the gathering of non-timber forest products, and there is also a certain amount of hunting in the forests. The response tables in Appendix 1 give details of the species involved. Identifications are difficult to verify, but as far as possible the species have been checked against the IBAT listing.

104. Within the SRIWSM subproject area the land use is dominated by irrigated field to field paddy fields that cascade down the riparian flats of the Nam Tong River. Residential settlements are located along roads that align to upper terraces at the toe of the hill slopes that lead to the upper catchment. The subproject command area is a very homogenous highly modified agricultural landscape.

105. The Critically Endangered Mammals are *Manis pentadactyla* (Chinese Pangolin) and *Nomascus leucogenys* (northern white-cheeked gibbon). None of these are reported as seen by hunters in the forest, as recorded during the IEE consultation (see Appendix 1).

106. The Critically Endangered birds comprise a pochard (a type of wild duck), a bunting, a myna and three vultures. None of these are listed in Appendix 1 as reported seen by hunters. One of the Endangered species listed by IBAT is a species of junglefowl, which could be the one listed by hunters as occasionally seen but not hunted.

The Critically Endangered fish is the giant pangasius, a shark catfish that is endemic to Indochina. The Critically Endangered and most of the endangered reptiles are freshwater turtles.

Table 8: Threatened Species in the Proximity of the Nam Tong Catchment

Order	Critically Endangered	Endangered	Vulnerable
Amphibians	0	1	0
Birds	6	3	7
Fishes	1	0	8

Invertebrates	0	1	2
Mammals	2	4	11
Plants	0	0	1
Reptiles	1	5	2

107. There is a lack of detailed information to determine whether any threatened species are present in the Nam Tong catchment or not. It is unlikely that many could be, since even the best remaining forest in the upper parts of the watershed have been altered. In preparing the IEE, consultations were held with local people, including hunters, who confirmed that the very rare species were formerly found in the area, but have not been seen for many years. Before 2010, all of the remaining evergreen forest (the MAF classification for primary or little-disturbed forest) had gone; although there still remains about 2,000 hectares of two forest types: moist deciduous; and coniferous and mixed broadleaved forest: these are MAF's classes of disturbed, partially logged forest that has not been cleared wholesale, or which is regenerating. Although the forests in the watershed appear to be gradually improving, the levels of degradation and fragmentation seen in the Nam Tong catchment suggests that there must have been a significant decline in habitat quality, and its recovery is likely to lag behind that of the actual trees. As a general rule, the more rare a species is, the less able it usually is to adapt to disturbance and habitat change. Hence it seems unlikely that there is a critical remaining population of any threatened species remaining in the catchment.

108. Despite the fragmented and highly disturbed nature of the habitat residual populations of less sensitive species are likely present. Even disturbed and fragmented, secondary forest occupies just over half of the catchment, and 2,000 hectares of forest can harbour a wide range of small species, with other species likely to re-colonise the area if the forest and habitat qualities improve.

F. Air Quality

109. There are no records of air quality measurements in the Nam Tong catchment, and being a rural area with no significant industries other than agriculture, the air quality is generally good. There are the usual short-duration impacts from road traffic in the vicinity of the existing roads, in the form of dust and vehicle emissions, but traffic levels are usually very low.

G. Ambient Noise

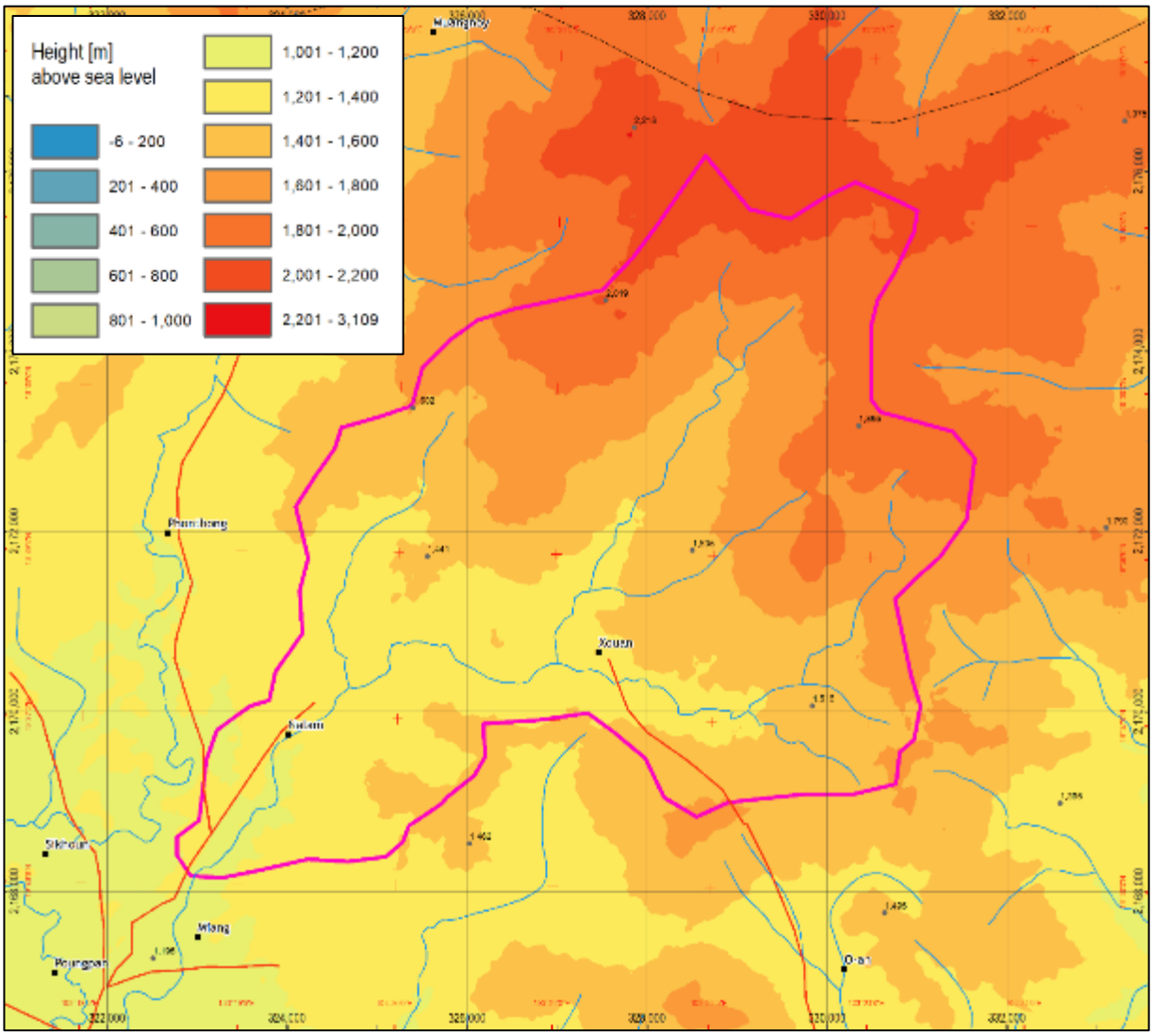
110. As with air quality, there are no records of ambient noise measurements in the Nam Tong catchment, and being a rural area with no significant industries other than agriculture, ambient noise levels are generally very low. Again, there is the usual short-duration impact from vehicle noise in the vicinity of the existing roads, but traffic levels are usually very low.

H. Infrastructure

111. An infrastructure map of the catchment is given in Figure 10. An earth road runs into the bottom of the catchment from the nearest highway, ending just beyond the village of Nalam. Another earth road runs over the hill from the south to reach the isolated village of Xouan, in the bottom of the steeper part of the catchment, above the irrigable command area. In 2017, a narrow

earthen track was constructed from Xouan towards the north-east. This climbs towards the ridge and was created to serve the tea farms in that part of the catchment. It is accessible only by motorbike.

Figure 12: Infrastructure Map of the Nam Tong Subproject Area. This shows: roads (thin dark red lines) and the catchment boundary (purple line)



I. Pollutants

112. There are no written or quantified records of significant pollutants of the soil, water or air in the Nam Tong catchment. During field visits and consultations, there was no evidence of significant use of agrichemicals in the watershed, since agriculture is relatively limited. For this reason, and with no evidence of erosion giving rise to raised levels of suspended solids in the river, the quality of water was considered likely to be adequate to meet the government's standards for irrigation. There is virtually no use of agrichemical upstream of the existing headworks and as such no pollutant is expected.

113. Agrichemicals are mostly absent from the upper watershed due to the important of forest based tea production. In the irrigation command area Khoa Koi Noi specialist small grain rice is not supposed to be sprayed with pesticide as part of the controlled supply chain. Field investigation identified limited fertiliser use, with wet season rice crops receiving 40 kg/ha of urea equivalent during the wet season with little or no phosphatic fertiliser used.

114. Current dry seasons crops are very small scale with Garlic, Chilli and Vegetable produced. Aside from the small scale 2 to 5 ha organic vegetable production on the lower irrigation scheme on the south western margin of the command area the remaining dry season crops received 40 to 80kg per ha of urea. The organic producers use compost.

115. Project crop use during the dry season is expected to focus on green vegetable production with urea application (40 to 80 kg/ha) and increased use of organic composts of 40 kg/ha. Specialist cucumber crop etc may see the use of increased NPK especially for the potash requirement. All applications rates are extremely low by regional and international standards.

116. Project pesticide use is currently extremely limited, with possible applications required for crops such as cucumber, however the limited presence of such crops may limit pest population build up and as such the Lao GAP program that includes IPM techniques and programs should reduce the need for chemical controls.

117. The EARF gives details of the approach to a risk based approach to water quality monitoring within the support program for irrigated agriculture including PRT and IPM to be financed and implemented under the IFAD PICSA program. Where necessary water quality testing will respond to anticipated threats based on likely chemical use and will require customized sampling and testing programs to be developed as part of the irrigated agriculture support program. Obtaining reliable water tests requires a concerted programme of sampling over a considerable period of time. If there are significant changes to the use of agricultural inputs that the monitoring should be undertaken during project implementation to ensure that the quality of water remains satisfactory.

J. Unexploded Ordnance

118. Xieng Khouang Province as a whole was one of the main bombing zones of the 1960s and 1970s. Most of this was directed to the southern part of the province, around the Plain of Jars to the south of Phonesavanh. No unexploded ordnance is known of in the Nam Tong catchment. The Government will be required to certify to ADB that all Project areas are clear of UXO, with any UXO clearance activities being the responsibility of the Government of Laos. No Contract may be awarded without this certification.

K. Population and Ethnicity

119. Full details of the socio-economic characteristics of the subproject communities are given in the report on village and household surveys undertaken for the Nam Tong Subproject in parallel with the preparation of this IEE. A summary is provided in the paragraphs below and the following sections. The demographic characteristics of all subproject villages are presented in Table 10.

120. In the subproject villages there reside 230 households (266 families) with 1,428 inhabitants (751 females), and comprising two ethnic groups. Among them, 92 percent (212 households) are Phuan ethnic, following Buddhism and speaking the Lao language, and belonging to the Lao-Tai ethno-linguistic group. The remaining 8 percent (18 households) are of

Hmong ethnicity, speaking the Hmong and Lao languages, following Animism and belonging to the Hmong-Mien ethno-linguistic group. There is no significant vulnerable ethnic minority residing within the villages, as confirmed by the WUG committee and the village authorities of all subproject villages.

121. Households generally comprise one family, but 16 percent or 36 households have two families. The average size of household is 6.2, with a range of 5.7 to 6.2 persons per household for Lao ethnic people, and 10.3 persons per household for Hmong ethnic people.

122. There are seven female-headed households among all of the subproject villages, with five in Khang Vieng and the other two in Mieng or Nalam village and Suan village respectively. The village authorities confirmed that they regularly organise help for them in rice transplanting and harvesting.

123. The number of poor households makes up at 4 percent (3 households in Mieng / Nalam and 1 percent (1 household) in Suan village. These households have limited and disabled labour. There was one divorced single vulnerable woman in Khang Vieng village.

L. Social Resources

124. All villages are connected to the power grid and are covered by mobile cell phone signals. It was confirmed by the village authorities that all school-aged children have access to the schools.

125. There is one primary school in each of Khang Vieng and Mieng / Nalam villages, but in Suan there is only an elementary school (classes 1 to 3); the children have to move for classes 4 and 5, and for secondary school, to Nhot Ngeum village. The youngsters of Mieng / Nalam Village have a joint secondary school in Khang Vieng, 5 km away. Higher education facilities such as technical and vocational colleges are located some 20 km away in Phonsavanh, the urban centre of Pek District. Universities are located in Louang Prabang City (about 300 km) and Vientiane Capital (about 350 Km).

126. There is one dispensary located in Khang Vieng to provide basic primary health care for less serious cases within the villages. For birth attendance and more severe health problems, villagers have to go to the Xieng Khouang Provincial Hospital in Phonsavanh City, some 20 km distant.

127. The primary means of getting to health and other public facilities is by motorbike, and sometimes by pickup. The condition of the road is very good and it is trafficable in all seasons, since National Road No. 7 was upgraded in 2002 with ADB support, and Provincial Road No. 1C was upgraded in 2010. The distances to the public facilities are shown in Table 9.

128. It was stated that some villagers drink bottled water produced by and delivered from factories located in Phonsavanh City, although the majority of inhabitants drink boiled water (hot tea and traditional medicinal herbs) and use water from the gravity feed systems for boiling. In terms of domestic water, all inhabitants share water from the village gravity feed systems supported by non-government rural development organisations. All households in Khang Vieng and Mieng / Nalam villages have their own household toilets, but in Suan village, only 36 percent of total households have a toilet.

Table 9: Access to Public Facilities in District and Provincial Centres

Subproject Village	Distance to primary school (km)	Distance to high school (km)	% School aged at school	Distance to health post (km)	Distance to nearest regular market (km)	All year road access (Y/N)
Khang Vieng	0.2	0.2	100	0.3	0.4	Yes
Mieng / Nalam	5.0	5.0	100	5.0	5.0	Yes
Suan	0.3	12	100	10.0	10.0	No

M. Livelihoods, Agriculture, Development and Economic Conditions

129. Agriculture dominates the livelihoods of the subproject villages. The total low-lying land areas are around 347 ha, of which 271 ha are irrigated and used for wet season rice by 221 households, and 73 ha are used for the cultivation of different cash and consumable crops, including tea, chili, sweet and hard corn, and vegetables.

130. Khao Kai Noi is a popular sticky rice planted over 95 percent of the land during the wet season for both household consumption and sale. The local ordinary rice variety (Khao Chao Deng) is a traditional rice planted on around 5 percent of the land and used for noodle processing.

131. There are 59 ha of lowland area used for dry season cash and consumable crops, including garlic, cabbage, cucumber and mixed vegetable. IN total it is estimated that up to 145 households are involved in dry season cropping many of them simply grow for their household requirements. Some farmers in Khang Vieng produce organic vegetables that are only sold locally.

Table 10: Demographic Characteristics of the Subproject Villages

Subproject Village and Hamlet	Population				Religion/ Belief		Ethnic Group						Average HH size	Average family size (person/ Fam)	No. of female headed HHs	No. Poor HHs	No. of vulner-able HHs	No. of landless HHs
							Lao ethnic			Hmong ethnic								
	No. of total household / Subproject Village (Hamlet)	No. of Family	Total population	No. of female	Buddhism	Animism	No. of HH	No. of Population	No. of female	No. of HH	No. of Population	No. of female						
	(HH)	(Fam.)	(Pers.)	(Pers.)	(HH)	(HH)	(HH)	(Pers.)	(Pers.)	(HH)	(Pers.)	(Pers.)	(pers./HH)	(pers./Fam.)	(HH)	(HH)	(HH)	(HH)
1. Khang Vieng	**135**	**162**	**769**	**445**	**135**		**135**	**769**	**445**				**5.7**	**4.7**	**5**		**1**	**1**
- Khang Vieng Hamlet	53	65	280	136	53		53	280	136				5.3	4.3	3		1	
- Phai Gnum Hamlet	42	57	233	119	42		42	233	119				5.5	4.1				
- Poungpan Hamlet	40	40	256	190	40		40	256	190				6.4	6.4	2			
2. Mieng/ Nalam	**77**	**77**	**473**	**213**	**77**		**77**	**473**	**213**				**6.1**	**6.1**	**1**	**3**	**1**	
- Mieng Hamlet	25	25	113	52	25		25	113	52						1	1	1	
- Namlam & Gnan Hamlets	40	40	189	92	40		40	189	92							2		
- Nasang Hamlet	12	12	171	69	12		12	171	69									
3. Suan	**18**	**27**	**186**	**93**		**18**				**18**	**186**	**93**	**10.3**	**6.9**	**1**	**2**	**1**	**1**
Total	**230**	**266**	**1,428**	**751**	**212**	**18**	**212**	**1,242**	**658**	**18**	**186**	**93**	**6.2**	**5.4**	**7**	**5**	**3**	**2**
% of female population (%)			**100%**	**53%**				**100%**	**53%**		**100%**	**50%**						
% of Population by Ethnic Group (%)	100%						92%			8%								
% of HHs by religion/ Belief (%)	100%				92%	8%												

132. Since the Land Use Planning and Land Allocation campaign has been applied in all three villages, the slash and burn and use of upland area has mostly stopped. In the upper catchment approximately ten households still practice some upland cultivation. This involves upland rice mixed with some consumable crops over an area of 7 ha, with fallow periods of three to five years.

133. Under perennial upland cultivation, around 300 ha of Forest tea is grown on Phousan Mountain. Villagers in Suan and other adjacent villages own and manage these tea plantations, harvesting fresh leaves for sale to Chinese Tea Processing Company.

N. Cultural and Scenic Matters

134. None of the communities or authorities consulted reported any areas of cultural value that would be affected by the proposed subproject.

135. There are potential tourist development plans for Phousan (wild tea) ecotourism, including tea plantations and ancient wild tea trees, as well as general forest ecotourism in watershed areas. There is also a district-level potential plan to develop tourism at the historical village of Ban Kung Vieng. However, none of these is in any stage of development and so will not be affected by the subproject.

136. About 20 km to the south of the catchment lies the Plain of Jars. This includes some of the most extensive and important Iron Age archaeology in Indochina. The subproject will not have any impacts on this important cultural site.

O. Data Gaps

137. With respect to rainfall and hydrology data, the complete absence of detailed information for the subproject catchment is the single biggest concern regarding the evaluation of the environment within which the proposed works and development will be undertaken. For the province as a whole, there is one weather station with a data set covering 35 years, with many of the data only covering six years. More local rainfall data collection is required to help develop a robust understanding of variability and extremes.

138. As well as water quantity, there are major data gaps for water quality. Certain activities in the catchment may be causing soil contamination (e.g. over-use of fertilisers or pesticides), which might in turn be giving rise to pollution in water courses. This could result in a poor quality of irrigation water or places aquatic biota at risk and water quality that does not meet government standards. The catchment is included in a restricted agrichemical management zone to protect the integrity of mountain tea products and the high value markets for Moucha Tea. Field work found no evidence of agrichemical use in the catchment of Nam Tong.

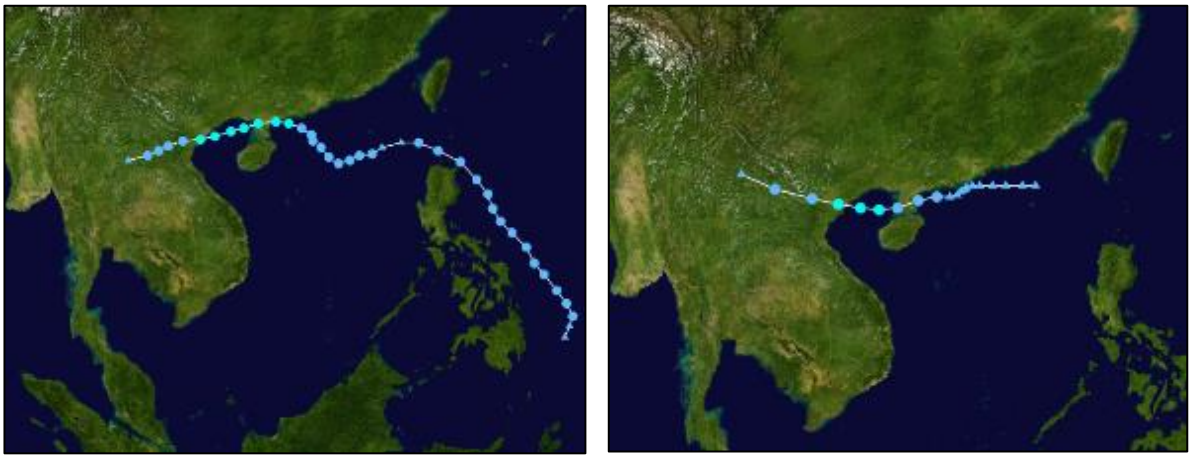
139. For biodiversity, the obvious data gap is the absence of catchment-specific biological studies. For the general area, the Integrated Biodiversity Assessment Tool highlights the large proportion of fishes which are listed as Data Deficient by the IUCN, which is a concern since a considerable number of the fishes listed are known to be threatened. Many of the invertebrates are also listed as Data Deficient.

IV. CLIMATE CHANGE CONSIDERATIONS

A. Current Understanding of Climate in Xieng Khouang

140. The current understanding of climate in Xieng Khouang is limited by the restricted data for the province, and the consequent need to extrapolate from other areas. Figures 7 to 9 give the available precipitation data from the meteorological station at Thonghaihin, the only weather station in Xieng Khouang Province. The analysis given in the baseline statement on climatic conditions earlier in this IEE also discusses the evidence for extreme rainfall events, which are mostly linked either to tropical storms, particularly when developed into cyclones or full typhoons, or localised thunderstorms. Figure 11 shows the tracks of a two severe tropical storms (typhoons at the point of landfall in Viet Nam) which both led to unusually heavy rainfall in the province.

Figure 11. Tracks of two Tropical Storms affecting Northern Lao PDR: Left, Haima in June 2011; Right, Lekima in September-October 2007.

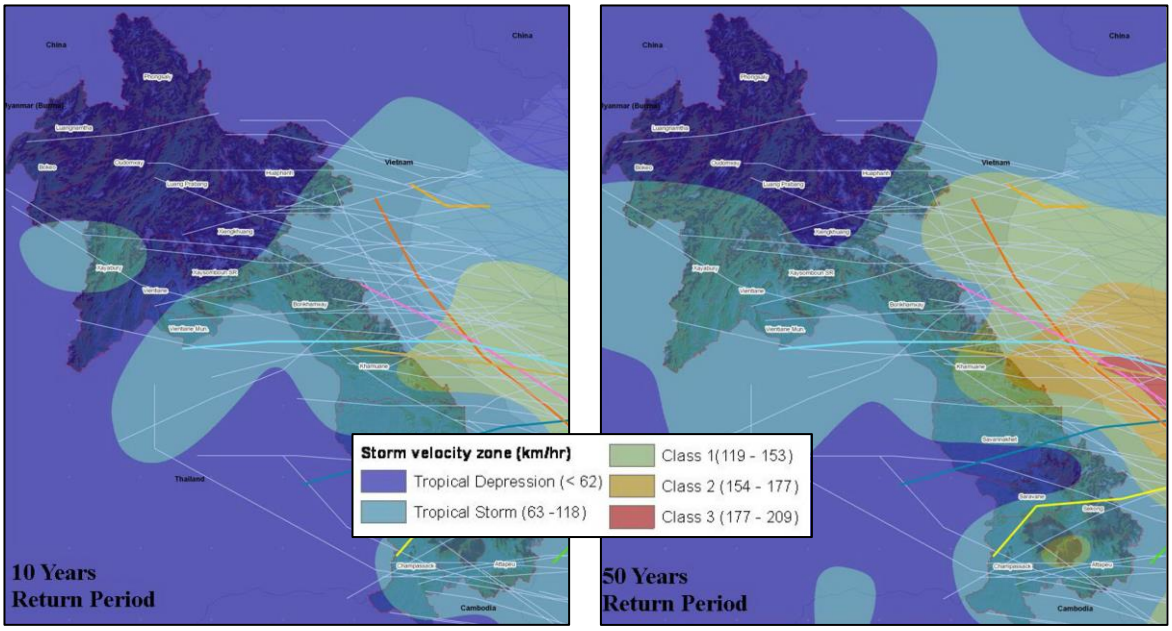


Sources: NASA.

141. While Figure 11 shows the effects of two storms several years apart, a wider range of data have been analysed to determine the overall storm risk: these are shown in Figure 12 for two possible return periods. Even so, these data so far cover only a 30-year period, and so also give only what can best be described as an approximation. While they show that the whole of Laos is susceptible to the impacts of tropical depressions, especially on a projected 50-year return period, storms of typhoon force frequently appear to reach Xieng Khouang Province: the risk is present, even if it is much less than in Khammouane Province, far towards the south. Sometimes the proximity of storms does not actually translate into extreme rainfall: for example, storm Kai-tak in 2005, which moved north-westwards through Viet Nam after making landfall at Hué and came close to Xieng Khouang (the red track shown on the maps in Figure 12), cannot be distinguished in the rainfall records in Figures 7 to 9.

142. At the other end of the climate moisture scale, droughts can also be a feature in Xieng Khouang. These can occur as relative effects at any time of year, since in meteorological terms they are defined as a drier deviation from “normal” rainfall. Drought hazard maps and frequency charts for a range of depths of drought are shown in Figure 13. These demonstrate that droughts can occur at any time of year in Xieng Khouang Province, but are more likely in the wet season. The risk seems to be relatively high, with 15 to 20 wet season droughts in the Nam Tong area, in 30 years of data: in other words, there is a drought in most years.

Figure 12: Storm Risk Maps of Lao PDR. Left, 10 Years Return Period; Right, 50 Years return Period. Based on Data from 1979 to 2009



Source: United Nations Development Programme. 2010. Developing a National Risk Profile of Lao PDR. Part 1: Hazard Assessment.

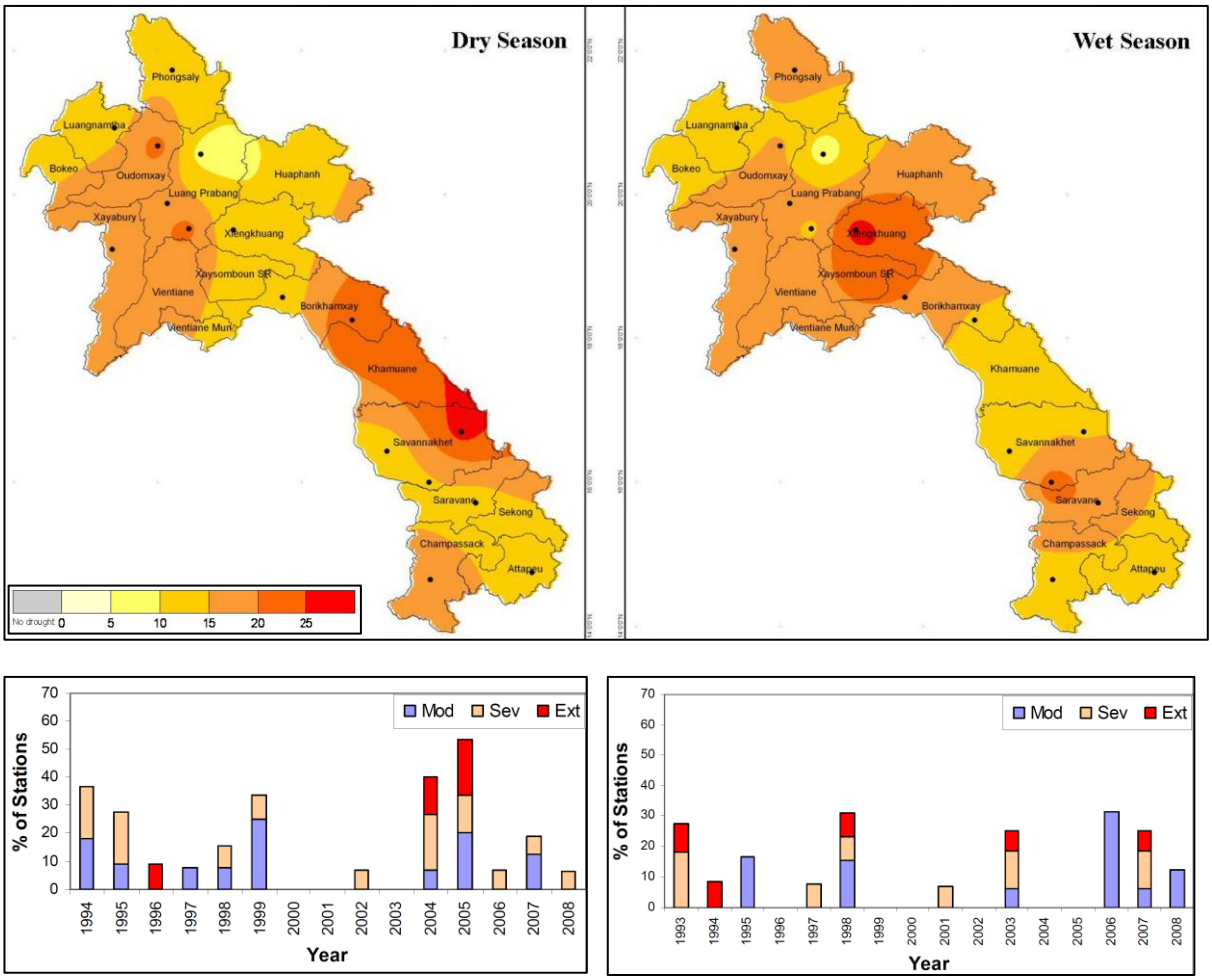
B. Initial Climate Change Risk Assessment

143. The Nam Tong subproject has been screened using the regional-level AWARE™ climate risk assessment tool. The overall climate risk level determined is “medium risk”. This is on the basis of an identified high risk of floods; and moderate risks of changes in precipitation (either increase or decrease), changes in solar radiation and temperature increases. A radar chart presenting these risks is given in Figure 14. A project falling into the overall medium risk rating does not necessarily require further analysis, but this is provided for all participating provinces in the project’s Climate Risk and Vulnerability Assessment.

144. The radar chart provides only an overview of individual risks that are likely to be significant. Floods are clearly related to extreme precipitation events. As described above, these are already a serious threat to infrastructure, and certainly require careful consideration.

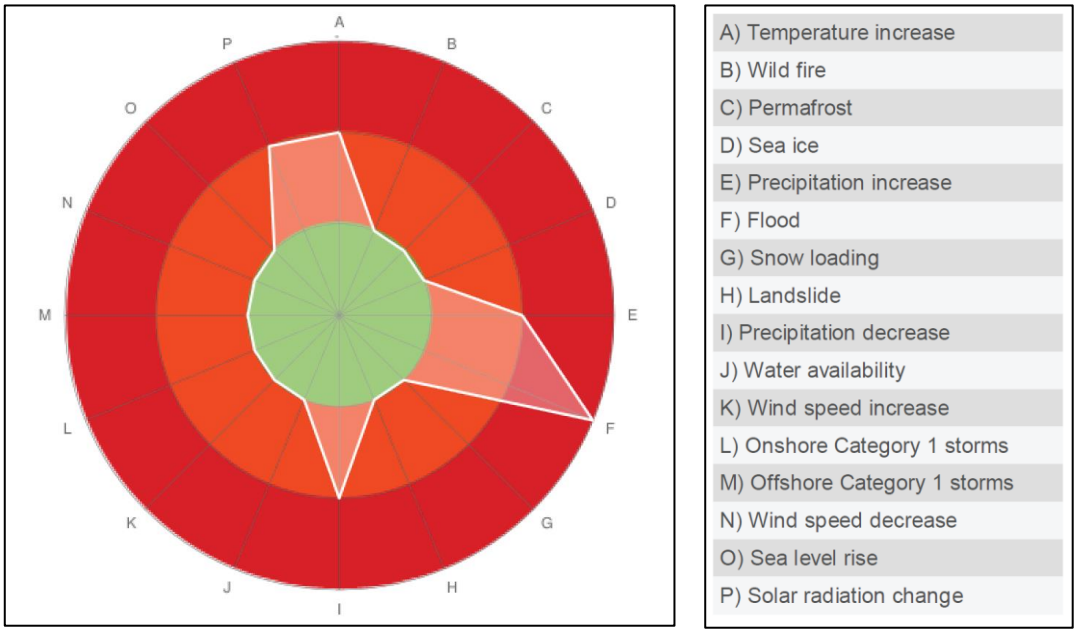
145. Drought risk is not considered by the AWARE™ tool, although the decrease in precipitation is a possible risk. However, as this could be a potentially serious issue in relation to irrigation, it is considered in the project’s CRVA.

Figure 13: Moderate to Extreme Drought Susceptibility Maps: Numbers of Droughts between 1980 and 2009, based on Standardised Precipitation Indices.
Below: Drought Occurrence by Year, Severity and Proportion of Recording Stations: Left, Dry Season; Right, Wet Season.



Source: United Nations Development Programme. 2010. Developing a National Risk Profile of Lao PDR. Part 1: Hazard Assessment.

Figure 14: Climate Risk Radar Depiction from the AWARE™ Tool
The Red Outer Band Denotes High Risk Parameters.



V. ENVIRONMENTAL IMPACTS AND THEIR MITIGATION

A. Environmental Justification

146. The main justification for the Nam Tong Subproject is that it will provide improved irrigation facilities for 230 households in three villages. The upgraded irrigation systems will allow for better dry season cropping options through more reliable water supplies outside the rainy season. This will allow each participating household to increase its incomes from the more intensively used irrigated land, thereby improving livelihoods. Improved livelihoods will enable households to access social capital opportunities such as health care and education. Hence there should be significant benefits to socio-economic environmental conditions.

147. Improved lowland irrigation generally also results in reduced pressures on the less productive uplands. This in turn helps to move the farming system away from its dependence on the remaining upland forests, because they are no longer reliant on the traditional systems of shifting cultivation and the growing of the less productive dryland rice and other crops. Forests will still retain a place in the livelihoods system, but more for the collection of non-timber forest products than for cropping. This is still disturbing for biodiversity, but far less damaging than the wholesale slash and burn clearance that is part of shifting cultivation. Hence there is expected to be a greater degree of forest conservation in the revised upland land use management plan that will accompany the subproject, with better soil protection and safeguarding of biodiversity. Therefore the subproject is also expected to generate benefits for the bio-physical environment.

B. Environmental Safeguards – Overview

148. Under the SRIWSM, ensuring environmental safeguards is a requirement of ADB financing. For this reason, adherence with the findings of this IEE and the EMP that accompanies it, forms a loan covenant.

C. Potential Adverse Environmental Impacts – Overview

149. The largest environmental impacts from the subproject are likely to relate to the volumes of water taken off the Nam Tong, and the effects on downstream users and ecology. At the design stage it is difficult to know exactly how much water is available due to the lack of year-round data on the flows of small rivers in northern Lao PDR, and the large amount of study that would be required to understand the exact requirements of other water uses. To overcome these potential impacts, the following process must be followed to address potential negative impacts.

(i) Any rainfall and flow data for the river catchment that have become available by the time the subproject implementation starts will be collected and assessed to provide a working model of average monthly flows throughout the year. Limitations in the data must be acknowledged to make clear both the requirements for further knowledge and the extent to which the design is based on approximations.
(ii) The proximity and flows of tributary streams close downstream from the proposed headworks must also be assessed. These might help to resolve downstream requirements while allowing a greater offtake.
(iii) A calculation must then be made as to the offtake that can be allowed. The rationale and assumptions used must be recorded as part of the scheme design, since these will need to be revisited when more information is available.
(iv) If it becomes apparent that there is unlikely to be adequate water for the proposed irrigation scheme, then water-saving irrigation systems must be considered.
(v) Once scheme operation commences, the gauged river flows and water offtake volumes must be reassessed. These, along with any complaints from downstream users, must be used to recalculate the allowable offtake. The scheme must then be revised accordingly.

150. It may not be possible to establish a fully quantified calculation of the minimum downstream flows, particularly because of the difficulty of determining ecological needs without long term studies. In this case, the rule of thumb to be used is that a compensatory flow must always be released that is at least 10 percent of the average monthly flow in each calendar month; if the river starts to show evidence of a strong ecological condition with rich aquatic biodiversity or develops a significant fishery, then the compensatory flow must be agreed with MONRE / PONRE and an minimum environmental flow agreed and applied. Ecological requirements normally vary through the year, with most species adapted to higher wet season flows or requiring them as part of their life cycle. Other users may also have seasonal variations in their requirements. Flow variations are also required in most rivers to prevent a build-up of sediment.

151. Reduced flows in rivers and streams can have consequences on both biodiversity and downstream water uses. Aquatic biodiversity is directly affected for the following main reasons: (i) water flow levels are a major determinant of physical habitat in streams, which in turn is a major determinant of biotic composition; (ii) aquatic species have evolved life history strategies primarily in direct response to their natural flow regimes; (iii) maintenance of natural patterns of longitudinal and lateral connectivity is essential to the viability of populations of many riverine species; and (iv) the invasion and success of exotic and introduced species in rivers is facilitated by the alteration of flow regimes (Bunn and Arthington, 2002). Mitigation is by setting minimum environmental or compensatory flows, which must be maintained throughout the year. These might typically be based on a proportion of dry season flow; but as flow regimes are not well understood in most small catchments, they may need to be based on approximations. There are various methods for doing this (Tennant, 1976; Acreman and Dunbar, 2004), but there are still

too few data available for the subproject catchment to use any of the recognised quantitative methods.

152. Excessive water flows are also damaging, but mainly to infrastructure. Floods can damage irrigation headworks but more often cause damage along canals. Flood overflow structures are needed, either to reduce flood water entry into canals, or to divert the water back into the river from an overflow weir on the side of the canal.

153. The increased use of agrichemicals, both fertilisers and pesticides, are potential risks from the intensification and diversification of irrigated agricultural. Excessive phosphates and nitrates can alter the biochemistry of waterways significantly, particularly affecting algal growth and its use of dissolved oxygen. Many pesticides are very damaging to aquatic biota, and some can persist in the soil or at different levels in the food chain. Two legal provisions are in place to control pesticides: Regulation on the Control of Pesticides in Lao PDR (Regulation No 2860/MAF, 11 June 2010); and Decree on Pesticide Management: (Decree No. 258/GOV, 24 August 2017). Nevertheless, there is evidence that enforcement is ineffective or absent, especially in remote areas where banned substances are easily brought across national borders and sold with labels only in Thai and Chinese scripts. The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, to which Lao PDR acceded on 9 October 2010 and entered into force on 20 December 2010, gives an international dimension to potential control measures.

154. ADB investment into SRIWSM targets hard infrastructure while support to farming system intensification is planned to be financed by IFAD. In the case of delay, ADB has budgeted support for quality assurance and Lao GAP systems that include PRT and IPM programs for the subprojects where warranted. These programs will be delivered by Provincial Plant Protection Centers. Based on market assessment the expected dry season cropping pattern will move towards increased production of green vegetables, chili, garlic and fodder for livestock.

155. The risk from increased pesticide use in Nam Tong is considered to be very low in the short to medium term, however with increased areas and extent of vegetable crops pest populations may build and require more direct intervention. This period of possible build up needs to be used to introduce the understanding of pests and pest population management through the LAO GAP certification best practice systems.

D. Evaluation of Potential Adverse Environmental Impacts

156. The identified environmental impacts have been listed according to the various subproject periods: (i) planning and design phase; (ii) construction phase; and (iii) the subsequent indefinite operation period. They have then been rated according to the judged level of significance. The significance is further elaborated by the ease and extent to which these impacts can be mitigated. Many of the criteria have required an essentially qualitative judgement, which has been undertaken by environmental specialists not involved in the design proposals, and in consultation with local authorities and farmers. The anticipated potential adverse environmental impacts and the rating of their significance is given in Table 11. Brief comments are also provided on the rationale behind the significance evaluation.

Table 11: Anticipated Environmental Impacts and their Level of Significance

No.	Environmental Impact	Anticipated Significance
Subproject Planning Phase		
1.01	Loss of land or other property to infrastructure.	Low. Very little land affected and land values will increase. There are 5 Affected Households along the proposed Ban Xuon road
1.02	Loss of land of importance for biodiversity.	Low. Infrastructure is in areas of very low biodiversity value according to IEE consultation and fieldwork findings.
1.03	(a) Incomplete hydrological data and as yet poorly developed climate change models lead to inaccurate designs for infrastructure. (b) Infrastructure is damaged by high flood levels, reducing the scheme's lifespan or effectiveness and causing damage to the nearby environment. (c) Downstream riverine quality is affected in very dry years due to abstraction of water for irrigation.	High Mitigation measures for both high and low flow levels are required to resolve data gaps.
1.04	Disruption of hydrological flows by increased offtake from rivers.	Low. Designs are to be fine-tuned and managed on the basis of environmentally allowable offtake.
1.05	Water supplies polluted by upstream land management practices do not comply with national standards for surface water.	Low. Water quality appears to be good in the Nam Tong.
1.06	Upstream land uses cause a decline in the quality and quantity of water available for the irrigation scheme.	Low. The Nam Tong catchment is in a relatively good condition and will be enhanced by a watershed management scheme as part of the subproject. The plan will support perennial land use to reduce soil erosion risks while a community land use agreement will provide irrigation in return for the release of the remaining 5 shifting cultivation blocks in the Ban Suan PLUP
Subproject Construction Phase		
2.01	(a) Release of silt into water courses from excavations and earthworks during construction. (b) Release of silt into water courses from poorly finished earthworks following construction.	Medium. This is a common problem on many projects, but it can be managed by the contractor and monitored by the project implementing agency. Appropriate bio-engineering measures are recommended.

No.	Environmental Impact	Anticipated Significance
2.02	Environmental damage results from the poor understanding of subproject requirements by the contractor and subcontractors.	Medium. This is a common problem, but the PPIT must manage the contractor to ensure that it does not happen here. Clear mitigation measures are to be included in all works contracts.
2.03	Clearance of vegetation leads to the unnecessary removal of trees and other plants.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.04	Temporary closure of irrigation systems during construction.	Low. This can be agreed between the water users and contractor.
2.05	Disposal of soil from excavations such as irrigation canals.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.06	Release of dust into the atmosphere from excavations and other construction activities.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.07	Release of noxious gases into the atmosphere.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.08	Noise nuisance from construction activities.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.09	Temporary use of land for construction affects livelihoods or leaves it damaged. This may include borrow pits.	Low. This must be agreed between landowners and the contractor, and monitored by the project implementing agency.
2.10	Influx of temporary labour disrupts local communities.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.11	Operation of construction machines affects both workers and local society.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.12	Pollution by hydrocarbons from construction plant.	Low. This can be managed by the contractor and monitored by the project implementing agency.

No.	Environmental Impact	Anticipated Significance
2.13	Pollution from construction site wastewater, from camps and other work sites.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.14	Pollution from solid waste materials.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.15	Injuries to workers and others.	Low. This can be managed by the contractor and monitored by the project implementing agency.
2.16	Disruption of cultural sites.	Low. This can be managed by the contractor and monitored by the project implementing agency. All chance finds of such assets or sites will trigger a stop work and a reporting to the PPIT. The PPIT shall assess the need for mitigation or additional management requirement for the contractor
2.17	Subsequent users may not fully understand how to manage the subproject works.	Medium. This is a common problem, but the PPIT must manage the handover to ensure that it does not happen here.
Subproject Operation Period		
3.01	Disruption of downstream hydrological flows due to offtake from river.	Low. Water offtake is to be fine-tuned and managed on the basis of environmentally allowable volumes.
3.02	Upstream land uses cause a decline in the quality and quantity of water available for the irrigation scheme.	Low. Pro-soil conservation watershed management schemes to be implemented as part of the subproject.
3.03	(a) Extraction of water from river causes a decline or loss of aquatic biodiversity. (b) Extraction of water from river leaves downstream users short. (c) Subproject irrigation scheme requires more water than is available.	Low. The river is already a highly altered environment, the changes to the flow regime are expected to be modest and have been the subject of detailed assessment. In addition, long term monitoring and refinement is a required mitigation measure.
3.04	(a) Flood damage to headworks. (b) Erosion of canal banks, either from flood surges or normal flows.	Low. The subproject design specifically aims to make these resilient.

No.	Environmental Impact	Anticipated Significance
3.05	Increased Agrichemical Use	Low Increased fertiliser use will arise from the increased extent of dry season cropping Increased pesticide use during the dry seasons will occur with the increased area of cropping plus over the medium to long term increased agrichemical is likely to be incorporated into intensive dry season cropping Higher risk to farmer workers and handlers of agrichemicals related to the EHS risks of agrichemical handling, mixing and application in the short term. Produce and environmental risk from agrichemical over use is unlikely in the medium term however LAO GAP certification requires safe production principles including IPM and PRT.
3.06	Greenhouse Gas Emission	Very low significance Upper watershed emission reductions are probable due to reductions in forest degradation with grazing controls. Command area intensification will see additional cultivation and fossil fuel use however dry season cropping with residue incorporation provides substantial soil structure improvement and reduces cultivation and nutrient requirements for wet season. Overall it seems unlikely that there is a significant change in GHG emissions.
3.07	Water Quality Impact	Low significance. Water quality will be improved through upper watershed management and within the command area the ability to control water movement will limit contamination risk and the proposed cropping agrichemical use is low.
3.08	Environmental Flows	Dry season water flows are likely to be reduced through the use of irrigation water in the December to February growing season. Flow data from CMI and from field investigation indicate low risk to dry season flows.

E. Environmental Mitigation Measures – General

157. Under the classification of the proposed subproject into MONRE category 1 and ADB category B, all adverse environmental impacts must be mitigated; if they cannot be mitigated, then the category of the subproject would need to be changed and a full EIA undertaken, making it ineligible for SRIWSM financing. Hence ways must be found to avoid, minimise or restore all potential impacts found in the course of designing and implementing the Nam Tong Subproject. The detailed mitigation measures depend on individual site conditions. However, in most cases there are only a limited number of options for the mitigation of certain issues. The proposed mitigation measures are therefore listed in the EMP, covering all of the main impacts that are likely to occur. Most of them represent simple, practical, common sense measures to ensure that disruption is limited to the minimum as a result of all subproject activities.

158. In some cases, mitigation measures cannot be defined precisely because there is inadequate information on which to base precise actions. Water flows are particularly little understood because to date there have been very few gauging stations maintained in smaller catchments. Defining compensatory flows throughout the year is therefore difficult, and initially must be based on estimates. The mitigation strategy in this case is to use as much information as possible to ensure that the initial estimates are as accurate as they can be, while starting to collect continuous series monitoring data. Because of natural variations from year to year, this process needs to be continued every year for at least ten years, and ideally throughout the life of the infrastructure, so that the compensatory flows can be updated as the running averages, minima and maxima for flow in each month become more statistically robust.

159. Both to realise the environmental benefits of the project and to safeguard the infrastructure investments, catchment land use needs to be improved in the Nam Tong watershed. Part of the rationale for the SRIWSM is to assist the rural population to reduce its dependence on upland agriculture, since in many parts of northern Laos other land pressures mean that shifting cultivation is used by a limited population for subsistence. Periodic disturbances to vegetation cover have also increased sediment fluxes in the rivers. In the long term, the effectiveness of the subproject irrigation facilities depends on the stabilisation of the forest cover in the upper catchment. This in turn requires the communities within the catchment to adopt improved land use planning, which will focus on intensified agriculture in the irrigated land and leave a greater proportion of the watershed under a longer term cycle of forest use. Better land use management is therefore critical to the subproject achieving its purpose and to the mitigation of the impacts of increased infrastructure.

160. In a steep hilly catchment and with the intense rainfall that occurs in the Nam Tong watershed, the protection of soil surfaces is essential around all of the infrastructure that will be installed. This includes irrigation headworks, canals and access roads. There are two main purposes for this. The first is to avoid erosion from rainfall, with bare surfaces highly prone to the entrainment of soil particles as a result of raindrop impact and runoff, leading to the loss of topsoil and increased amounts of sediment in water courses. The second is to protect earthworks from flood scour, when river or canal flows overtop the structures during high floods. Simple bio-engineering measures are the only effective way of protecting large surface areas from rainfall-induced erosion, and so this is a straightforward but critical mitigation measure in targeted areas.

F. Potential Adverse Environmental Impacts – Design Phase

161. Design phase environmental impacts are expected to be minimal, but should still be recorded and plans made for their mitigation. Potential impacts might come particularly from

geotechnical site investigations for structure foundations, or as a result of vegetation clearance for surveying.

162. Identified impacts and the proposed mitigation measures for the subproject design phase are listed in Table 12: these are an extract from the impact, mitigation, responsibility and monitoring tables provided in the EMP.

163. A key part of the design period is to set the scene and conditions for the successful implementation of the project and the subsequent operation of the infrastructure it will provide. To ensure that this happens effectively, there are non-negotiable key environmental elements that must be incorporated into all subproject agreements and which, like all environmental compliance, are a condition of financing.

(i) A river gauging station will be established. Arrangements must be made for the assigned WUG to download the data and feed it back to the PAFO for collation. The PAFO must show an annual review of calculations for minimum base compensatory flows within each river course, during each calendar month. Records of the data (both primary and interpreted) and reviews must be lodged with the Department of Irrigation (MAF) and the Department of Water Resources (MONRE) in Vientiane, to help build up the national databases.

(ii) An existing catchment land use plan is agreed for the subproject. The plan must be both socio-economically beneficial and environmentally sound, in that its primary objective is upstream catchment protection to ensure that the subproject irrigation scheme is safeguarded in terms of water supply and limited sediment supply.

(iii) Protection measures must be designed and implemented as part of all elements of infrastructure. Engineering designs must not be approved without adequate provision of protection against high flood conditions. Construction must not be approved as complete before all protection works have been finished as per the design. The purpose of the protection measures is to ensure that the subproject infrastructure and surrounding land can sustain climate-induced events – mostly high flood levels – both under current climate conditions and potentially more extreme over the period between 2020 and 2050. These measures would typically be a combination of bio-engineering and hard engineering works.

(iv) The proposed upgrading of two instream headworks will result in increased restriction in fish passage within the Nam Tong. The Design phase will incorporate fish passage designs that target the species and season migratory movement of the identified species. The design of the fish passages has been completed and included in the detailed feasibility report.

Table 12: Anticipated Environmental Impacts and Mitigation Measures during the Subproject Planning Phase

Subproject Planning Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
1.01	Loss of land or other property to infrastructure.	1. Full consent to the subproject must be sought through standard consultative processes. 2. Full and fair compensation as defined in the Land Acquisition and Resettlement Framework is applied.
1.02	Loss of land of importance for biodiversity.	1. Subproject landtake is to be minimised. 2. Landtake is to use land that is already degraded, to the greatest extent possible. 3. Subprojects in forest or protected areas, would not be eligible for SRIWSM financing.
1.03	(a) Incomplete hydrological data and as yet poorly developed climate change models lead to inaccurate designs for infrastructure. (b) Infrastructure is damaged by high flood levels, reducing the scheme's lifespan or effectiveness and causing damage to the nearby environment. (c) Downstream riverine quality is affected in very dry years due to abstraction of water for irrigation.	1. Care is to be used to interpret as well as possible the best available data for the subproject catchment. 2. A significant margin is to be allowed to ensure that infrastructure is likely to be resilient under current climatic conditions. 3. An additional margin is to be allowed to ensure that infrastructure remains resilient under possible future more intense or prolonged rainfall events. 4. Specially designed protection measures such as bio-engineering must be incorporated into designs as a matter of course. 5. Engineering designs must not be approved without adequate provision of protection against high flood conditions. 6. In very dry periods, released flows from the intake must be monitored to ensure that the minimum agreed environmental base flow is always provided downstream of the intake.
1.04	Disruption of hydrological flows by offtake from rivers.	1. A hydrological gauging station must be established on the subproject catchment, upstream of the headworks, to help define acceptable dry season minimum flows. 2. Where no flow data exist, initial minimum flows of at least 10 percent are required however if the flow rate is less than 30 percent of the estimated monthly average flow, PONRE will provide a recommendation to PAFO as part of the design technical review . 3. Offtake regimes must be refined as more data become available.

Subproject Planning Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
1.05	Water supplies polluted by upstream land management practices do not comply with national standards for surface water.	1. Given the nature of land use above the headworks no risk is identified. PONRE and Department Agriculture Land Management (DALAM) will monitor the use of chemicals during the life of the project
1.06	Upstream land uses cause a decline in the quality and quantity of water available for the irrigation scheme.	1. Updating the existing catchment land use plan should be initiated within project year 1. The plan should be both socio-economically beneficial and environmentally sound, in that its primary objective would be upstream catchment protection to ensure that the subproject irrigation scheme is safeguarded in terms of water supply and limited sediment supply.
1.07	In stream headwork structures impede fish movement	All instream structures will have integrated with fish passages based on understanding of fish species, fish migratory periods and the respective requirement to enable fish movement

G. Potential Adverse Environmental Impacts – Construction Phase

164. Although the subproject construction phase will be relatively short, the impacts from it can be very significant. Access routes can be particularly destructive, and so should be subject to environmental management in as much detail as the main infrastructure works, with appropriate mitigation measures. Contractors' construction sites can be very damaging to the environment. Physical construction may be only in limited areas, but may require borrow pits or quarries elsewhere, fuel transport and storage, and temporary site camps for materials, plant, offices and labour. Poor scheduling during construction can result in activities taking place at inappropriate times, for example with earthworks being kept open through the wet season.

165. Impacts during construction may be short-lived, but they can be intense. Dust and noise pollution can be highly disturbing to local residents. A single season of sediment flows into rivers can devastate the aquatic biota, requiring perhaps years or even decades for the river to recover. One large spillage of fuel can take many years to clean up. Mitigation is therefore through the provision of preventative measures, such as through using noise abatement measures, dust suppression, sediment control and sound fuel management measures.

166. Identified impacts and the proposed mitigation measures for the construction phase are listed in Table 13: these are an extract from the impact, mitigation, responsibility and monitoring tables provided in the EMP.

Table 13: Anticipated Environmental Impacts and Mitigation Measures during the Subproject Construction Phase

Subproject Construction Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
2.01	(a) Release of silt into water courses from excavations and earthworks during construction. (b) Release of silt into water courses from poorly finished earthworks following construction.	1. The removal of vegetation and creation of bare surfaces must be minimised to essential areas only. 2. Vegetation clearance and earthworks may only be undertaken during the months of October to April. 3. Temporary sediment settling ponds built using strong stone or timber check dams (not bamboo or fabric silt fences) must be constructed to trap sediment from all earthworks that have unprotected surfaces at any time during the months of April to October inclusive. 4. Borrow areas, camp sites, temporary access tracks etc. must be fully rehabilitated back to a condition that is fully protected against soil erosion. 5. Bio-engineering surface protection must be planted on all bare earthworks during the months of May to July.
2.02	Environmental damage of any form results from the poor understanding of subproject requirements by the contractor and subcontractors.	1. At a pre-mobilisation site meeting, the contractor must demonstrate a full understanding of the requirements of the EMP. 2. All of the sub-plans listed below must be created, reviewed, improved if necessary and accepted for approval. 3. The contractor must demonstrate that he is fully responsible for all subcontractors' adherence to the provisions of the EMP, and that he has formally ensured this.
2.03	Clearance of vegetation leads to the unnecessary removal of trees and other plants.	1. No tree over 200 mm diameter at breast height (1.5 metres above the ground) may be cleared unless the design drawings specifically require it. 2. The contractor's site clearance plan must be limited to the agreed work site boundaries and must be approved by the PPIT's environmental representative before any clearance may be commenced.

Subproject Construction Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
2.04	Temporary closure of irrigation systems during construction.	1. Contractors must provide a plan in advance to provide irrigation water into existing supply channels, which must be approved by the project implementing agency and the Water User Group. 2. If it is not possible to avoid temporary closure, then full and fair compensation is to be paid for loss of crops as a consequence.
2.05	Disposal of soil from excavations such as irrigation canals.	1. Soil from excavations should be re-used in designs wherever possible. 2. Where soil is excess to engineering requirements and is treated as spoil, it must be disposed of in the nearest available approved location, and stabilised and protected from rainfall using bio-engineering measures.
2.06	Release of dust into the atmosphere from excavations and other construction activities.	1. Earthworks must be halted during periods of strong winds. 2. Heavily used access tracks must be sprayed with water during dry periods. 3. On all unmetalled surfaces, construction traffic must be limited to 30 kmh within 250 metres of habitation and 80 kmh elsewhere. 4. Loads of dust-making materials must be covered. 5. Crushers must be fitted with water sprays to prevent dust emissions.
2.07	Release of noxious gases into the atmosphere.	1. Vehicles and machines must be in a good condition and serviced regularly, to ensure minimal emissions. 2. All vehicles and machines must comply with the Lao PDR emissions standards.
2.08	Noise nuisance from construction activities.	1. Contractors must not exceed statutory noise levels at any time. 2. Work sites within 500 metres of habitation: (a) must not operate during the hours of darkness or on holidays; and (b) must have noise-abatement measures installed for other periods.

Subproject Construction Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
2.09	Temporary use of land for construction affects livelihoods or leaves it damaged.	1. Land for use by any contractor or subcontractor must be agreed by both the PPIT and the local community authority before the contractor may have access. 2. Full and fair compensation is to be paid for loss of crops or other assets before the contractor may have access to the land. 3. The contractor must have a land restoration plan, which must have been implemented to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid.
2.10	Influx of temporary labour disrupts local communities.	1. Contractors and subcontractors are required to use the maximum local labour possible. 2. If a significant number of staff and workers (i.e. more than 20) are to be brought into the subproject site, then the contractor must provide a management plan and code of conduct for the staff and workers, that is approved by the local community authority.
2.11	Operation of construction machines affects both workers and local society.	1. The noise and dust reduction measures listed above must be adhered to. 2. Safety measures for machine operation must be defined and approved by the project implementing agency. 3. Machine operators and workers must be trained and certificated in the safe use of machines.

Subproject Construction Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
2.12	Pollution by hydrocarbons from construction plant.	1. The contractor must prepare a plan for the management of hydrocarbons, which must be approved by the PPIT before the contractor is permitted to mobilise to site. 2. Fuel and oil must be transported in properly designed vehicles meeting national standards. 3. Fuel and oil must be stored at least 50 metres from a water body, in covered and bunded locations, and dispensed under strict controls. 4. Vehicle and machine parking and service areas must have impermeable surfaces and the outlet drains must be fitted with oil traps. 5. Contractors must have spill clean-up equipment on site, and persons always present who know when and how to use it. 6. The contractor must have a land restoration plan that includes hydrocarbon facilities, which must have been implemented to the satisfaction of both the project implementing agency and the landowner before the contractor's final bill may be paid. 7. Any subcontractor must comply with the same rules, at the contractor's liability.
2.13	Pollution from construction site wastewater, from camps and other work sites.	1. The contractor must prepare a plan for the management of wastewater, which must be approved by the PPIT before the contractor is permitted to mobilise to site. 2. "Black" wastewater from sanitation facilities must be led to a properly constructed septic tank and soakaway. 3. "Grey" wastewater from washing and cooking facilities must be led to a septic tank or to a specially built reed bed filtration system. 4. Oil-contaminated water from workshops and fuel stores must be collected and taken to an approved municipal waste management facility. 5. The contractor must have a land restoration plan that includes wastewater facilities, which must have been implemented to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid. 6. Any subcontractor must comply with the same rules, at the contractor's liability.

Subproject Construction Phase		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
2.14	Pollution from solid waste materials.	1. Solid waste must be recycled wherever possible. 2. Non-recyclable solid waste must be sent to an official landfill site. 3. Any open burning of solid waste is prohibited 4. The contractor must have a land restoration plan that includes solid waste, which must have been completed to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid. 5.
2.15	Injuries to workers and others.	1. Work sites must be clearly demarcated using barrier tape and all non-project personnel excluded. 2. All staff, workers and visitors to construction sites must be issued with appropriate personal protective equipment. 3. All staff, workers and visitors to construction sites must be briefed on safe working procedures for that site. 6. Every construction site must have a first aid kit and at least two persons always present who are trained and competent to use it.
2.16	Disruption of cultural sites.	1. All small cultural sites (such as small shrines and graves) must be protected by the contractor during works periods. 2. A plan for the protection of cultural sites must be approved by the PPIT. 3. All chance finds of such assets or sites will trigger works to stop. The PPIT shall assess the need for mitigation or additional management in co-ordinating with the relevant authority. 4. Once construction is complete the surrounding of such sites must be restored to their pre-construction condition.
2.17	Subsequent users may not fully understand how to manage the subproject works.	1. An operations manual must be drafted initially by six months before handover. 2. The operations manual will be shared with and explained to the water User group. 3. Before handover, the operations manual will be finalised and the EMP requirements built into it.

H. Potential Adverse Environmental Impacts – Operation Period

167. Impacts during the operation phase can be overlooked during environmental appraisal, when the tendency is to focus on the design and construction phases, since those are the periods

of maximum investment. Yet the operation phase is the much longer period of time and means that environmental impacts can become progressively more significant if they are not adequately mitigated.

168. Identified impacts and the proposed mitigation measures for the operation period are listed in Table 14: these are an extract from the impact, mitigation, responsibility and monitoring tables provided in the EMP.

Table 14: Anticipated Environmental Impacts and Mitigation Measures during the Subproject Operation Period

Subproject Operation Period		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
3.01	Disruption of downstream hydrological flows due to offtake from river.	1. Once scheme operation commences, the gauged river flows and water offtake volumes must be reassessed. These, plus any complaints from downstream users, must be used to recalculate the allowable offtake. 2. The scheme must then be revised accordingly.
3.02	Upstream land uses cause a decline in the quality and quantity of water available for the irrigation scheme.	1. The updated catchment land use plan, should be continued indefinitely to ensure that the scheme is safeguarded throughout its operational life. Arrangements for implementation of the plan must be maintained.
3.03	(a) Extraction of water from a river causes a decline or loss of aquatic biodiversity. (b) Extraction of water from a river leaves downstream users short. (c) Subproject irrigation scheme requires more water than is available.	1. If these impacts occur, then it shows that the assumptions of water flow made during subproject design were wrong. This is likely to be due to a lack of flow data at design stage. 2. The minimum flow release must be recalculated, based on user needs and the latest data on river flow. 3. Water use by the subproject scheme must be reviewed against what is actually available. 4. A revised scheme management plan must be introduced, implemented, monitored and adjusted until it resolves the problem.
3.04	(a) Flood damage to headworks. (b) Erosion of canal banks, either from flood surges or normal flows.	1. All flood protection works must be maintained as per the design of the subproject, or any subsequent engineering works. 2. Any flood damage must be reviewed and appropriate measures designed for resolution. 3. Occasional minor flood damage should normally be resolved by using appropriate measures. 4. The use of civil engineering structures (i.e. concrete or gabion works) may be required in the event of serious damage from exceptional floods.

Subproject Operation Period		
No.	**Anticipated Impact**	**Proposed Mitigation Measures**
3.05	Increased pesticide use	Crop selection and husbandary management training Lao Gap Certification training and systems established Pesticide reduction training by the provincial plant protection centers IPM programs for specific crops implemented to manage pest populations in an integrated manner that minimizes the use of agrichemicals
3.06	Increased nutrient use	Crop rotation and conservation agriculture systems to improve soil structure and organic manner Nutrient management training as part of Lao GAP certification to be supported under the IFAD project

I. Cumulative and Transboundary Impacts

169. It is considered that the subproject will not induce any cumulative or transboundary impacts.

170. Cumulative environmental impacts would occur if other significant developments were to be proposed in the subproject area or close to it. At the time of planning, no such major proposals were known about. This was one of the subjects of enquiry at both provincial and district levels during the preparation of this IEE.

171. Transboundary impacts are theoretically possible because the subproject catchment flows into the Mekong, which later forms a border with Thailand, and ultimately flows through Cambodia and Viet Nam. However, the likely impacts were judged to be negligible on account of the nature of the subproject proposals, and the very large dilution by the Mekong mainstream of the waters from the Nam Tong watershed.

VI. CONSULTATION

A. Consultation Process

172. During planning, construction and operation, the subproject developer – in this case the PAFO supported by the SRIWSM – is obliged under the EIA Decree to inform project-affected people and other stakeholders of project activities which are likely to create environmental and social impacts, and to provide access to general information about the subproject.

173. The process for public consultation and information disclosure is described in the EIA Decree. The project developer is required to make people in the affected area aware of the project and what it will involve, and to collect their views, early in the IEE process. These initial disclosure and consultation meetings must then be followed up later on, to release a draft of the IEE for comment over a period of at least 30 days. Potentially damaging impacts must be made clear to all stakeholders. Associated with this consultation process is a grievance redress mechanism that allows complaints to be heard by the authorities responsible for the project, and

recorded at the district administration. The mechanism must allow concerns to be raised from village to district level and if still not resolved, to national level.

174. During IEE preparation, a series of meetings was held in the province, district and village centres, at which the following activities were undertaken: (i) a summary of the works proposed under the subproject was presented; (ii) discussion was held on the subproject objectives, and likely positive and negative environmental impacts, covering the construction phase and longer term operational period; and feedback was gathered in the form of any comments that the various stakeholders made, along with their suggestions on mitigation. The dates, attendees, topics covered and conclusions of consultations are recorded and included in Appendix 1. In some cases, comments, corrections or further information have been provided alongside the records.

175. During IEE preparation, a series of meetings was held in the provincial, district and village centres, at which the following activities were undertaken: (i) a summary of the works proposed under the subproject was presented; (ii) discussion was held on the subproject objectives, and likely positive and negative environmental impacts, covering the construction phase and longer term operational period; and feedback was gathered in the form of any comments that the various stakeholders made, along with their suggestions on mitigation. Table 15 provides a list of the groups consulted and the dates of the meetings. Full information on the dates, attendees, topics covered and conclusions of consultations are recorded and included in Appendix 1. In some cases, comments, corrections or further information have been provided alongside the records.

Table 15: Consultative Meetings Held Regarding the Nam Tong Subproject

Group consulted	Date of meeting
Provincial Agriculture and Forest Office: related offices of Irrigation, Forestry, Livestock, Plantation	21 March 2018
District Agriculture and Forest Office	22 March 2018
Provincial Public Works and Transport Office	21 March 2018
District Irrigation Office	22 March 2018
Provincial Energy and Mine Office	21 March 2018
District Energy and Mine Office	22 March 2018
Provincial Environment Office	21 March 2018
District Environment Office	22 March 2018
Provincial Information, Culture and Tourism Office	21 March 2018
District Information, Culture and Tourism Office	22 March 2018
Village group meetings	22 March 2018

B. Design Completion Consultation

176. Following completion of a draft IEE, the EIA Decree requires public consultation to be conducted in the same period as reporting on the social impact assessment. Once the IEE is completed, it should be summarised and made available to the public for a period of at least 30 days. For this purpose, the IEE must be prepared in both English and Lao, and distributed to district administrations, where they will be made available for public review.

177. The PCM consultation was conducted within a combined social and environmental safeguard consultation process including in 3 sessions on 2 days. The first for Provincial Implementing agency representatives and the other in the subproject community with a focus on affected households and water user groups. Day one was conducted on the morning of 12th November 2018 at PAFO, Irrigation section office under the chairmanship of Mr. Somesamone Phalichan Deputy Director PAFO. A total of 15 participants were present – see the attendance sheet appended. Both environmental and social safeguard policy and the proposed EMP and LARP procedures and findings presented.

178. The presentation included reconciliation of ADB SPS and Lao PDR legislative and policy, presentation of the Grievance procedures, discussed and described the EMP provision for the range of environmental impacts and the expected mitigation responses, responsibilities and the time table for implementation plan for Nam Tong Project.

179. At the end of the consultation the chairman had communicated to other participants that everyone should remember and understand clearly the policy and know how to explain or describe the various requirement to project stakeholders.

180. Day 2 consultation was conducted in Khang Vieng administrative village. A total 51 participants were present – see table below.

Day 2 Participants:

Village	Total AHH	AHH attended	APAs	Female
Khangvieng	32	31	31	17
Meing	8	5	5	3
Nalam	7	4	4	1
Xuan	4	3	3	0
Total	51	43	43	21
		84%		49%

181. The meeting was presented with the environmental management plan and the LARP. Everything was explained slowly with regular discussion to ensure participants fully understood the presentation. Ethnic specific translation and discussion was provided for queries or clarifications.

182. Final consultations ion the IEE and EMP raised no direct concerns or issues. The facilitator directly challenged the group for the lack of issues in the EMP and was informed that there were

none. Focus on land issues within the LARP were not a concern as the Ahs reported that they had been consulted one on one and fully understood the proposed plans and responses.

183. The major issues raised is the time taken for the subproject to be delivered. A further consultation was held on the social impacts based on personal interviews at the Khang VIeng Village hall or in their own households. AH information from the 2 surveys (SES & DMS) were combined in a specific form for each AHH and used to explain each individual's situation along with land compensation and donation procedures. Two of adversely AHH from Xuan village reported they did not care about their land loss or compensation levels as the services received from the road is more important so their children can access schools more easily.

C. Information Disseminated

184. The preliminary engineering designs, along with estimates of potential impacts on land, the acquisition needed and compensation and resettlement for the subproject implementation, were used as the basis for discussions in meetings with the community. Additional specific meetings were then conducted with households whose land would be affected by the proposed rehabilitation or construction. Safeguard specialists assisted project engineers to disseminate and discuss the preliminary engineering designs with the community, and particularly with the affected households.

185. The meetings provided the information required to clarify: (i) the justification of the proposed subproject rehabilitation or construction works considering the anticipated resettlement impacts; (ii) mitigation measures to restore the affected households' livelihoods and standard of living; and (iii) assistance from the community or the district administration to plan, agree and implement the mitigation and support measures for the affected households. The consultations also covered the villagers' views on measures to mitigate the anticipated impacts including compensation and design alternatives to reduce impacts.

186. More details on information dissemination and consultation are provided in the SRIWSM's Resettlement Land Acquisition and Ethnic Group Development Framework, which forms a parallel safeguard document to this IEE.

D. Results from Consultation

187. Few environmental concerns were raised by the village participants at the consultative meetings. It was pointed out that the extent of agriculture in the catchment has decreased in the last 20 years, and the quality of forest increased, as a result of the government's policy of watershed improvement in this part of Xieng Khouang Province.

188. Few environmental concerns were raised during the consultations in the subproject area. Those that emerged are listed in Table 17. While most of the discussions focussed on accounts of development and environmental conditions in the general area, many participants at the consultative meetings were concerned that the quality of the catchment forests would be preserved and enhanced. This was not just for catchment protection, but also to ensure that it remains suitable for future exploitation of ecotourism potential. The local villagers had few concerns, mainly because they will be the beneficiaries of the project, though they recognised the need for capacity building in order to ensure that the benefits can best be attained.

Table 16: Matrix of Concerns Raised by Participants during Consultations

Consulted groups	Concerns raised
Provincial Agriculture and Forest Office	The PAFO's main concerns are to ensure that land utilisation in the catchment is well managed. They pointed to the difficulties of improving uses of the grassland for better livestock husbandry, and reducing the degradation of the forests because of the demand for firewood for drying tea.
Provincial Public Works and Transport Office District Public Works and Transport Office	The only concerns raised were the lack of this ministry's ability so far to provide the planned infrastructure for the villages in the subproject area, which will apparently be resolved by SRIWSM financing.
Provincial Energy and Mine Office District Energy and Mine Office	At present there are no formal mineral concessions in the subproject area. However, there are concerns about unregulated and illegal prospecting, which the offices are endeavouring to control.
Provincial Natural Resources and Environment Office District Natural Resources and Environment Office	The Phousan catchment area had been designated as national protected forest, which needs to be managed accordingly. A number of concerns were raised about aspects of environmental management by the project. These generally revolve around good land husbandry and the ensuring of sustainable agriculture to promote the livelihoods of the village residents. Control of fertiliser use was a particular concern.
Provincial Infrastructure, Culture and Tourism Office	Maintenance of the national protected forest for its ecotourism potential was mentioned as this office's key concern.
Village consultation groups	In general the villagers are highly supportive of the subproject, since they are to be the key beneficiaries. Support to build farmers' capacities to make the most of the new infrastructure was a requirement that they raised.

E. Grievance Redress Mechanism

189. The process for public consultation and information disclosure is described in the EIA Decree and the ADB SPS. The project developer is required to make people in the affected area aware of the project and what it will involve, and to collect their views, early in the IEE process. Likewise, the SPS, requires 'meaningful consultation' with affected persons to enable their informed participation in the project development process. The design process outlined in the PAM defines clearly the consultation steps required at the district, community, and water user group level. The initial disclosure and consultation meetings must then be followed up later on, to

release a draft of the IEE for comment over a period of at least 30 days through DONRE, Subproject village leadership and through consultations with villages and water users. Then consultation will be undertaken by PAFO with input from the national LIC consultant. Potentially damaging impacts must be made clear to all stakeholders.

190. Affected persons should also be consulted on project entry points and effective media and entry points for the project GRM. The project GRM is established to receive and facilitate resolution of affected peoples' concerns and grievances about the borrower's social and environmental performance at project level using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people. Key GRM focal points should be identified within Contractor, PPIT (being the Social Safeguards Staff member), PGT (being the safeguard focal point) and affected villages. GRM focal points will be trained on GRM implementation, including recording, monitoring and reporting requirements.

191. During the preparation of this IEE, the SPS and EIA Decree requires dissemination meetings to inform the affected villagers of the proposed project and the possible environmental and social impacts. The meetings must also be used to collect opinions from people who may be affected by the project and feedback provided on how the project will respond to issues raised. Assistance is to be provided by the local administrations. The following agenda should be used to ensure that there is an adequate exchange of information and opinions.

(i) A summary of the works proposed under the subproject.
(ii) A summary of subproject objectives, and likely positive and negative environmental impacts, covering the construction phase and operational impacts.
(iii) Invitation for feedback in respect of any areas of concern that the public may have, and suggested means of mitigation.
(iv) Acceptability of the proposed works to the public.
(v) A request for information on the known occurrence of unexploded ordnance in the area where the scheme components will be built.

192. The dates, attendance records (names/gender/age/occupation), topics covered, summary of consultations and photos, are recorded and included in the IEE report. The consultation record should document how the project will respond to the issues raised. Comments may be added as to the ways in which corrections or further information have been provided subsequently.

193. Following completion of the draft IEE, the EIA Decree requires consultation meetings at provincial, district and again at village level. These were completed as part of the social and environmental consultations. Key issues raised were the need for community participation in monitoring of the Project, a desire to end the role of the banana concession, to ensure canal leakage and the impact on the access road were included in the project. Discussions with the community using drainage water informed these stakeholders about the continued access to drainage water after the SC1 command area is fully developed.

194. Once the IEE is completed, it should be summarised and made available to the public for a period of at least 30 days. For this purpose, the IEE must be prepared in both English and Lao, and distributed to district administrations, where they will be made available for public review.

195. During construction and operation, the project developer is obliged under the EIA Decree and SPS to inform project-affected people and other stakeholders of project activities which are

likely to create environmental and social impacts, and to provide regular access to general information about the subproject.

196. In addition, should people affected by the subproject have any grievances, they have the right to lodge complaints through a GRM established for the subproject. The GRM provides a process for affected persons to lodge complaints regarding any aspect of the subproject, including implementation of environmental, social and resettlement safeguards. This process does not affect their right to file complaints with a court of law at any point in the process. Costs are borne by the project developer. Where complainants do not have sufficient literacy skills to express themselves in writing, they are to be encouraged to seek assistance from the subproject and nominated local non-governmental organisations, or other family members or village heads to have their grievances recorded in writing. All complaints and resolutions must be properly documented by the receiving entry point, whether through the project GRM entry points or through the country system. The GRM involves a series of procedural steps which provide recourse to district, provincial and national level authorities as may become necessary. These are described in Table 17.

Table 17: Procedural Steps in the Grievance Redress Mechanism

Step	Action
1	At the village level, an affected person (AP) files a complaint or grievance verbally or in writing to the Village Committee (VC) to seek resolution at village level. If unwritten the VC will record details of the complaint and provide consideration based on their traditional method of conciliation and mediation. Resolution is to be within five days after the complaint or grievance was received.
2	If no solution or understanding is reached within 5 days, the AP can bring the complaint at the district level. The GRU at the district level will meet the AP, and resolve within 10 days after receiving the complaint. If the AP is part of an ethnic group and requires assistance, representatives from the District LNF shall be appointed to assist by the DRC.
3	If the AP is still unsatisfied or has not received any decision from the GRU at the district level, he or she can seek redress at provincial GRU (within the PRC) that should decide the issue in 10 days. If the AP is part of an ethnic group and requests assistance, a representative from the provincial LNF will be appointed by the PRC.
4	If still unsatisfied with the decision of GRU at the provincial level, the AP may lodge an appeal with MONRE and the NPMO will monitor to ensure each complaint is resolved within 10 days after receiving the appeal.
5	As a last resort, the AP may request the case be heard by either the National Assembly or the local Court of Law.

VII. ENVIRONMENTAL MANAGEMENT AND MONITORING

A. Environmental Management and Monitoring Plan

197. The EMP is the key document that underpins this IEE and ensures that the required environmental safeguards will be adequately implemented. The EMP for the Nam Tong subproject is an essential document that must be read in combination with this IEE.

198. Although environmental management and environmental monitoring plans are often issued as separate documents, for SRIWSM they are combined. The purpose of the monitoring plan is to ensure that the management plan is being implemented. Combining the two helps to ensure that this happens, and also clarifies the institutional responsibilities.

B. Institutional Responsibilities

199. **Institutional arrangements for implementation of environmental safeguards.** The **PGT** will appoint a qualified environmental safeguards officer to supervise and co-ordinate implementation of environmental safeguard requirements with support of the LIC International and National Environment Specialists. The PGT Project Director will be responsible for submitting environmental safeguard reports to ADB for clearance and disclosure. They will also carry out regular monitoring during implementation and prepare a summary of progress of EMP and GRM implementation for the quarterly project progress reports. They will participate in ADB loan review missions, ensure that semi-annual environmental safeguards monitoring reports are submitted to ADB on time and follow-up on agreed actions.

200. Each **PPIT** will nominate an environmental safeguards focal point to support LIC Environment Specialists and PGT with co-ordination at the province and district level. The PPIT environmental safeguards focal point will undertake joint site visits with subproject Supervision Consultants and Contractors to review implementation of EMP and GRM and report issues to PGT and LIC. PPIT will co-ordinate environmental quality monitoring with PONRE and invite PONRE to join site visits and ADB loan review missions.

201. The **LIC Environmental Specialists** (LIC ES) will provide safeguards capacity development training for PGT, PPIT, LIC, Contractors and GRM focal points on EMP mitigation and monitoring measures, Contractor EMP preparation, templates for environmental monitoring and report. LIC ES will screen and assess additional subprojects proposed under Output 3 and any other infrastructure requiring civil works under other outputs and prepare the environmental safeguards reports and ensure that RSP environmental safeguard reports are updated based on detailed engineering design.

202. The **Contractor** will be required to develop a site-specific Construction Environmental Management Plan (CEMP) in accordance with the IEE/EMP and designate an environmental health and safety (EHS) Officer to supervise and train workers on occupational and community health and safety practices and to monitor and report on implementation of EMP/CEMP and corrective actions. A GRM focal point/community liaison officer should also be designated to ensure public disclosure of planned construction to affected persons and monitoring and reporting on GRM. Each works Contractor EHS Officer will prepare a monthly report on EMP/CEMP and GRM implementation for submission to PPIT, PGT and LIC.

203. The **construction supervision staff member of each PPIT** (CS) will ensure a CEMP is prepared for each Category B subproject and an Environmental Code of Conduct for each Category C subproject. The CS will be responsible for day to day monitoring of implementation of health and safety and EMP/Code of Conduct requirements and issuing instructions for corrective actions, as needed.

C. Capacity Building

204. Training and capacity building of environmental capabilities will be part of the remit of the project implementation consultant see Table 1. At provincial, district and subproject levels, it will

use formal seminars and training courses focused on the needs of the individuals working with each of the stakeholder organisations, as well as guided on-the-ground action learning-through-doing.

Table 18: Environmental Safeguard Capacity Strengthening Plan

Topic	Trainee	When	Training Responsibility
Project Awareness	WUG Official DONRE PONRE assigned staff and Section Head PAFO Safeguard Focal Point PAFO Construction Supervision	Q1-2 Project year 1	PGT Project Management Advisor
ADB and Govt Environment Safeguard Requirements	DONRE PONRE assigned staff and Section Head PAFO Safeguard Focal Point PAFO Construction Supervision PPIT DIrector	Q2 Py 1	LIC National Environmental Consultant and National Project Management Advisor
Environmental Documentation – Additional Subproject Processing	WUG, Assigned staff PONRE and DONRE PAFO – construction supervision	Q2-3 PY 1	LIC Project Management Advisor –PGT LIC International and National Consultant
Environmental Monitoring – RSP	WUG Assigned staff PONRE and DONRE PAFO – construction supervision	Q3 PY 1	LIC International and National Environmental Consultant Lt National Construction Supervision Consultant

Topic	Trainee	When	Training Responsibility
Environmental Reporting	Assigned staff PONRE and DONRE PAFO – construction supervision PPIT Project Management Advisor	Q4 PY1 and Q1 Py2	LIC International and National Consultant
Environmental Sampling and water Flow data analysis	Assigned staff PONRE and DONRE PAFO – construction supervision PPIT Project Management Advisor	Q1 Py 2Q2 PY 2	LIC International and National Consultant

D. EMP Budget

205. The budget[6] for the implementation of the IEE and EMP include the items in the following table – however training of PONRE and DONRE staff is included in the LIC terms of reference and are not included in the table below as they are not budgeted inputs by individual subproject.

Item	Amount (USD)
Monitoring Equipment	600
Sample Testing	5,800
Allowances	11,000
LaoGap- IPM implementation	17,800
Subtotal	35,200

VIII. CONCLUSIONS

A. Justification of the Proposed Subproject

206. This IEE provides an overview of the proposed subproject and its purposes. It provides a brief description of existing environmental conditions. It makes an evaluation of the likely impacts that will occur to the environment as a result of the proposed subproject activities. It outlines the

[6] Costs for implementing the water testing, if required due to the changed cropping intensity will be included in the irrigated agriculture support financed by IFAD PICSA project

mitigation measures that will be required to ensure that no part of the project causes significant damage to the environment.

207. The evidence assessed suggests that, as previously determined, the subproject indeed complies with environmental appraisal classes of MONRE category 1 and ADB category B, which are satisfied by the preparation, review and approval of an IEE and accompanying EMP. Overall, it is considered that the enhancements of rural livelihoods in the subproject catchment through increased access to reliable year-round irrigation and better access, along with the proposed watershed management improvements, will benefit the socio-economic environment directly and the bio-physical environment indirectly. Adverse environmental impacts will certainly occur in the implementation and operation of the subproject, but ways have been identified to mitigate them and keep them within acceptable limits.

208. It is therefore recommended that the Nam Tong Subproject be approved for funding and implementation, conditional on full and diligent adherence to the Environmental Management and Monitoring Plan that accompanies this IEE.

B. Environmental Management and Monitoring

209. The EMP has been prepared on the basis of the design for the subproject, and its likely effects on the environment, that has been evaluated in this IEE. It defines the anticipated environmental impacts, the measures required to mitigate them, the responsibilities for doing so and the responsibility for monitoring that they have been undertaken effectively at the right time. Following the approval of this IEE, the EMP forms the guiding document to ensure that all necessary environmental safeguards are put in place.

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Appendix 1. Records of Consultations

Provincial Agricultural and Forestry Office

General information (whole province)

"The existing irrigation dam were destroyed due to the natural disaster in 2013.
In the catchment area has less encroach forest because it is the protected forest and was provided the development program (TABI) until 2016. "

Current situation of catchment use

In the catchment area still occur the forest encroach over controlling,

The reforestation need, and need to conduct the awareness program on the reforestation,

The decreasing of the shifting cultivation by supporting the sustainable agriculture programs,

The general measure for preventing the soil erosion from the steep agriculture activities and including the upland rice field, had been aware that the upland plantation should not be over than 35 degree of the land slope, but somehow for the actual activities of the agriculture programs and local activities could not fully follow the dissemination because of the limited of land use and actual condition of geological condition.

The tea plantation and natural tea collection at Phousan at Ban Xouan has been one of the village income, the trader proposes villager to collect the quality tea at Phousan and come to buy the tea at the village. Local authority provided the priority for the village to conduct this kind of their occupant and earn more income from the tea collecting, and also support villagers to have the tea seeing and planting along the protected forest condition.

"Province and district authorities had provided the land use management program (called TABI program) to the Village Development Group which included the Nam Tong catchment, in order to support villagers and local people well understanding on the land use management and sustainable use of land along the National Protected Forest Phousan, which includes the tea planting and collecting measure for sustainable forest and catchment protection.

Providing the awareness program for the local people on the conserving water course for the fish seeding, and fish passage area.

During the rain season support to plant the Kainoi rice, vegetable planting and natural release the fish in the paddy field, corn planting and other.

During the dry season support to plant the garlic, fish pond, organic vegetation.

"

"Provincial concern issue on:

The limit of the land use for agriculture are (1) barren area could not be used for plantation and (2) extending the shifting cultivation and (3) under well control of the grass land development for livestock, (4) lack of permanent occupant of the villagers, and (5) over due use of fire wood for tea oven; which of those reasons have reflected to the lack of forest and/or catchment protected concern, even there are not large reflecting in the Nam Tong catchment area but the future socio-economic development demand may cause of the land use.

So, the provincial authority has proposed the potential solution by propose the development programs to support the villagers in order to having the permanent occupation and income such as (i) providing the sufficient cycling upland field, (ii) providing the livestock fund (iii) support the developed grass land for village group but not for individual (iv) support the tea seeding at the natural forest and sustainable use of the forest and tea planting (v) providing the accessibility to the local people for tea and other original tea and vegetable plantation, (vi) support to plant the fruit plantation and economic timber trees (vii) support to fish pond product (viii) providing the cycling rice field for no land household and (ix) supervise on the possible market trend and investment. "

Provincial Public Works and Transport Office and District Public Works and Transport Office

"The current access road condition around Nam Tong catchment are (1) pave road through Ban Khungvieng to Ban Nalam is the garvel road which could be used into 2 seasons, and (2) there is 4.5 km length, and another pave road to access Ban Xouan is 4 km length.

The current development plan for improving another accessibility near by Nam Tong is no yet planned."

The potential development plan is to continuous the several social-economic development plan 2016-2020, which to focus on improvement the village become the developed villages until 2020.

There is a proposed plan for providing the access road from Ban Xuoan to Ban Nalam, which it is not progress until the present.

"Ban Khungvieng social economic condition, the economic infrastructures had been developed for facilitate the local people to having the electricity, and water supply. The agriculture activities are grass land planting for household livestock; rice plantation, the household fish pond, poultry and pig farm and organic vegetation. The conducting of the forest management had focused on the protected forest and land use management for village authorities conservation. The village access road and three bridges had been maintained by villagers.

Presently, all households has permanent toilets and the village has Nam Lin 65% and ground water 35%. The proposed development programs expects to have the extension of Nam Lin, electricity system, road maintenance, overflow irrigation, increasing the livestock program and increasing the organic plantation.

The agro-forest program proposed to increase more product 30%, increase the livestock income 10%.

The forest management and protection and preventing the forest encroach under the forest law.
"

"Ban Mieng NaLam social economic development, the livestock program is the income source for the villagers, the forest protection activity had been enforced by the district authority, there are 12 irrigations which could provide the water for annual rice plantation. The health centre is available for villagers and the specific case would be transported to district and provincial hospital. The village has one temple and no conflict of the traditional culture.

The villagers expect to increase the quality and quantity of the rice product, increasing the livestock program, supporting the handicraft program, and increase the dry season plantation, providing the village development fund, and arranging the forest and land use management.

Provincial Energy and Mining Office

"The mineral protection programs had been proposed in Pek district such as KKs Ltd and YangXern Mineral Ltd, which of those programs had end until 2017.

"There is no specific mining program in the Nam Tong catchment area, but there are a few small over flow dam for preserve the water use during the dry season.

Xiengkhouang province has 88.7% of the agriculture area, 0.4% is the economic tree plantation area and 10.9% of total area had mineral program, while there is not mineral program in Nam Tong catchment area.

Total approved projects in Xiengkhouang province area are 24 projects (44,163 ha) of agriculture program, 4 projects (173 ha) of the economic tree plantation and 62 projects (5,454 ha) of the mineral exploration program.

The agriculture activities are livestock, vegetable plantation, and economic tree plantation.

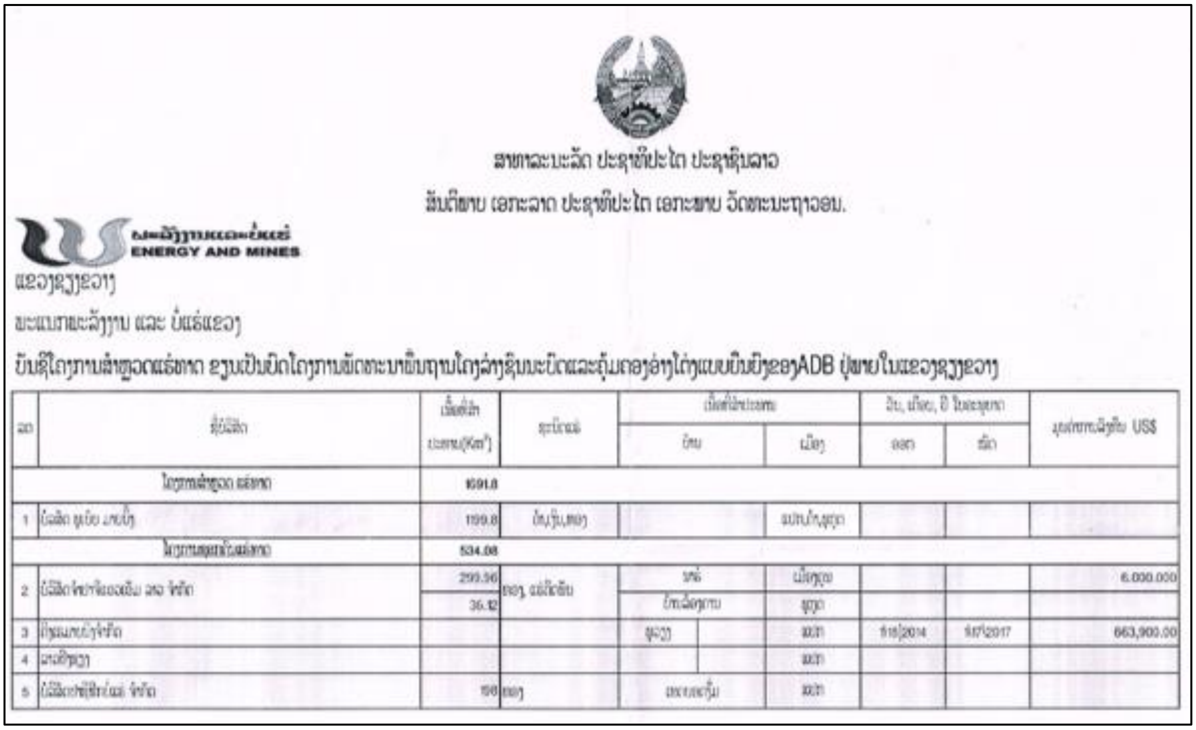
District Energy and Mining Office

Cooperate with the PEMO to conduct the field monitoring at Ban Somsavath on the proposed mineral prospecting project, by NaOum Trading and Agriculture Ltd. Ref.No: 028/DEMO.PD reporting document.

Continuous monitoring the unexpecting prospecting mineral project without the official informing and no official allowance.

"There are very few proposals for even small mineral exploitation programs in Pek district, but there is not any activity until the present.

CDE/TABI 2015, Lease and Concession project, Pek district, Xieng Khouang Province



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4	[illegible]				[illegible]			
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Provincial Office of Natural Resources and Environment

"There are 3 main villages under the project including Ban Nam Lam, Ban Khungveng and Ban Xouan which included into the TABI program until 2013.

"There is no potential infrastructure program at this moment.

There is a few proposed plan for small mineral exploitation but there is any progress until the present.

The Phousan catchment area had been announced to be as the national protected forest, which any tour development plan shall be the sustainable ecosystem tour and natural conserved tour program.
The germinated wild tea seeds collected from Phousan mountain above 1,700 masl and initial established tea gardens at Phoukhiou mountain(Phousand foothills) all are above 1,600 masl. Most of the big trees on this area are died standing in 2015 due to heavy frost.

"There is the trend for livestock, industrial vegetation, agriculture plantation and NTFP.
There is the trend for tour of the historical places, natural resources and cultural subject.
There is trend for export the traditional tea and other agro-forest product. "

Potential ISP on environmental concern

The environmental management plan could reflect to the socio-economic development sustainable including waste management, reduce the source of waste produce, manage and control the pollutant source, promote to reduce using the car instead of use bicycle and battery car, awareness for knowing about the air pollution into the villages, and monitoring on the pollutant

emission from the invested projects, protect and increase the forest area, promote the agriculture program, support the organic product, control the dangerous chemical import, provide the land use management and increase the green area.

The potential environmental mitigation on the agriculture by (1) limit the clear land use (2) support the organic vegetation, (3) limit the dangerous chemical (4) provide the clean technology (5) providing the awareness program, (6) Identify the native seed and environmental friendly.

The potential environmental mitigation on the industrial tree plantation by (1) control the chemical use and limited the waste produce (2) scope the land use clearly (3) create the land use management (4) having the participation from all related stakeholders, (5) provide the technical supervision (6) Awareness on the negative impact from chemical use.

The potential environmental mitigation on the livestock program by (1) scope the land use (2) identify the grass planting (3) disease check (4) inject vaccine (5) use of native and natural seed (6) monitoring QA/QC (7) build the union group (8) training on the technical supervision, and (10) to reuse of the compost fertilizer.

The potential environmental mitigation on the NTFP collection by (1) confirming on the market (2) increase the product price (3) build the union group for supporting the product (4) build the management system (5) build up the analized center (6) scope the protected area for NTFP.

For agriculture: paddy field and up land rice

Strong point	Weak point	Chance	Challenge	Env impact	Enviromental Mitigation measure
Producted area	No production technology	Market	Technical method to imcrese the	Soil quality decreasing due to the chemical use and no	Support and proposed the natural compost and fertilizer us
	Good seed	Organic product	Rice price	Waste water issue increasing due to the chemical use	Awarenesss on the use of pesticide and prevention
River	Labor	Upgrade of production system	Degarded soil	Lost original seed and traditional seed	Upgrade the product price by adding the natural value
Irrigation	Capital	Extending the irrigation system and channel	Seed	Conflict of land use management	Increase the modern technique and method
Electrical power	Vehicle and transport		Climate condition	Increasing the shifting clutivation area	Labour control
	Product price		Bio-agriculture	Decrease the forest area for extending the agricluture and other developed investment.	Control the use and sale the prohabited chemical product.
	Soil quality		Desease		Support and use of the organic product
	Agriculture development group		Decrease rice field for reseident area and other service		Awarenesss on the potential impact of the checmical use in the product.
	Technical supervisor				Increaseing the irrigation for sustainable agriculture

The main request to achieve to the social economic and environmental development plan are:
1. to have the specific public outreach to the local authorities on the development policy
2. Political training together with the actual implementation
3. Take more serious responsibility of the sectors' mandate and organization
4. Take more serious acknowledged and clearly understand the framework and target plan before any actual implementation
5. Take more focus into the local authorities and grown work with the clear technical supervision and support
6. Providing sufficient budget and plan
7. Improve the clarity of land use development plan and investment plan for increasing the investment unit and firms.

District Office of Natural Resources and Environment

The ISP is one of the guiding book for the district development plan, the catchment and environmental management plan are one of the ISP.
The main focus is to mitigate the use of chemical fertilizer from the agriculture program.
The district land use management and ISP mentioned that the potential land use of the Nam Seng catchment area is for reforestation in order to protect the protected forest and watershed area.

Provincial Infrastructure, Culture and Tourism Office

There is potential development plan on the (1) Phousan ecotourism, tea plantation and ancient tree tour, (2) Conserved the watershed area for forest ecotourism.

The potential plan shall be the district responsibility on the historical village at Ban Kung Vieng.

Village Consultations: Mieng Nalam, Khung Vieng and Ban Xouan

The villages agreed and welling to see the subproject occurs, there are a few proposes for this subproject are:
- to set the role and provide the irrigation system for use in whole year and could conduct 2 season rice plantation.
- to provide the agriculture fund
- to have the annual evaluation of the agriculture program and product
- to support the market for plantation product
- to provide the technical supervision for sustainable agriculture program
- to provide sufficient water quantity for agriculture plantation and livestock
- to supervise on the life rehabilitation and increasing the capacity building for living with the agriculture

Wildlife

No	Name	Always see	Rarely seen	Hunting number (-Unit)	Hunting time (-Time/Month)	Remark
1	Wild boar, Mupa		√ (at Houy Tong)	20 /year	Occasion	The wildlife has been decreased from before 20--- to 30 % due to the (1) increasing of the hunting nummber, (2) decreasing the natural habitat caused of the shifting clutivation.
2	Common palm civet, Ngen		√ (at Houy Tong)	20 /year	Occasion	
3	Wild chiken, kaipa		√ (all fellow forest)	20 /year	18 time a year	
4	Rat	√ (all fellow forest)	√ (all fellow forest)	20 /year	18 time a year	
5	Muntiacus feai, Fan		√ (at mixed deciduous forest)	20 /year	No	
6	Porcupine, Men		√ (At the streams)	20 /year	Occasion	
7	Monkey		√ (Mixed forest)	20 /year	Occasion	
8	Sciuridae, Kahok	√ (at mixed deciduous forest)		20 /year	18 time a year	
9	Tupaiidae, Katea			20/year	18 time a year	
10	Euroscaptor klossi, Aun	√ (all fellow forest)		20 /year	6 times a year	

Birds

No.	Bird name	Always see	Rarely see	Hunted bird per time (bird number)	Hunting freqency(time per season)	Remark
1	Riparia paludicola, Nok Aen	√		10 unit/year	6 time per dry season	Rarely seen and no hunt, in case of tracked for once occasion which it is for family only.
2	Barbet, Nok Tunglor	√		Occasion	Occasion	
3	Cisticola exilis, Nokkajip	√		30unit/year	6 time per dry season	
4	Baillon's crake, Nok Khaina		√	No hunt	No	
5	Leaf brid, Nok Khiewng		√	No hunt	No	
6	Asian Fairy Bluebird, Nok Sew		√	Occasion	No	
7	Crested Finchbill, Nok Khoak		√	No hunt	No	
8	Common shelduck, Nok Pet	√		Occasion	Occasion	
9	Parrot, Nok Keo	√		Occasion	Occasion	

Fish

No	Fish name	which stream had seen (name of stream)	distance from village (กม)	How many kg per time fishing(average per week)	Domestic Consumption	Sale, how many kg	Where to sale (village or market)
1	Poropuntius laocnsis, Pa Jad	Nam Tong and Nam Ngum branch	0.5-1km	0.3	Yes	No	For family
2	Puntiusaurotaeniatus, PaKhao			0.3	Yes	No	
3	Osphronemus goramy, PaMen			0.3	Yes	No	
4	Nemacheilidae, Pa Phanh			0.3	Yes	No	
6	Cyprinidae, Osteochilus lini, Pa morm			0.3	Yes	No	
7	Cyprinus carpio , Pa Nai			0.3	Yes	No	
8	Oreochromis niloticus, PaNin		500m-1km	0.3	Yes	No	
9	Devario salmonatus, Pa Siew			0.3	Yes	No	For family
10	Channa striata, Pa Kor			0.3	Yes	No	
11	Claias batrachus, PaDouk			0.3	Yes	No	
12	Anabas testudineus, Pa Kheng			0.3	Yes	No	
13	Macrobrachium sp. shrimp, Kouing			0.3	Yes	No	
14	Frog, Kob			0.3	Yes	No	
15				0.3	Yes	No	
16				0.3	Yes	No	

Forest Products Using Trees

No	Timber type	Last seen	Use or not	Use for what	Still have in the project area (many, not so many)	Finding place
1	Bamboo tubes, Mai Pong	current	use	sale	Many	All forest
2	Pine tree, Mai Pek	current	use for family	sale	Compare to 5 yr ago, it is decrease because it was used	Phou Kiew
3	Mai Mee	current	use	For community use	No change becaue no use	All forest
4	Teak, Mai Sakhai	current	use	sale		Mixed deciduouds forest
5	Apocynaceae tree, Mai XoumXoi	current	use	sale	Compare to 5 yr ago, it is decrease because it was used more by people..	
6	Castanea tree, Mai Kor	current	use	For community use	increase because of the protected forest program	
7	Rubiaceae tree, Mai Kao	current	use		Increasing because of its quick expanding	
8	Leguminosae, Mai Khea	current	use	sale	Compare to 5 yr ago, it was decreased 50% belcause it was used more by people.	

Non-timber Forest Products

No	NTFP type	Collect month, which forest	Whom collect(male or female)	Domestic consumption (Eat or sale)	How many Kg per year	Price per kg (kip)	Where to sale	Remark
					Kg		(village or market)	
1	Mushroom	Nov-April (mixed foresst)	Female	Eat and sale	300	60000	Market	The NTFP has been decreased from before 20- to 30 % due to the (1) increasing of the collecting people, (2) decreasing the forest area (3) was eatten by wildlife and animal/livestock (4) shifting clutivation and burning forest
2	San Bamboo shot	Sept- Nov (Phousan)	Female/Male	Eat and sale	10000	2000	Market	
3	Wild Vegetable	All year (all forest)	Female	Eat	No	No	No	
4	Mark	Nov-Apri, (mixed forest)	Female/Male	Eat and sale	10T/yr	15000kip/kg	Market	
5	Tea, xa	October - April (Phousan)	Female/Male	Eat and sale	1T/yr	100000kip/kg	Trader collects at village	
6	Oak, Castanea mollissima Blume, Mak Kor,	Nov-Dec (all forest)	Female	Eat and sale	200	400000/yr	Market	
7	Leguminosae, Phuk Xieng	Nov-April, (Phousan)	Female/Male	Sale	20 T/ yr	5000kip/kg	Trader collects at village	
8	Bannan leave and flower	Nov-March(all forest)	Female	Sale	NA	No	Market	
9	Rattan, Waii	Nov-March, (all forest)	Female	Sale	NA	No	Trader collects at village	
10	Euphorbiaceae, Kham Porm	Nov- Dec(all forest)	Female/Male	Eat and sale	10 T/ yr	1500kip/kg	Trader collects at village	
11	Passion furit, Mak Not	Oct- April(all forest)	Female/Male	Eat and sale	600kg	8000kip/kg	Market	
12	Passion vegetable, Yorth Mak N	Oct- April(all forest)	Female/Male	Eat and sale	400kg	500kip/kg	Market	

Participant Lists from Consultation Meetings

ໃບລົງທະບຽນ

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ວັນທີ: 22/03/2013

ລ/ດ No.	ຊື່ ແລະ ນາມສະກຸນ (Name and surname)	ຕາແໜ່ງ (Position)	ມາຈາກພາກສ່ວນ (Organizational)	ເບີໂທ (Phone No.)	ທີ່ຢູ່ອີເມວ (Email address)	ລາຍເຊັນ (Signature)
1	[illegible]	[illegible]	[illegible]	[illegible]		
2	[illegible]	[illegible]	[illegible]	55549995		
3	[illegible]	[illegible]	[illegible]	55661860	[illegible]	
4	[illegible]	[illegible]	[illegible]	55556340		
5	[illegible]	[illegible]	[illegible]	22094140		
6	[illegible]	[illegible]	[illegible]	29213555		
7	[illegible]	[illegible]	[illegible]	55049876		
8	[illegible]	[illegible]	[illegible]	55069232		
9	[illegible]	[illegible]	[illegible]	22533315		
10	[illegible]	[illegible]	[illegible]	22340657	chanthaouanthavong@gmail.com	
11	[illegible]	[illegible]	[illegible]	55599358	Touplome@gmail.com	
12	[illegible]	[illegible]	[illegible]	55876987		

ລ/ດ No.	ຊື່ ແລະ ນາມສະກຸນ (Name and surname)	ຕຳແໜ່ງ (Position)	ມາຈາກພາກສ່ວນ (Organizational)	ເບີໂທ (Phone No.)	ທີ່ຢູ່ອີເມວ (Email address)	ລາຍເຊັນ (Signature)
[illegible]	[illegible]	[illegible]	ADB TA [illegible]	5866 7070	[illegible]@gmail.com	[signature]

ກອງປະຊຸມ:

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ວັນທີ: 22 / 03 / 2018.

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1	[illegible]	[illegible]	[illegible]	55562226		[illegible]
2	ທ. [illegible]	[illegible]	—— ແ ———	52988689	demxkh@hotmail.co	[illegible]
3	ທ. [illegible]	[illegible]	[illegible]	22533315	sysouphanthorn@gmai	[illegible]
4	ທ. [illegible]	[illegible]	[illegible]	55599353		[illegible]
5	ນ. [illegible]	[illegible]	TA ADB [illegible]	58667070	[illegible]	[illegible]
6	ທ. [illegible]	[illegible]	[illegible]	29988999	Kmxpv8@gmail.co	[illegible]
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ວັນທີ: 22/03/2018.

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1	...	...	...	22240491		
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3	...	...	...	...		
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8	...	...	...	55367664		
9	...	...	...	030 5099999		
10	...	...	...	55019876		
11	...	...	...	030 5219273		
12	...	...	...	5684 0058		

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13	ທ ຄຳ ພາຍ	ນ/ກ	[illegible]	56581445		
14	ທ. ບຸນວັນ	ນ/ກ.	ບ້ານ [illegible]	0309937606		
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16	ທ ສົມສັກ	ຮ. ນາຍບ້ານ	ບ້ານ ນາລາມ.	23826664		
17	ທ ວັນໄຊ [illegible]	ຮ ນາຍ ບ້ານ	ບ້ານ ນາ ລາມ	99823484		
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19	ທ. [illegible]	[illegible]	[illegible]	22340652	pedclaos@gmail.com	
20	ທ. ບຸນ[illegible]	ວິຊາການ	[illegible]	55599353		
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ວັນທີ: 21/03/18.

ລ/ດ No.	ຊື່ ແລະ ນາມສະກຸນ (Name and surname)	ຕຳແໜ່ງ (Position)	ມາຈາກພາກສ່ວນ (Organizational)	ເບີໂທ (Phone No.)	ທີ່ຢູ່ອີເມວ (Email address)	ລາຍເຊັນ (Signature)
1	...	...	...	22996000	somsamone@live.com	
2	...	...	———	22533315	sysouphanthorn@gmail.com	
3	...	...	...	55599353	Touplome@gmail.com	
4	...	...	TA ADB ...	5866 7070	souvisb72@gmail.com	
5	...	...	...	22340549	Saylomsipd@hotmail.com	
6	...	...	...	23222220	simthanou_dxp@yahoo.com	
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1	ທ. [illegible]	[illegible]	[illegible]	22341148	Bounpany.o1@gmail.com	[signature]
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3	[illegible]	[illegible]	[illegible]	55049826		[signature]
4	ທ. [illegible]	[illegible]	[illegible]	55599353	Touplome@gmail.com	[signature]
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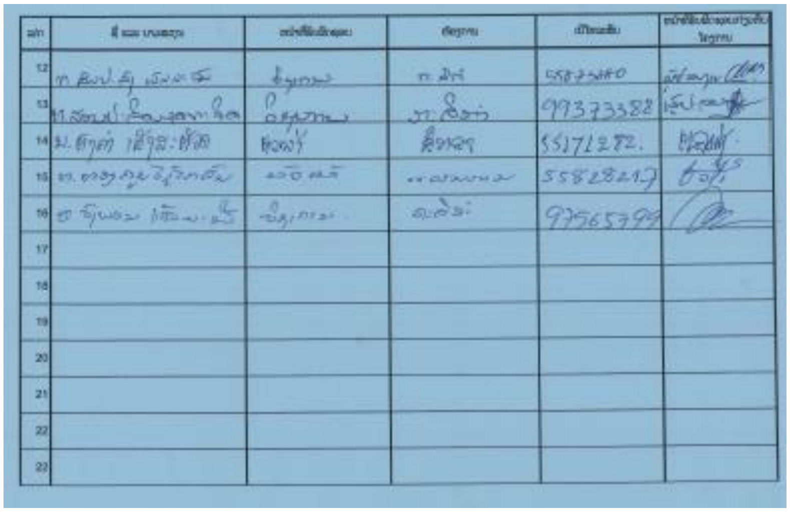
Appendix 2. Photographs from Consultation and Field Visits


ພັກປະຊາຊົນປະຕິວັດລາວ ຜູ້ມີກຽດສະຫງ່າ ໝັ້ນຍືນ!

ANNEX PCM Consultation Attendance sheets

Day 1: Officials



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Day 2:

ໃບລົງທະບຽນຜູ້ເຂົ້າຮ່ວມກອງປະຊຸມເຜີຍແຜ່ ນະໂຍບາຍປົກປ້ອງສັງຄົມ ແລະ ສິ່ງແວດລ້ອມ

ໂຄງການປັບປຸງ ແລະ ກໍ່ສ້າງຊົນລະປະທານ [illegible]

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ລ/ດ	ຊື່ ແລະ ນາມສະກຸນ	ໜ່ວຍທີ່ຮັບຜິດຊອບ	ທີ່ຢູ່ງານ	ເບີໂທລະສັບ	ໜ່ວຍທີ່ຮັບຜິດຊອບກ່ຽວກັບໂຄງການ
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7	[illegible]	—"—	—"—	55421633	[illegible]
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Environmental Management Plan

Project Number: 50236-002
April 2019

Lao PDR: Sustainable Rural Infrastructure and Watershed Management Sector Project

Nam Tong Irrigation and Catchment Subproject
Pek District
Xieng Khouang Province

Prepared by the Ministry of Agriculture and Forestry for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 5 April 2019)

Currency Unit	–	Lao Kip (LAK)
KN1.00	=	$0.000116
$1.00	=	LAK 8,600

ACRONYMS AND ABBREVIATIONS

ADB	:	Asian Development Bank
AF	:	Additional Financing
CCA	:	climate change adaptation
CIFOR	:	Center for International Forestry Research
COL	:	Concessional OCR lending
DAFO	:	District Agriculture and Forestry Office
DALAM	:	Department of Agricultural Land Management
DDMCC	:	Department of Disaster Management and Climate Change
DMF	:	Design and Monitoring Framework
DRR	:	disaster risk reduction
EIA	:	Environment Impact Assessment
ERP	:	Emissions Reduction Program
FAO	:	Food and Agriculture Organization (of the United Nations)
GCF	:	Green Climate Fund
GDP	-	Gross Domestic Product
GIZ	:	Deutsche Gesellschaft für Internationale Zusammenarbeit (German International Cooperation Agency)
GMS	:	Greater Mekong Subregion
IEE	:	Initial Environment Examination
IMT	:	irrigation management transfer
ISF	:	irrigation service fee
IUCN	:	International Union for the Conservation of Nature
IWMI	:	International Water Management Institute
LDC	:	least developed country
LIC	:	Loan Implementation Consultant
MAF	:	Ministry of Agriculture and Forestry
MONRE	:	Ministry of Natural Resources and Environment
NGO	:	Non-governmental Organisation
NRI	:	Northern Rural Infrastructure Development Project
NSEDP	:	National Socio-economic Development Plan
NTFP	:	non-timber forest product
O&M	:	Operations & Maintenance
OCR	:	Ordinary Capital Resources
ODA	:	Overseas Development Assistance
PAFO	:	Provincial Agriculture and Forestry Office
PAM	:	Project Administration Manual
PDR	:	People’s Democratic Republic (of Lao)
PGT	:	Programme Governance Team
PIS	:	Provincial Irrigation Section
PLUP	:	participatory land use planning
PONRE	:	Provincial Office of Natural Resources and Environment

PPIT	:	Provincial Project Implementation Team
PRAP	:	Provincial REDD+ Action Plans
PRI	:	productive rural infrastructure
PRT	:	Pesticide reduction training
REDD	:	Reduction of Emissions through Deforestation and forest Degradation
RRP	:	Report & Recommendations to the President
RSP	:	representative subproject
SME	:	Small-Medium Enterprises
SRIWSM	:	Sustainable Rural Infrastructure and Watershed Management
TRTA	:	Transaction Technical Assistance
VDF	:	village development fund
WUA	:	water users association
WUG	:	water user group

GLOSSARY

Catchment	In its totality a catchment is equivalent to a watershed, however a watershed may comprise of micro-catchments and sub-catchments. In this document a catchment refers to a subset of the larger watershed.
Watershed	A topographically delineated area from which rainwater drains as surface run-off via a river or stream to a common outlet point (e.g. a large river, lake or the sea).
Watershed management	Securing watershed functions in a sustainable manner. Broadly these functions include: ➢ Ecological function: availability of sufficient good quality water over time, space; erosion control, soil fertility, biodiversity, clean air, carbon sequestration; ➢ Economic function: sufficient natural resource products like food, fuel wood, timber, water, fish, energy required for basic needs of the local population; income generating opportunities; ➢ Social function: maintenance of social structures; protection and development of knowledge and lifestyle arrangements; maintenance and revitalisation of cultural identity and values, recreational facilities.

NOTE(S)

(i) In this report, "$" refers to US dollars unless otherwise stated.

CONTENTS

Reference Documents

List of Appendixes

I. INTRODUCTION

A. Nam Tong Subproject

1. The Nam Tong Subproject is to support the upgrading of two irrigation intake headworks and their distribution systems for a lowland command area of 173 hectares and support to change the catchment land use behaviour from annual cropping, use of burning, and the degradation of village forest from grazing. The productive rural infrastructure (PRI) element involves the upgrading of two hydrologically linked irrigation system, to make them more resilient and to provide dry season irrigation. At present the headworks and canal offtakes are at risk from flood events, so that floods in the river can be transmitted along canal causing damage to both the canal structures and at the headworks.

2. The proposed subproject engineering works will consist of the following elements: (i) improvement of two headworks (H3) in the lower reaches and replacement of headworks (H2) in the mid reaches of the Nam Tong system. The subproject will install fish passes at both of these headworks; (ii) installation of water control measures to stop floods from the river washing down the canals; (iii) repairs and upgrading of the existing canals, particularly lining; and (iv) construction of O.5 km of access road adjacent to Nalam Village and a further 2 km along the right bank of the river, above the upper headworks (H1) constructed under the CMI project.

3. Linked to the infrastructure work component of the subproject are safeguards in the catchment above the headworks, where watershed management improvements will be implemented to protect the watershed ecological services relating to soil and water protection.

B. Purpose of the Environmental Management and Monitoring Plan

4. This Environmental Management Plan (EMP) has been prepared in compliance with the specified safeguard requirements of the borrower, the Government of Lao PDR (the government), and the Asian Development Bank (ADB). It accompanies an Initial Environmental Examination (IEE) that: (i) provided an overview of the proposed subproject and its purposes; (ii) provided a description of existing environmental conditions; (iii) made an evaluation of the likely impacts that will occur to the environment as a result of the proposed subproject activities; and (iv) outlined the mitigation measures that will be required to ensure that no part of the project causes significant damage to the environment.

5. The EMP has been prepared on the basis of the design for the subproject, and its likely effects on the environment, as evaluated in the IEE. It defines the anticipated environmental impacts, the measures required to mitigate them, the responsibilities for doing so and the responsibility for monitoring that they have been undertaken effectively at the right time. Following the approval of the IEE, this EMP forms the guiding document to ensure that all necessary environmental safeguards are put in place.

6. Adherence to this EMP is a condition of the use of ADB financing for the Nam Tong Subproject. Acceptance of and a commitment to implement the EMP must form part of the contractual conditions for any physical engineering works under the subproject.

C. Use and Review of the EMP

7. Compliance with this EMP is an ADB loan covenant. The subproject works will construct infrastructure that support long-term changes to the environment. Consequently the management

and monitoring of environmental impacts should be continued for the life of the infrastructure, not just the construction period of the project. The EMP covers the design, construction and operation periods of the subproject. Each stakeholder requires to use different parts of the document at different times. It is recommended that the tables of responsibilities given in the appendices are extracted and used by the appropriate entities as the basis of their working practices on the project. The environmental monitoring team will need to use the monitoring table relevant to each phase. Once construction has been completed, it is recommended that the EMP be updated to form a simplified document for the operational period following handover of the infrastructure to its users. This should be done by the PAFO, supported by the Loan Implementation Consultant and in consultation with the PONRE.

II. RESPONSIBILITIES AND CAPACITY FOR ENVIRONMENTAL MANAGEMENT AND MONITORING

A. Summary of Institutional Arrangements

8. The executing agency of the SRIWSM is MAF, with support from the IA - Department of Irrigation (DOI). Implementation is decentralised to the Provincial Agriculture and Forestry Offices (PAFO) where implementation activities will be assigned to the respective sections of PAFO, co-ordinated by a Provincial Project Implementation Team (PPIT) for the management of the SRIWSM Project.

9. The executing agency (i.e. MAF) and IA (i.e. DOI) will establish a Program Governance Team (PGT) that would be responsible for: (i) establishing the operational procedures to be used by the PPIT, including planning, budgeting, financial management, procurement, disbursement, contract management, safeguard monitoring and compliance monitoring; (ii) ensuring both government and donor audit requirements are met; (iii) providing capacity building at the provincial level for both PPIT staff and potential contractors; and (iv) providing technical support for advanced engineering designs and project management teams, including the provision of skill mentoring and technical assistance input to procurement and contract management.

10. Government staff are involved in environmental management and monitoring at a number of levels and in two main ministries: MAF for both management and monitoring; and MONRE as delegated to PONRE for monitoring. Reforms of government to separate the environmental portfolio from agriculture and forestry started in 2017 and is not yet complete. Capacity in this respect is therefore still being developed, particularly at the provincial and district levels.

11. The capabilities required of staff varies depends on the phase of the subproject, and their level and remit, a sound understanding of the environment and society in the rural hill catchments of the northern provinces, and a particular understanding of current issues in both upland and irrigated agriculture is needed. PONRE staff have the underlying environmental knowledge but often lack the technical expertise to address specific issues. DONRE staff are far less experienced and qualified. The loan implementation consultant will be expected to help improve capacity and assist the government to improve its staff skills and knowledge in this respect. This should include support to PONRE and DONRE staff in their capabilities for environmental monitoring. The Loan Implementation Consultant (LIC) – both international and National will provide (i) Project awareness training, (ii) technical training with respect to environmental monitoring systems and techniques that will apply to their specific subproject, (iii) PONRE staff receive budgetary support for their additional costs on an output basis ie PAFO will pay for monitoring reports received. In addition, PONRE and DONRE monitoring staff will be supported for regular site visits by the construction supervision staff of PAFO.

12. During the project implementation period, which effectively involves subproject design and construction phases, safeguards are the responsibility of the Vice Governor Office represented by PAFO with support from the PGT within the Department of Irrigation. Environmental safeguard monitoring responsibility will be assigned to PONRE through a Memorandum of Understanding (MoU) between the Vice Governor Office, Director of PAFO and Director of PONRE.

13. At the provincial level, a PAFO will assign overall project management to an existing PAFO Deputy Director General to implement subprojects. Within each PAFO, the technical staff will be assigned to the PPIT must be able to monitor the implementation of works programs.

14. Following construction and commissioning, the subproject infrastructure will be handed over to and operated by the Water User Groups. The relevant PONRE will be responsible for environmental monitoring during operation.

15. The project implementation responsibilities as set out in the PAM are provided in Table 1.

Table 1: Project Implementation Responsibilities

Project organisation	Management Roles and Responsibilities
Ministry of Finance (MOF)	• Establish the Project's Advance Account, • Manage direct payments to contractors, • Provide replenishment reports to ADB, • Provide advances to Implementing Agencies Subaccounts, • Overarching financial control.
Ministry of Agriculture and Forestry (MAF) - Executing Agency (EA)	• The EA will constitute a national steering committee with representatives of MAF, Office of Governor (Implementing Agency – IA) of four northern provinces (FNP), MOF, Ministry of Planning and Investment (MPI) and Ministry of Natural Resources and Environment (MONRE). • Responsible for ensuring loan agreements and covenants and assurances are achieved. • Responsible for internal monitoring of the States' interests.
National Steering Committee (NSC)	• Provide guidance to the IAs and EAs in terms of project scope of work, expected performance standards, remedial action. • Ensure cross sector coordination and integration of work plans • Confirm annual performance. • Membership will include MAF – Minister, Governors of the FNP, Provincial Agriculture and Forestry Offices (PAFO) Director Generals (DG) from each province, and Deputy Director Generals (DDG) of Department of Irrigation (DOI).
DOI - IA	• Support and operate the Program Governance Team and represent the EA in the day to day implementation of the project. • Provide technical support on irrigation and institutional issues. • Consolidate financial and progress reports for the MAF ADB. • Consolidate and quality check all withdrawal applications and replenishment requests to be forwarded to MAF's Department of Planning and Finance (DOPF) for clearance and onward forwarding to MoF.
MAF's DOPF	• Define and validate the project management systems to be applied across the programme to ensure that government and ADB requirements are met. • Verify all subproject draft procurement (including safeguards) documentation prior to be submitted to ADB or publicly advertised.

Project organisation	Management Roles and Responsibilities
	• Undertake a quality control and verification of the quarterly and annual reports that will have document quality control procedures and an endorsement page. • Ensure financial management systems (FMS) are consistent with MAF's requirements. • Ensure that project reporting systems support both Government and ADB requirements. • Provide quality assurance for the replenishment and disbursement documentation to be provided to ADB and MOF.
Program Governance Team (PGT) within the DOI	• Overall program management and coordination of the project • Prepare a code of conduct including accountability of individuals, authority and levels of delegated authority, jurisdiction and mandate limits. • Produce a project management manual, and the supporting templates, guidelines for planning, budgeting, financial accounts, disbursement, procurement, contract management, reporting, safeguards and audit. • Provide the consolidation and quality assurance function with the project for all work planning, budgeting and financial management records, replenishment requests, withdrawal applications that are then forwarded to DOPF. • Conduct assigned procurement of (i) vehicles, (ii) equipment, (iii) LIC, and (iv) other consultants and service providers. • Facilitate the development of provincial contractor awareness and capability. • Provide technical support for setting up project management systems and templates in the Provincial project implementation team (PPIT) and the required capability to operate these systems • Appoint a Gender focal point from MAF' Women Advancement Unit (WAU) to oversee and support the implementation of the gender action plan (GAP). • Undertake safeguard screening of additional subprojects in line with Resettlement and Ethnic Group Development Framework (REGDF) and Environmental Assessment and Review Framework (EARF) to confirm classifications, and that subprojects that would be classified as Category A to be excluded. • Ensure safeguard frameworks (REGDF and EARF) are applied in the screening, selection and assessment of subprojects and preparation of safeguard plans, Resettlement and Ethnic Group Development Plans (REGDPs) and Initial Environmental Examination / Environment Management Plans (IEEs / EMP) at the subproject level, to be reviewed and commented on within 30 working days by ADB. • Monitor implementation of safeguard requirements as set out in the REGDF/REGDPs and IEEs / EMPs/Environmental Code of Conduct (ECC) during subproject implementation. • Ensure that all subproject design reports (SDR) clearly demonstrate dry season water availability for the reliable irrigation whilst ensuring environmental minimum flow is sustained. • Assign two staff to act as safeguards focal points – one for resettlement and social safeguards and one for environmental safeguards, to provide safeguard oversight and input to semi-annual safeguards reports for submission to ADB.

Project organisation	Management Roles and Responsibilities
Provincial Steering Committee (PSC)	• Each of the FNPs will establish a PSC chaired by the Governor, participating District Governors, Directors General of PAFO, Finance, Planning and Investment, Public Works and Transport Office (PWTO), Plant Protection Center, and Provincial office of Natural Resources and Environment (PONRE). • Review annual work plans and provide guidance on project scope and performance standards. • Approve annual work plans and receive regular progress reports • Establish operational memorandums of understanding (MOUs) between PAFO, PONRE, and PWTO.
Provincial Procurement Committee (PPC)	• Each of the FNPs will establish a PSC chaired by the Governor and including Provincial representatives. • Manage evaluation bidding documents, conduct scoring and ranking of bids. • Provide recommended procurement actions to PSC and PAFO.
Provincial Project Implementation Team (within the PAFO)	• Each provincial government will form within PAFO a Project Implementation Team (PPIT), aligned to the Provincial Irrigation Section (PIS). The PAFOs will identify implementation focal points in Department of Agriculture and Land Management (DALAM) and DOF to be seconded into the project management structure of the PPIT to support activities relating to land use planning, catchment management and land registration administration. • PAFO will establish a gender focal point from the WAU that will be responsible for ensuring the GAP is implemented and that all stakeholders are fully aware of the GAP and the associated responsibilities • Each PAFO will appoint a safeguards focal point to supervise implementation of safeguard requirements and to co-ordinate project specific grievance redress mechanism and support provincial program safeguards focal point on periodic safeguards monitoring and reporting. • Establish operational systems with staff assigned who have the capacity to maintain the project administration and management systems. • Establish and maintain subproject monitoring and impact assessment using the productive rural infrastructure (PRI) representative subprojects (RSP) as learning sites. • Coordinate the ADB-financed activities and integrate these with the activities of other donor-financed programmes working on watershed management. • Provide quarterly and annual reports and semi-annual safeguards reports according to the templates specified by the PGT. • Ensure subproject REGDPs if any and IEE/EMPs are updated based on detailed engineering design, approved by ADB and disclosed on ADB website prior to contract awards. • Obtain final approval from the PAFO DG in accordance with the Irrigation Law 2014 - (Article 38). • Obtain environmental compliance certificates from the relevant PONREs prior to award of civil works contracts. • With support from the PGT, identify local contractors and conduct awareness and capacity building programmes to increase the inclusiveness of local contracting companies.

Project organisation	Management Roles and Responsibilities
	• Complete land acquisition and compensation as per the REGDF prior to award of civil works contracts. • Contract management during implementation. • Ensure implementation of the mitigation and monitoring measures as set out in the EMPs and any required safeguards corrective actions. • Ensure implementation of the REGDF action plan. • Safeguards monitoring as per the land acquisition and resettlement plans (LARP) and REGDF subproject documents. • On project completion as confirmed by the construction supervision consultant (PG the Project Director (PAFO) conduct a site inspection in accordance with the Public Work and Irrigation Law. On confirmation of contract completion, PAFO will transfer the operation and maintenance (O&M) of the asset to the water user group (WUG). **For WUGs** • Provide awareness and capacity building on project activities, WUG implementation roles and procurement modalities. • Monitor and mentor water WUG contracting of in-command area works.
PONRE Land Registration Department	• Conduct land registration. • Issue land title and demarcation.
PONRE Environmental Management Department	• Conduct regular environmental monitoring of subprojects. • Undertake a general programme of monitoring environmental parameters (e.g. water quality) at strategic sample locations throughout the province. • A budget provision has been made for (i) training, (ii) travel and (iii) field allowances. Training is in the terms of reference (ToR) for the LIC consultants.
MAF _ Plant Protection Centers	• Identify the need for Pesticide Reduction Training (PRT), Crop Surveillance and integrated pest management as part of the LAOGAP quality assurance support
MAF – DALAM	• Agricultural land use planning guidelines and verification.
PAFO – DALAM	• Agricultural land registration survey. • Consultation of land users in command areas. • Land registration proposal for agricultural land. • Participatory land use planning (PLUP) responsibilities
MAF - Department of Forestry	• Provide training and leadership in the issues surrounding ecological service protection for the land use change programs • Forest Land Use Guidelines and quality verification
PAFO - Department of Forestry	• Forest Land use zonation and survey demarcation. • Participate in PLUP when requested. • Supervision of forestry activities funded by ADB.
Provincial Nutrition Committees	• Facilitate multi-sectoral coordination for nutrition, including coordinating joint baseline and end line surveys to be developed by the National Nutrition Committee (NNC) Secretariat; ensuring alignment with any National Nutrition Advocacy and Communication Strategy and Plan of Action, or similar; supporting Joint Government of Lao PDR – Development Partners Monitoring Missions, etc. • Coordinate implementation and monitoring.

Project organisation	Management Roles and Responsibilities
	• Undertake field monitoring activities. • Receive monitoring reports from districts and projects and provide annual and biannual reports to the NNC. • Provide leadership and support for District Nutrition Committees (DNC)
DNC	• Facilitate multi-sectoral coordination for nutrition, including identifying priority villages • Coordinate implementation and monitoring • Undertake field monitoring activities and provides annual and bi-annual reports to Provincial Nutrition Committee (PNC).
District Agriculture and Forestry Office (DAFO)	• Assign a focal point who should be at least a Deputy Head of the DAFO and should be the representative on the DNC. This officer will be responsible for planning and oversight of project Nutrition Support Advisor (NSA) activities in the district, including agreeing monthly and weekly workplans with the assigned technical staff • Assign one staff member to be responsible for the financial management related to project NSA activities • Assign up to 3 full-time equivalent technical staff as members of District Nutrition Teams, with preference for female staff and staff belonging to local ethnic groups • Permit these assigned staff to participate in basic nutrition training and ensure that trained staff remain assigned for the duration of the project • Select priority villages in coordination with the DNC. The primary criterion will be nutrition needs as identified by the DNC, taking account of any other completed, ongoing or anticipated NSA interventions. The secondary criterion will be to give preference to nutrition priority villages in the watersheds and command areas of the PRI subprojects. • Collaborate with the Lao Womens Union (LWU) to form nutrition clubs in the selected villages, and provide them with NSA activities using a farmers' nutrition school approach, resulting in group and / or individual NSA development plans • Provide technical support to facilitate implementation of the development plans

B. Institutional arrangements for implementation of environmental safeguards

16. **PGT.** The PGT will appoint a qualified environmental safeguards officer to supervise and co-ordinate implementation of environmental safeguard requirements with support of the LIC International and National Environment Specialists. The PGT Project Director will be responsible for submitting semi-annual environmental safeguard reports to ADB for clearance and disclosure. They will also carry out regular monitoring during implementation and prepare a summary of progress of EMP and GRM implementation for the quarterly project progress reports. They will participate in ADB loan review missions, ensure that semi-annual environmental safeguards monitoring reports are submitted to ADB on time and follow-up on agreed actions.

17. **PPIT.** Each PPIT will nominate an environmental safeguards focal point to support LIC Environment Specialists and PGT with co-ordination at the province level. The environmental safeguard focal point shall have a background in environmental and social safeguards and will receive training in project environment and social safeguards requirements by the LIC. The PPIT environmental safeguards focal point will undertake joint site visits with subproject Supervision

Staff and Contractors to review implementation of EMP and GRM and report issues to PGT and LIC. PPIT will co-ordinate environmental quality monitoring with PONRE and invite PONRE to join site visits and ADB loan review missions. The environmental safeguard provisions of all contracts will be monitored and supervised by PPIT construction supervision staff and PoNRE.

18. **Loan Implementation Consultants.** The LIC will assist the executing agency (i.e. the PGT within DOI), the implementing agency (i.e. PAFO) and the other project stakeholders in the design and construction of the subproject. For this reason, the Program Governance Team will contract a LIC with two environmental specialists (9 months International Environment Specialist and 17 months National Environmental Specialist) - See PAM for detailed ToRs for LIC Environmental Specialists (LIC-ES) to support subproject designs and the preparation of IEE and for the supporting and monitoring of the EMP during subproject implementation.

19. The environmental safeguard consultants in the LIC will undertake screening, classification and assessment of future subprojects and will train and support PONRE and DONRE staff with monitoring visits and preparation of monthly and quarterly safeguard reports that will be submitted to the Vice Governor, and the EA via the PGT in DOI. The LIC will support the PGT to prepare a summary of safeguards and GRM implementation to be included in the quarterly project progress reports to be submitted to ADB. The LIC will support PGT to prepare semi-annual integrated safeguard reports to be submitted to ADB. These reports will include details of issues raised and resolved through the GRM during the reporting period. The semi-annual integrated safeguards monitoring report will be disclosed on ADB website once approved.

20. During the design and preparation phase, the LIC environmental specialists will work with the WUG, PAFO and DAFO and the contractors for the subproject, to ensure the required environmental mitigation measures are incorporated into the final engineering designs documents. During the construction period, they must work with the subproject implementation partners to ensure that all of the environmental management and mitigation measures are fully complied with, as agreed in each IEE and as outlined in every EMP. The LIC Environment Specialists will provide safeguards and GRM capacity development training for PGT, PPIT, LIC, Contractors and GRM focal points on EMP mitigation and monitoring measures, Contractor EMP preparation, templates for environmental monitoring and report.

21. **Contractors and Subcontractors.** All contract documents must include the EMP (category B) or Environmental Code of Conduct (category C) and an environment section in the terms of reference for bidders, and environmental contract clauses for contractors that include special conditions for the protection of the physical, biological and socio-economic environments. These will underpin the obligations towards the environment that must be upheld by all contractors. There is a need to ensure that contractors, as the stakeholders with the shortest-term involvement in the subproject, do not give rise to long term liabilities for the subproject owners and other stakeholders through reckless practices.

22. While the contractors themselves must fulfil their environmental responsibilities, in most cases success in this respect requires strict management and supervision of the contractor during site works: this is the responsibility of PAFO. Because of the competitive bidding process and the emphasis on engineering works, there is often a tendency for environmental safeguards to be delayed by contractors in the hope that costs can be saved and overlooked by management staff as being of lower importance than the primary functional infrastructure. The contractor and IA staff will report on EMP implementation during monthly site meetings, and will formally report to Provincial Administration. Failure to effectively implement safeguard provisions could result in site

close down until a corrective action plan implemented is prepared and agreed with PPIT and implemented at the cost of the contractor.

23. The Contractor will be required to develop a site-specific Construction Environmental Management Plan (CEMP) in accordance with the IEE/EMP and designate an environmental health and safety (EHS) Officer to supervise and train workers on occupational and community health and safety practices and to monitor and report on implementation of EMP/CEMP and corrective actions. A GRM focal point/community liaison officer should also be designated to ensure public disclosure of planned construction to affected persons and monitoring and reporting on GRM. Each works Contractor EHS Officer will prepare a monthly report on EMP/CEMP and GRM implementation for submission to PPIT, PGT and LIC.

24. The construction supervision consultants (CSC) will review and approve the CEMP and ensure it covers all the required provisions of the subproject IEE and EMP. The CSC will be responsible for day to day monitoring of implementation of health and safety and EMP requirements and issuing instructions for corrective actions, as needed.

25. ADB will visit project sites and review project performance against the EMPs and legal agreements and as documented in periodic environment monitoring reports submitted by the PGT. If any of the safeguard requirements that are covenanted in the legal agreements are found not to be satisfactorily met, ADB will require the PGT to develop and implement an appropriate corrective action plan (CAP) agreed upon with ADB. If unanticipated environmental impacts become apparent during project implementation, ADB will require the PGT with support of LIC ES to (i) assess the significance of such unanticipated impacts; (ii) evaluate the options available to address them; and (iii) prepare or update the IEE and EMPs.

III. SUMMARY OF THE POTENTIAL ENVIRONMENTAL IMPACTS

A. Potential Impacts on the Environment

26. The IEE identified a number of potential environmental impacts. Some of these are beneficial, mainly directly to the socio-economic environment but also indirectly to the bio-physical environment. Although on balance these are judged to outweigh the negative impacts, as with most projects there are long lists of potential adverse impacts. As described below, and given in tables in this plan, there are means of mitigating these impacts so that the effects do not cause significant damage.

B. Enhancement Measures

27. Community organisation and development is the basis of the subproject. This will be enabled through assistance to the WUG to establish improved capacity and management systems, so that their members can best gain from the rehabilitated and enhanced infrastructure that the subproject will fund. Improved livelihoods are the intended outcomes for the beneficiaries, giving households dependent on agriculture a wider range of choices and access to more productive farming systems. These supports are to be financed under a IFAD project that provides market connectivity and agricultural and farming systems support and are considered as associated facilities within the ADB safeguard framework. ADB has included costs for these activities should the IFAD cofinancing be delayed.

28. An existing watershed management plan will be updated and then be used to guide the improved management of the Nam Tong catchment, which is the supply of the irrigation water

used. The plan is intended to ensure that the forested areas of the catchment are stabilised and degradation of forest reversed, and that upland agriculture is managed on a conservation basis with better protection of soils and judicious use of agrichemicals. Water courses are to be better protected from runoff from farmland, to ensure that the water quality in the Nam Tong remains safe for use in irrigation and fish ponds.

29. The infrastructure rehabilitated and upgraded by the subproject is designed to be resilient. This means that it should withstand both current and likely future extreme climatic effects while remaining functional. This is achieved by careful design on the basis of analysis of climate variables and change possibilities, to ensure that the structures are robust but not over-engineered at too high a cost.

C. Mitigation Measures for Adverse Environmental Impacts

30. Under the classification of subprojects into MONRE category 1 and ADB category B, all adverse environmental impacts must be mitigated; if they cannot be mitigated, then the category of the subproject would need to be changed and a full EIA undertaken; this would make it ineligible for SRIWSM funding. The identified risks are considered to be relatively easily mitigated in the course of designing and implementing an SRIWSM subproject.

31. The mitigation measures are listed in the Environmental Management and Monitoring Matrix, which is given below and forms the main operational core of this EMP. They cover all of the impacts identified. Most of them represent simple, practical, common sense measures to ensure that disturbance to the environment is limited to the minimum as a result of all subproject activities.

D. Specific Key Priority Concerns

32. Catchment land use needs to be improved in the water supply catchment of the subproject, both to realise the environmental benefits of the project and to safeguard the infrastructure investments. Part of the rationale for the SRIWSM is to reduce the risk to irrigation water sources and infrastructure to provide increased reliability to water users for them to invest in intensification and diversification of irrigated cropping systems. This is turn is expected to assist community members reduce its dependence on upland agriculture, since other land pressures mean that shifting cultivation is no longer just used by a limited population for subsistence, but is being used to produce cash crops for export and as a result is giving rise to an unsustainable rate of forest conversion.

33. The Nam Tong catchment has a relatively small proportion of land under annual cropping and more perennial land uses agriculture and is showing improvements to the areas and conditions of its forests, past loss and fragmentation of the forests had an impact on forest cover and the associated biodiversity. The extent that the underlying hydrology of the steep hilly watershed of the Nam Tong has been affected is unknown. Periodic disturbances to vegetation cover would also increase sediment fluxes in the river. In the long term, the effectiveness of the subproject irrigation facilities depends on the continued improvement in the quality and extent of vegetative cover in the catchment. This in turn requires the communities within the catchment to adopt improved land use planning, which will focus on intensified agriculture in the irrigated lowlands and leave more of the upper catchment under a longer-term cycle of forest use. Better land use management is therefore critical to the subproject achieving its purpose. Although in some provinces the responsibility for watershed management activities lies with other projects, in Xieng Khouang it is a core activity under the SRIWSM.

34. In some cases, mitigation measures cannot be defined precisely because there is inadequate information on which to base precise actions. Water flows are particularly little understood due to the lack of gauging stations maintained in smaller catchments. Defining compensatory flows throughout the year is therefore difficult, and initially must be based on estimates. The mitigation strategy in this case is to use as much information as possible to ensure that the initial estimates are as accurate as they can be, while starting to collect continuous series monitoring data. Because of natural variations from year to year, this process needs to be continued every year for at least ten years, and ideally throughout the life of the infrastructure, so that the compensatory flows can be updated as the running averages, minima and maxima for flow in each month become more statistically robust.

35. In a steep hilly catchment like that of the Nam Tong, and with the intense rainfall that occurs throughout northern Lao, the protection of soil surfaces is essential around all of the infrastructure that will be installed through the subproject. This includes irrigation headworks, canals and access roads. There are two main purposes for this. The first is to avoid erosion from rainfall, with bare surfaces highly prone to the entrainment of soil particles as a result of raindrop impact and runoff, leading to the loss of topsoil and increased amounts of sediment in water courses. The second is to protect earthworks from flood scour, when river or canal flows overtop the structures during high floods. Simple bio-engineering measures are the only effective way of protecting large surface areas from rainfall-induced erosion, and so this is a straightforward but critical mitigation measure in targeted key locations.

IV. ENVIRONMENTAL MONITORING

A. Environmental Management Plan

36. The EMP is the key document underpinning each IEE and ensuring that the required environmental safeguards are adequately implemented. This EMP follows the format provided in the EARF for the SRIWSM.

37. Although environmental management and environmental monitoring plans are often issued as separate documents, for SRIWSM they are combined. The purpose of the monitoring plan is to ensure that the management plan is being implemented. Combining the two helps to ensure that this happens, and also clarifies the institutional responsibilities.

B. Institutional Responsibilities for Environmental Monitoring

38. The institutional responsibilities for both the implementation and monitoring of environmental management measures is provided in detail above. Implementation of environmental management actions follows the same responsibilities as the overall construction and implementation of the subproject itself. The PAFO PPIT is responsible for subproject implementation and the participation of the WUG. During the project construction period, the PPIT and PONRE will be supported by LIC for monitoring.

39. The operational responsibilities for the subproject infrastructure will lie with the Water User Groups who will continue to be assisted by IFAD under the PICSA project. The combination of ADB and IFAD support seeks to institutionalize the operational management of irrigation infrastructure based on the increased incentives from dry season irrigated cropping. The application of irrigation service fees are sufficient to finance the operation and maintenance of infrastructure.

V. ENVIRONMENTAL MANAGEMENT AND MONITORING MATRIX

A. Introduction

40. The matrix below forms the practical management tool of the EMP. It lists the environmental impacts expected to be experienced on the Nam Tong Subproject, and the typical mitigation measures that can be used to avoid, minimise or restore the effects of these impacts.

41. The division of responsibilities between different agencies during the planning, construction and subsequent operation phases are given in simplified tables for the various sections of the PAFO (Appendix 2), the contractor (Appendix 3) and the Water User Group (Appendix 4).

42. Additional environmental monitoring by appropriate units of both the Ministry of Agriculture and Forests and the Ministry of Natural Resources and Environment is not always referred to in the matrix, but represent further safeguards on the project's activities.

43. The standards against which compliance is to be monitored are: (i) the Lao PDR National Environmental Standards (2017), including the surface water quality standards given in Appendix 5 of this EMP[1]; (ii) the International Finance Corporation's Environment, Health and Safety General Guidelines (2007); and (iii) the SRIWSM environmental guidelines given in Appendix 6.

B. Subproject Planning Phase during Project Implementation

44. Environmental mitigation in the design phase is principally the responsibility of the provincial representative of the project implementing agency (i.e. the Programme Governance Team in the Department of Irrigation), supported by the Provincial Project Implementation Team in the PAFO and the Loan Implementation Consultant company.

[1] Under Government If Lao Environmental Assessments an Environmental Management and Monitoring Plan (EMMP) is required, ADB requires a broader assessment within an Environmental Management Plan (EMP) … EMP is used to cover both of these documents

Table 2: Planning Phase Environmental Management and Monitoring

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
1.01	Loss of land or other property to infrastructure.	1. Full consent to the subproject must be sought through standard consultative processes. 2. Full and fair compensation As defined in the Land Acquisition and Resettlement Framework is applied	PIS - PAFO, supported by PAFO representative and project preparation consultant. 1. Before application to the project implementing agency for subproject funding. 2. Before signing a contract for the commencement of physical works.	DALAM - PAFO. 1. Before approval of project funding for the subproject. 2. Before approving any contract for physical works.
1.02	Loss of land of importance for biodiversity.	1. Subproject landtake is to be minimised. 2. Landtake is to use land that is already degraded, to the greatest extent possible. 3. No projects to go ahead in forest or protected areas. 4.	PIS - PAFO and engineering team of the project preparation consultant, supported by environment team of preparation consultant. 1. At the start of subproject design. 2. At each design review.	PONRE. Before approval of project funding for the subproject.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
1.03	(a) Incomplete hydrological data and as yet poorly developed climate change models lead to inaccurate designs for infrastructure. (b) Infrastructure is damaged by high flood levels, reducing the scheme's lifespan or effectiveness and causing damage to the nearby environment. (c) Downstream riverine quality is affected in very dry years due to abstraction of water for irrigation.	1. Care is to be used to interpret as well as possible the best available data for the subproject catchment. 2. A significant margin is to be allowed to ensure that infrastructure is likely to be resilient under current climatic conditions. 3. An additional margin is to be allowed to ensure that infrastructure remains resilient under possible future more intense or prolonged rainfall events. 4. Specially designed protection measures such as bio-engineering must be incorporated into designs as a matter of course. 5. Engineering designs must not be approved without adequate provision of protection against high flood conditions. 6. In very dry periods, released flows from the intake must be monitored to ensure that the minimum agreed environmental base flow is always provided downstream of the intake.	PIS - PAFO and engineering team of the project preparation consultant, supported by environment team of preparation consultant. 1. At the start of subproject design.	DG PAFO, DG PONRE. During subproject design.

1.04	Disruption of hydrological flows by offtake from rivers.	1. All available rainfall and flow data for the river catchment must be collected and assessed to provide a working model of average monthly flows throughout the year. 2. A hydrological gauging plate will be established upstream of the headworks, to help define acceptable dry season minimum flows. The proximity and flows of tributary streams close downstream from the proposed headworks must also be assessed. 3. A survey must be undertaken which establishes the cumulative minimum water needs of other existing users, plus ecological requirements. 4. A calculation must then be made as to the offtake that can be allowed. 5. Where no flow data exist, initial minimum flows of at least 10 percent apply as an absolute minimum however where the residual flow is found to be less than 30 percent of the estimated monthly average flow PONRE will review and provide PAFo guidance. . 6. Offtake regimes must be refined as more	PIS - PAFO and engineering team of the project preparation consultant, supported by environment team of Loan Implementation Consultant. 1. Gauging station to be installed at the start of subproject design. 2. Data to be re-assessed at each design review. 3. Data and offtake regime to be reviewed annually from the date of starting subproject implementation.	PONRE. 1. Review the emerging data in the light of observations and comments from water users, and discuss with the PIS whether adjustments to water flows are desirable.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
		data become available.		
1.05	Water supplies polluted by upstream land management practices do not comply with national standards for surface water. Given the extremely small extent of cropping in the catchment this is considered unlikely.	1. If there is doubt about water quality a water testing regime should be agreed with PONRE and implemented. 2. Under the PICSA IPM and Pesticide management programs a water quality risk assessment will be undertaken to, if required, customize a water quality testing program of surface water discharged from the command area	Project preparation consultant. During subproject design. PAFO, supported by Loan Implementation Consultant. PPIT, IFAD implementation team and P0NRE	PONRE. During subproject design. During the planning season for the first dry season crop
1.06	Upstream land uses cause a decline in the quality and quantity of water available for the irrigation scheme.	1. Discussions on updating the existing catchment land use plan will start within 6 months of project effectiveness to be included in the PAFO project workplan. The PPTA land use behaviour change programs will be implemented. Based on the design documents.	Watershed management, agriculture and forestry teams in PAFO and DAFO.	DALAM Before approval of project funding for the subproject.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
1.07	In stream headwork structures impede fish movement	1. All instream structures will have fish passage integrated into their design based on field survey of fish species, migratory pattern of these species.	PAFO – Irrigation Section Design engineers with input from PGT PAFO Procurement experts to ensure inclusion in works contracting Terms of references	Design review input – PONRE and Design Approval of procurement TORs for works contractors by PAFO and Provincial Steering Committee

C. Subproject Construction Phase during Project implementation

45. Environmental mitigation in the construction phase is principally the responsibility of the contractor, managed by the Provincial Project Implementation Team as the provincial project implementing agency, supported by the DAFO and the Loan Implementation Consultant.

Table 3: Construction Phase Environmental Management and Monitoring

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.01	(a) Release of silt into water courses from excavations and earthworks during construction. (b) Release of silt into water courses from poorly finished earthworks following construction.	1. The removal of vegetation and creation of bare surfaces must be minimised to essential areas only. 2. Vegetation clearance and earthworks may only be undertaken during the months of October to April. 3. Temporary sediment settling ponds built using strong stone or timber check dams (not bamboo or fabric silt fences) must be constructed to trap sediment from all earthworks that have unprotected surfaces at any time during the months of April to October inclusive. 4. Borrow areas, camp sites, temporary access tracks etc. must be fully rehabilitated back to a condition that is fully protected against soil erosion. 5. Bio-engineering surface protection must be planted on all bare earthworks during the months of May to July.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Throughout the subproject construction period. 2. Before issuing the contractor's certificate of substantial completion. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.02	Environmental damage of any form results from the poor understanding of subproject requirements by the contractor and subcontractors.	1. The Contractor EHS officer will prepare a CEMP to be approved by supervision consultant prior to starting works. 2. EHS Officer/GRM focal point to ensure details of subproject GRM entry point contacts are disclosed at camp, sites and affected villages. 3. EHS Officer to induct/ train workers on occupational and community health and safety practices 4. GRM focal points/community liaison officers to carry out regular consultation with affected persons. 5.	Contractor, PPIT Before mobilisation and as required eg. whenever the contractor mobilises a new subcontractor.	Programme Governance Unit in DOI. As per the timings given for implementation.
2.03	Clearance of vegetation leads to the unnecessary removal of trees and other plants.	1. No tree over 200 mm diameter at breast height (1.5 metres above the ground) may be cleared unless the design drawings specifically require it. 2. The contractor's site clearance plan must be limited to the agreed work site boundaries and must be approved by the PPIT's environmental representative before any clearance may be commenced.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Throughout the subproject construction period. 2. Before issuing the contractor's certificate of substantial completion. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.04	Temporary closure of irrigation systems during construction.	1. Contractors must provide a plan in advance to provide irrigation water into existing supply channels, which must be approved by the project implementing agency and the Water User Group. 2. If it is not possible to avoid temporary closure, then full and fair compensation is to be paid for loss of crops as a consequence.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before allowing the contractor to commence work. 2. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.
2.05	Disposal of soil from excavations such as irrigation canals.	1. Soil from excavations should be re-used in designs wherever possible. 2. Where soil is excess to engineering requirements and is treated as spoil, it must be disposed of in the nearest available approved location, and stabilised and protected from rainfall using bio-engineering measures.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Throughout the subproject construction period. 2. Before issuing the contractor's certificate of substantial completion. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.06	Release of dust into the atmosphere from excavations and other construction activities.	1. Earthworks must be halted during periods of strong winds. 2. Heavily used access tracks must be sprayed with water during dry periods. 3. On all unmetalled surfaces, construction traffic must be limited to 30 kmh within 250 metres of habitation and 80 kmh elsewhere. 4. Loads of dust-making materials must be covered. 5. Crushers must be fitted with water sprays to prevent dust emissions.	Contractor, managed by the PPIT and Loan Implementation Consultant. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.
2.07	Release of noxious gases into the atmosphere.	1. Vehicles and machines must be in a good condition and serviced regularly, to ensure minimal emissions. 2. All vehicles and machines must comply with the Lao PDR emissions standards.	Contractor, managed by the PPIT and Loan Implementation Consultant. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.
2.08	Noise nuisance from construction activities.	1. Contractors must not exceed statutory noise levels at any time. 2. Work sites within 500 metres of habitation: (a) must not operate during the hours of darkness or on holidays; and (b) must have noise-abatement measures installed for other periods.	Contractor, managed by the PPIT and Loan Implementation Consultant. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.09	Temporary use of land for construction affects livelihoods or leaves it damaged.	1. Land for use by any contractor or subcontractor must be agreed by both the PPIT and the local community authority before the contractor may have access. 2. Full and fair compensation is to be paid for loss of crops or other assets before the contractor may have access to the land. 3. The contractor must have a land restoration plan, which must have been implemented to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before work is permitted to start. 2. Throughout the subproject construction period. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.
2.10	Influx of temporary labour disrupts local communities.	1. Contractors and subcontractors are required to use the maximum local labour possible. 2. If a significant number of staff and workers (i.e. more than 20) are to be brought into the subproject site, then the contractor must provide a management plan and code of conduct for the staff and workers, that is approved by the local community authority.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before work is permitted to start. 2. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.11	Operation of construction machines affects both workers and local society.	1. The noise and dust reduction measures listed above must be adhered to. 2. Safety measures for machine operation must be defined and approved by the project implementing agency. 3. Machine operators and workers must be trained and certificated in the safe use of machines.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before work is permitted to start. 2. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.12	Pollution by hydrocarbons from construction plant.	1. The contractor must prepare a plan for the management of hydrocarbons, which must be approved by the PPIT before the contractor is permitted to mobilise to site. 2. Fuel and oil must be transported in properly designed vehicles meeting national standards. 3. Fuel and oil must be stored at least 50 metres from a water body, in covered and bunded locations, and dispensed under strict controls. 4. Vehicle and machine parking and service areas must have impermeable surfaces and the outlet drains must be fitted with oil traps. 5. Contractors must have spill clean-up equipment on site, and persons always present who know when and how to use it. 6. The contractor must have a land restoration plan that includes hydrocarbon facilities, which must have been implemented to the satisfaction of both the project implementing agency and the landowner before the contractor's final bill may be paid. 7. Any subcontractor must comply with the same rules, at the contractor's liability.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before the contractor is permitted to mobilise to site. 2. Throughout the subproject construction period. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.13	Pollution from construction site wastewater, from camps and other work sites.	1. The contractor must prepare a plan for the management of wastewater, which must be approved by the PPIT before the contractor is permitted to mobilise to site. 2. “Black” wastewater from sanitation facilities must be led to a properly constructed septic tank and soakaway. 3. “Grey” wastewater from washing and cooking facilities must be led to a septic tank or to a specially built reed bed filtration system. 4. Oil-contaminated water from workshops and fuel stores must be collected and taken to an approved municipal waste management facility. 5. The contractor must have a land restoration plan that includes wastewater facilities, which must have been implemented to the satisfaction of both the PPIT and the landowner before the contractor’s final bill may be paid. 6. Any subcontractor must comply with the same rules, at the contractor’s liability.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before the contractor is permitted to mobilise to site. 2. Throughout the subproject construction period. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.14	Pollution from solid waste materials.	1. Solid waste must be recycled wherever possible. 2. Non-recyclable solid waste must be sent to an official landfill site. 3. The contractor Open burning of solid waste is prohibited 4. must have a land restoration plan that includes solid waste, which must have been completed to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid. 5.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Throughout the subproject construction period. 2. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.
2.15	Injuries to workers and others.	1. Work sites must be clearly demarcated using barrier tape and all non-project personnel excluded. 2. All staff, workers and visitors to construction sites must be issued with appropriate personal protective equipment. 3. All staff, workers and visitors to construction sites must be briefed on safe working procedures for that site. 4. Every construction site must have a first aid kit and at least two persons always present who are trained and competent to use it.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before the contractor is permitted to commence work. 2. Throughout the subproject construction period.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.16	Disruption of cultural sites.	1. All small cultural sites (such as small shrines and graves) must be protected by the contractor during works periods. 2. A plan for the protection of cultural sites must be approved by the PPIT. 3. Once construction is complete the surrounding of such sites must be restored to their pre-construction condition.	Contractor, managed by the PPIT and Loan Implementation Consultant. 1. Before the contractor is permitted to commence work. 2. Throughout the subproject construction period. 3. Before returning retention monies.	PPIT environmental section. Quarterly or as required. PONRE. At quarterly inspections throughout subproject construction period.
2.17	Subsequent users may not fully understand how to manage the subproject works.	1. Instructions on managing the infrastructure must be provided to the end users before handover. 2. The operating instructions must be explained to the Water User Group. 3. Before handover, the operating instructions must be finalised and the EMP requirements included.	Contractor, supported by the PPIT and Loan Implementation Consultant. 1. By 6 months before scheduled handover of infrastructure. PPIT and Loan Implementation Consultant. 2. 6 months and 3 months before handover, and at handover. 3. At infrastructure handover.	Director of PAFO and PONRE. 1. 3 months before handover. 2. At infrastructure handover.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
2.18	Fish Passage design is correctly specified and implemented during construction	Construction supervision oversight Fisheries experts from Lao Aquatic Resource Research Center (LARReC) participate in site meeting pre construction and during construction of fish passage	PAFO irrigation section engineers	PAFO construction supervisor during site planning, (ii) pre inspection before any concrete or form work is completed, (iii) during final construction of the passage LIC env consultants to Review during all site visits

D. Subproject Operation Period following Project implementation

46. Environmental mitigation in the operation period is principally the responsibility of the Water User Group and the Provincial Irrigation Section in the PAFO, supported by other sections of the PAFO and the DAFO.

Table 4: Operation Period Environmental Management and Monitoring

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
3.01	Disruption of downstream hydrological flows due to offtake from river.	1. Once scheme operation commences, the gauged river flows and water offtake volumes must be reassessed. The scheme must then be revised accordingly.	PIS - PAFO. Annually.	PONRE. Annually.
3.02	Upstream land uses cause a decline in the quality and quantity of water available for the irrigation scheme.	1. The catchment land use plan should be continued indefinitely to ensure that the scheme is safeguarded throughout its operational life. 2. Arrangements for implementation of the plan must be maintained.	PAFO. Annually.	PONRE. Annually.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
3.03	(a) Extraction of water from a river causes a decline or loss of aquatic biodiversity. (b) Extraction of water from a river leaves downstream users short. (c) Subproject irrigation scheme requires more water than is available.	1. If these impacts occur, then it shows that the assumptions of water flow made during subproject design were wrong. This is likely to be due to a lack of flow data at design stage. 2. The minimum flow release must be recalculated, based on user needs and the latest data on river flow. 3. Water use by the subproject scheme must be reviewed against what is actually available. 4. A revised scheme management plan must be introduced, implemented, monitored and adjusted until it resolves the problem. 5. Instream structures will include fish passes	PIS - PAFO. If necessary, specialist expertise should be requested from the central Department of Water Resources and the central Department of Irrigation. Annually.	PONRE. Annually.

No.	Potential Impact	Safeguards or Mitigation	Responsibility to Implement and Timing	Monitoring, Checking and Timing
3.04	(a) Flood damage to headworks. (b) Erosion of canal banks, either from flood surges or normal flows.	1. All flood protection works must be maintained as per the design of the subproject, or any subsequent engineering works. 2. Any flood damage must be reviewed and appropriate measures designed for resolution. 3. Occasional minor flood damage should normally be resolved by using appropriate measures. 4. The use of civil engineering structures (i.e. concrete or gabion works) may be required in the event of serious damage from exceptional floods.	Water User Group, calling on the PIS – PAFO for advice if damage is severe. Annually.	PAFO and PONRE. Annually.
3.05	Increased use of agrichemicals	1. Identification of crops, cropping and farming systems 2. Support for Lao GAP training and awareness 3. Where warranted PRT 4.Where required, IPM training for specific crops that require pesticide use 5. Nutrient management regimes built into farm technology demonstrations	1. PAFO with Input from IFAD financed support services 2. PAFO Plant Protection Centre staff	1. Cropping season monitoring to capture detail of agrichemical use – PPIT, PAFO monitoring program implemented by WUG through mobile phone systems at sowing and harvest of each cropping season

VI. ENVIRONMENTAL MONITORING FORMAT

A. Recommended Format

47. Environmental monitoring in both the subproject construction phase and the subsequent operation period is principally the responsibility of the Environmental Section of the PONRE. During the construction phase, monitoring must be undertaken quarterly, or more frequently if deviations are observed or complaints received. During the subsequent and indefinite operation period, monitoring must be undertaken annually, or more frequently if deviations are observed or complaints received.

48. It is recommended that a simple table and traffic light system is used to indicate the level of seriousness of any lapses. A key and format for this is given below. The intention is to give a quick and clear indication of anything that is going wrong, who needs to take action to resolve it, and what they must do.

Category 3	Serious issue causing widespread pollution or other environmental damage.
Category 2	Significant issue causing localised pollution or other environmental damage.
Category 1	Minor lapses causing short term environmental damage that can be easily rectified.
Category 0	No environmental problems or previous problem resolved.
Category D	Issues requiring action but deferred due to plans for future activities that will affect them, or for other reasons.

Table 5: Monitoring Action Report

No.	Mitigation	Assessment of Condition	Corrective Actions Required	Timing	Cat.

B. Example of the Monitoring Format Used

49. The version of the monitoring table below shows a hypothetical worked example for some of the mitigation measures during the construction phase of the subproject.

Table 6: Monitoring Action Report – Nam Tong Subproject
[*Hypothetical Example, 1 September 2020*]

No.	Mitigation	Assessment of Condition	Corrective Actions Required	Cat.
2.01(1)	The removal of vegetation and creation of bare surfaces must be minimised to essential areas only.	Contractor is complying well and there are no areas cleared unnecessarily.	DAFO to continue encouraging contractor to go on complying.	**0**
2.01(2)	Vegetation clearance and earthworks may only be undertaken during the months of October to April.	Contractor commenced vegetation clearance on feeder canal in August to try to improve its schedule. Erosion has started and some neighbouring land has been inundated with sediment.	DAFO engineer must hold a site meeting with the contractor. The contractor must install emergency erosion control measures within one week. The contractor must also rehabilitate the damaged land in consultation with the engineer and the landowner, within one month.	**2**
2.01(3)	Temporary sediment settling ponds built using strong stone or timber check dams must be constructed to trap sediment from all earthworks that have unprotected surfaces at any time during the months of April to October inclusive.	These were installed successfully in March. However, the heavy rains in early August caused some damage near the headworks construction site, leading to some erosion and soil washing into the irrigation canal.	The contractor must repair the damaged sediment traps within two weeks. The DAFO engineer is to ensure this is done.	**1**
2.01(4)	Bio-engineering surface protection must be planted on all bare earthworks during the months of May to July.	Bio-engineering works were implemented on schedule in June. The grass has established well and is already providing a good protection from erosion on the main canal embankment.	The contractor is to continue to protect the site and ensure that livestock do not graze it during the forthcoming dry season. The DAFO engineer is to monitor.	**0**
2.03(1)	No tree over 200 mm diameter at breast height (1.5 metres above the ground) may be cleared unless the design drawings specifically require it.	No trees had to be cut in the process of these works.	Not applicable.	**0**

No.	Mitigation	Assessment of Condition	Corrective Actions Required	Cat.
2.03(2)	The contractor's site clearance plan must be limited to the agreed work site boundaries and must be approved by the PPIT's environmental representative.	The contractor is keeping to the agreed site boundaries in most cases. However, there are lapses in that the contractor's trucks are frequently parked overnight on the river bank and not taken back to the camp. Engine oil is dripping on to the soil surface and could be leached into the river.	The contractor must ensure that the trucks are parked in the correct location overnight, with immediate effect. The contractor must clean up the oil contamination within two days. The DAFO engineer is to ensure this is done.	**1**

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Appendix 1. Subproject Terms of Reference for Technical PONRE Staff

Category	Description
A: Position /Title	**Provincial Environmental Officer**
B: Position / Type	Staff member of the PONRE
C: Source	National
D: Qualifications	Degree in an environmental subject (e.g. soil science, botany, zoology, physical geography, ecology, forestry, agronomy or environmental science).
E: Experience	At least five years of field experience in the operation of rural infrastructure development projects (i.e. in project implementation).
F: Posting	Provincial Centre
G: Reporting To	DG-PONRE and National Environmental Safeguards Consultant
H: Role duration	21 person months over project years 2 to 6 inclusive.
I: Starting Date	Q2 of project year 2.
J: Deliverables	1. Successful implementation of the Environmental Management and Monitoring Plan for every GOL Category 1 subproject, or Environmental Codes of Conduct for non-qualifying subprojects, in the officer's province. 2. Provincial Quarterly Environmental Monitoring Reports.
K: Outputs	The officer will contribute as follows to the Project outputs in their province: 1. Environmental safeguarding of all subprojects are implemented and monitored as per the requirements of the Subproject EMP and as per the provisions of the Project Administration Manual (PAM).
L: Tasks	SRIWSM Outputs 1, 2 and 3: As directed by the National Environmental Safeguards Consultant, to undertake the following tasks. 1. Participate in training seminars provided by the Loan Implementation Consultant's team. 2. Support the Loan Implementation Consultant's team in undertaking the field studies and consultations necessary for future subprojects. 3. Co-ordinate the implementation of the EMP or Code of Conduct for every subproject in the province. Work with the relevant subproject stakeholders to support them in fulfilling their obligations under the plans and codes. 4. Undertake active on-site monitoring throughout the construction period of the subproject infrastructure. This should involve at least two site visits per week while the contractor is mobilised to ensure that it is fully compliant with the requirements of this EMP. 5. Undertake regular on-site monitoring during the infrastructure operation period until the termination of the project in the province. This should involve one site visit per month to ensure that the WUG's management of the new infrastructure is fully compliant with the requirements of this EMP. 6. Monitor the subproject areas that are the target of activities under these outputs, to determine whether there are any unexpected negative environmental impacts caused by the upgraded rural infrastructure. 7. Report findings to the Provincial Steering Committee and DG-PAFO. 8. Implement practical demonstrations of environmental mitigation actions as necessary to assist the subproject stakeholders in fulfilling the environmental safeguards as needed. 9. Assist project stakeholders in the collection of additional environmental data, particularly relating to meteorology and hydrology. 10. Undertake environmental sampling as necessary to ensure that safeguards are in place or to quantify lapses affecting air, water or soil.

	11. Complete the quarterly monitoring of the subprojects using the formats in the EMP to compile Provincial Quarterly Environmental Monitoring Reports from Q2 of year 2 onwards.

Appendix 2. Responsibilities of the Provincial Agriculture and Forest Office

Provincial Irrigation Section of the PAFO – Planning Phase		
No.	**What you Must Do**	**Why You Must Do It**
1.01	1. Full consent to the subproject must be sought through standard consultative processes. 2. Full and fair compensation as defined by the Land Acquisition and Resettlement Framework is applied	To compensate adversely affected persons for losses of land or other property to infrastructure.
1.02	1. Subproject landtake is to be minimised. 2. Landtake is to use land that is already degraded, to the greatest extent possible. 3. If previously undisturbed forest must be used (not planned as part of the design), the subproject would be changed to a different environmental category and would no longer be eligible for SRIWSM financing.	To compensate for the loss of land of importance for biodiversity.
1.03	1. Care is to be used to interpret as well as possible the best available data for the subproject catchment. 2. A significant margin is to be allowed to ensure that infrastructure is likely to be resilient under current climatic conditions. 3. An additional margin is to be allowed to ensure that infrastructure remains resilient under possible future more intense or prolonged rainfall events. 4. Specially designed protection measures such as bio-engineering must be incorporated into designs as a matter of course. 5. Engineering designs must not be approved without adequate provision of protection against high flood conditions. 1. In very dry periods, released flows from the intake must be monitored to ensure that the minimum agreed environmental base flow is always provided downstream of the intake.	To protect infrastructure from high flood levels in an uncertain climate setting.

Provincial Irrigation Section of the PAFO – Planning Phase		
No.	**What you Must Do**	**Why You Must Do It**
1.04	1. All available rainfall and flow data for the river catchment must be collected and assessed to provide a working model of average monthly flows throughout the year. 2. A hydrological gauging station must be established on the subproject catchment, upstream of the headworks, to help define acceptable dry season minimum flows. The proximity and flows of tributary streams close downstream from the proposed headworks must also be assessed. 3. A calculation must then be made as to the offtake that can be allowed. 4. Where no flow data exist, initial minimum flows of at 10 percent and where the residual flow is less than 30 percent of the estimated monthly average flow , PONRE will provide an assessment and recommendations to DG PAFO	To minimise the disruption of hydrological flows by offtake from rivers.

PAFO and DAFO Watershed Management, Agriculture and Forestry Teams – Planning Phase		
No.	**What you Must Do**	**Why You Must Do It**
1.05	1. IF evidence of excess agrochemical use in the catchment is found an assessment of the quality of water at the headworks is required 1. If the water quality is proven using robust sampling and testing regimes to be inadequate the subproject cease to operate.	In case water supplies polluted by upstream land management practices do not comply with national standards for surface water.
1.06	1. Updating the catchment land use plan and implementation of the PPTA land use change behaviour programs will be initiated in the first project year.	So that upstream land uses do not cause a decline in the quality and quantity of water available for the irrigation scheme.

Provincial Project Implementation Team of the PAFO – Construction Period		
No.	**What you Must Do**	**Why You Must Do It**
2.02	1. At a pre-mobilisation site meeting, the contractor must demonstrate a full understanding of the requirements of the EMP. 2. All of the sub-plans listed below must be created, reviewed, improved if necessary and accepted for approval. 3. The contractor must demonstrate that it is fully responsible for all subcontractors' adherence to the provisions of the EMP, and that it has formally ensured this.	To ensure that environmental damage of any form does not result from the poor understanding of subproject requirements by the contractor and subcontractors.
2.17	1. Instructions on managing the infrastructure must be provided to the end users before handover. 2. The operating instructions must be explained to the Water User Group. 3. Before handover, the operating instructions must be finalised and the EMP requirements included.	To ensure that subsequent users fully understand how to manage the subproject works.

Provincial Irrigation Section of the PAFO – Operation Period		
No.	**What you Must Do**	**Why You Must Do It**
3.01	1. Once scheme operation commences, the gauged river flows and water offtake volumes must be reassessed. 2. The scheme must then be revised accordingly.	To ensure that there is no disruption of downstream hydrological flows due to offtake from river.
3.03	1. If water shortages occur, which would show that the assumptions of water flow made during subproject design were wrong. This is likely to be due to a lack of flow data at design stage. 2. The minimum flow release must be recalculated, based on User needs and the latest data on river flow. 3. Water use by the subproject scheme must be reviewed against what is actually available. 4. A revised scheme management plan must be introduced, implemented, monitored and adjusted until it resolves the problem.	So that the extraction of water from a river does not cause a decline or loss of aquatic biodiversity, or leave downstream users short, if the subproject irrigation scheme requires more water than is available.

PAFO and DAFO Watershed Management, Agriculture and Forestry Teams – Operation Period		
No.	**What you Must Do**	**Why You Must Do It**
3.02	1. The catchment land use plan be updated and implemented indefinitely to ensure that the scheme is safeguarded throughout its operational life. The plan's primary objective is upstream catchment protection to ensure that the subproject irrigation scheme is safeguarded in terms of water supply and limited sediment supply. 1. Arrangements for implementation of the plan must be maintained.	So that upstream land uses do not cause a decline in the quality and quantity of water available for the irrigation scheme.

Appendix 3. Responsibilities of the Contractor

The subproject civil works contractor is responsible for the following actions during the construction phase.

Contractor – Construction Phase		
No.	**What you Must Do**	**Why You Must Do It**
2.00	1. Appoint qualified Environmental, Health and Safety Officer to manage site safety and implementation of EMP and GRM requirements. 2. Prepare subproject specific Construction EMP (CEMP) confirming how EMP requirements will be implemented. 3. EHS Officer to provide induction, training and toolbox talks for all Contractor staff and other site visitors. 4. EHS Officer to liaise with affected persons and local community 5. EHS Officer to implement and monitor any required corrective actions and resolution of issues raised through the GRM. 6. EHS Officer to report monthly to PPIT on implementation of EMP and GRM.	To ensure Contractor fulfils their contractual requirements to: provide and maintain a safe and hygienic working environment; implement, monitor and report on subproject EMP and GRM requirements effectively.
2.01	7. The removal of vegetation and creation of bare surfaces must be minimised to essential areas only. 8. Vegetation clearance and earthworks may only be undertaken during the months of October to April. 9. Temporary sediment settling ponds built using strong stone or timber check dams (not bamboo or fabric silt fences) must be constructed to trap sediment from all earthworks that have unprotected surfaces at any time during the months of April to October inclusive. 10. Borrow areas, camp sites, temporary access tracks etc. must be fully rehabilitated back to a condition that is fully protected against soil erosion. 11. Bio-engineering surface protection must be planted on all bare earthworks during the months of May to July.	To avoid water course pollution from releases of silt from excavations and earthworks during construction, and from poorly finished earthworks following construction.
2.03	1. No tree over 200 mm diameter at breast height (1.5 metres above the ground) may be cleared unless the design drawings specifically require it. 2. The contractor's site clearance plan must be limited to the agreed work site boundaries and must be approved by the PPIT's environmental representative before any clearance may be commenced.	So that the clearance of vegetation does not lead to the unnecessary removal of trees and other plants.

Contractor – Construction Phase		
No.	**What you Must Do**	**Why You Must Do It**
2.04	1. Contractors must provide a plan in advance to provide irrigation water into existing supply channels, which must be approved by the project implementing agency and the Water User Group. 2. If it is not possible to avoid temporary closure, then full and fair compensation is to be paid for loss of crops as a consequence.	To avoid temporary closures of irrigation systems during construction.
2.05	1. Soil from excavations should be re-used in designs wherever possible. 2. Where soil is excess to engineering requirements and is treated as spoil, it must be disposed of in the nearest available approved location, and stabilised and protected from rainfall using bio-engineering measures.	To ensure the safe disposal of soil from excavations such as irrigation canals.
2.06	1. Earthworks must be halted during periods of strong winds. 2. Heavily used access tracks must be sprayed with water during dry periods. 3. On all unmetalled surfaces, construction traffic must be limited to 30 kmh within 250 metres of habitation and 80 kmh elsewhere. 4. Loads of dust-making materials must be covered. 5. Crushers must be fitted with water sprays to prevent dust emissions.	To minimise the release of dust into the atmosphere from excavations and other construction activities.
2.07	1. Vehicles and machines must be in a good condition and serviced regularly, to ensure minimal emissions. 2. All vehicles and machines must comply with the Lao PDR emissions standards.	To minimise the release of noxious gases into the atmosphere.
2.08	1. Contractors must not exceed statutory noise levels at any time. 2. Work sites within 500 metres of habitation: (a) must not operate during the hours of darkness or on holidays; and (b) must have noise-abatement measures installed for other periods.	To minimise noise nuisance from construction activities.
2.09	1. Land for use by any contractor or subcontractor must be agreed by both the PPIT and the local community authority before the contractor may have access. 2. Full and fair compensation is to be paid for loss of crops or other assets before the contractor may have access to the land. 3. The contractor must have a land restoration plan, which must have been implemented to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid.	To ensure that the temporary use of land for construction does not affect livelihoods or leave it damaged.

Contractor – Construction Phase		
No.	**What you Must Do**	**Why You Must Do It**
2.10	1. Contractors and subcontractors are required to use the maximum local labour possible. 2. If a significant number of staff and workers (i.e. more than 20) are to be brought into the subproject site, then the contractor must provide a management plan and code of conduct for the staff and workers, that is approved by the local community authority.	To minimise the disruption to local communities due to an influx of temporary labour.
2.11	1. The noise and dust reduction measures listed above must be adhered to. 2. Safety measures for machine operation must be defined and approved by the project implementing agency. 3. Machine operators and workers must be trained and certificated in the safe use of machines.	To minimise the effects on both workers and local society from the operation of construction machines.
2.12	1. The contractor must prepare a plan for the management of hydrocarbons, which must be approved by the PPIT before the contractor is permitted to mobilise to site. 2. Fuel and oil must be transported in properly designed vehicles meeting national standards. 3. Fuel and oil must be stored at least 50 metres from a water body, in covered and bunded locations, and dispensed under strict controls. 4. Vehicle and machine parking and service areas must have impermeable surfaces and the outlet drains must be fitted with oil traps. 5. Contractors must have spill clean-up equipment on site, and persons always present who know when and how to use it. 6. The contractor must have a land restoration plan that includes hydrocarbon facilities, which must have been implemented to the satisfaction of both the project implementing agency and the landowner before the contractor's final bill may be paid. 7. Any subcontractor must comply with the same rules, at the contractor's liability.	To avoid the pollution by hydrocarbons from construction plant.

Contractor – Construction Phase		
No.	**What you Must Do**	**Why You Must Do It**
2.13	1. The contractor must prepare a plan for the management of wastewater, which must be approved by the PPIT before the contractor is permitted to mobilise to site. 2. "Black" wastewater from sanitation facilities must be led to a properly constructed septic tank and soakaway. 3. "Grey" wastewater from washing and cooking facilities must be led to a septic tank or to a specially built reed bed filtration system. 4. Oil-contaminated water from workshops and fuel stores must be collected and taken to an approved municipal waste management facility. 5. The contractor must have a land restoration plan that includes wastewater facilities, which must have been implemented to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid. 6. Any subcontractor must comply with the same rules, at the contractor's liability.	To avoid the pollution from construction site wastewater, from camps and other work sites.
2.14	1. Solid waste must be recycled wherever possible. 2. Non-recyclable solid waste must be sent to an official landfill site. 3. The contractor must have a land restoration plan that includes solid waste, which must have been completed to the satisfaction of both the PPIT and the landowner before the contractor's final bill may be paid.	To avoid pollution from solid waste materials.
2.15	1. Work sites must be clearly demarcated using barrier tape and all non-project personnel excluded. 2. All staff, workers and visitors to construction sites must be issued with appropriate personal protective equipment. 3. All staff, workers and visitors to construction sites must be briefed on safe working procedures for that site. 4. Every construction site must have a first aid kit and at least two persons always present who are trained and competent to use it.	To avoid injuries to workers and others.
2.16	1. All small cultural sites (such as small shrines and graves) must be protected by the contractor during works periods. 2. A plan for the protection of cultural sites must be approved by the PPIT. 3. Once construction is complete the surrounding of such sites must be restored to their pre-construction condition.	To minimise the disruption of cultural sites.

Contractor – Construction Phase		
No.	**What you Must Do**	**Why You Must Do It**
2.17	1. Instructions on managing the infrastructure must be provided to the end users before handover. 2. The operating instructions must be explained to the Water User Group. 3. Before handover, the operating instructions must be finalised and the EMP requirements included.	So that subsequent users fully understand how to manage the subproject infrastructure.

Appendix 4. Responsibilities of the Water User Group – Operation Period

Water User Group – Operation Period		
No.	**What you Must Do**	**Why You Must Do It**
3.04	1. All flood protection works must be maintained as per the design of the subproject, or any subsequent engineering works. 2. Any flood damage must be reviewed and appropriate measures designed for resolution. 3. Occasional minor flood damage should normally be resolved by using appropriate bio-engineering measures. 4.	To prevent flood damage to headworks and the erosion of canal banks, either from flood surges or normal flows.

Appendix 5. Surface Water Quality Standards

Government of Lao PDR National Environmental Standards (2017)
10. Surface Water Quality Standards
Class 2: Water quality for aquatic animal conservation, fisheries and water sports.
Class 3: Water quality for agriculture, livestock and other uses.

No.	Substances	Symbol	Unit	Standard Value		Method of Measurement
				Class 2	Class 3	
1	Colour, Odour and Taste	-	-	n'	n'	Description
2	Temperature	t	°C	n'	n'	Thermometer
3	Potential of Hydrogen	pH	-	6-8	5-9	Electronic pH meter
4	Dissolved Oxygen	DO	mg/l	6.0	5.0	Azide Modification
5	Electro-conductivity	EC	µS/cm	≤ 1000	≤ 2000	EC meter
6	COD	COD	ml/l	5-7	7-10	Potassium Dichromate Digestion; Open Reflux or Closed Reflux
7	Total Coliform Bacteria	Coliform Bacteria	MPN/100 ml	5000	20000	Multiple Tube Fermentation
8	Faecal Coliform Bacteria	Faecal Bacteria	MPN/100 ml	1000	4000	
9	Total Suspended Solids	TSS	mg/l	≤ 25	≤ 40	Glass Fibre Filter Disk
10	Phosphate	PO_4	mg/l	0.5	1.0	Ascorbic Acid
11	Ammonium Ion	NH_4^+	mg/l	≤ 1.5	≤ 3.0	Kjeldahl
12	Nitrate-nitrogen	NO_3-N	mg/l	5.0	5.0	Cadmium Reduction
13	Ammonia-nitrogen	NH_3-N	mg/l	0.5	0.5	Distillation Nezzlerization
14	Phenols	C_6H_5OH	mg/l	0.005	0.005	Distillation, 4-Amino antipyrene
15	Copper	Cu	mg/l	1.5	1.5	Atomic Absorption Direct Aspiration
16	Nickel	Ni	mg/l	0.1	0.1	
17	Manganese	Mn	mg/l	1.0	1.0	
18	Zinc	Zn	mg/l	1.0	1.0	
19	Cadmium	Cd	mg/l	0.003	0.003	
20	Chromium, Hexavalent	Cr^{6+}	mg/l	0.05	0.05	
21	Lead	Pb	mg/l	0.01	0.01	
22	Mercury	Hg	mg/l	0.001	0.001	Atomic Absorption Cold Vapour
23	Arsenic	As	mg/l	0.01	0.01	Atomic Absorption Direct Aspiration, ICP
24	Cyanide	CN^-	mg/l	0.07	0.07	Pyridine-Barbituric Acid
25	Alpha Radioactivity	α	Becquerel/l	0.1	0.1	Geiger Counter
26	Beta Radioactivity	β	Becquerel/l	1.0	1.0	
27	Organochlorine Pesticide	-	mg/l	0.05	0.05	Gas Chromatography
28	Dichlorodiphenyl-trichloroethane (DDT)	$C_{14}H_9Cl_5$	µg/l	1.0	1.0	
29	Alpha-Benzene Hexachloride (BHC)	αBHC ($C_6H_6Cl_6$)	µg/l	0.02	0.02	
30	Dieldrin	$C_{12}H_8Cl_6O$	µg/l	0.1	0.1	
31	Aldrin	$C_{12}H_8Cl_6$	µg/l	0.1	0.1	

29	Heptachlor and Heptachlor Epoxide	$C_{10}H_5Cl_7$, $C_{10}H_5Cl_7O$	µg/l	0.2	0.2	
30	Endrin	$C_{12}H_8Cl_6O$	µg/l	None	None	

Appendix 6. Project Environmental Guidelines

The Government of Lao PDR National Environmental Standards (2017) will be used as the reference points for the areas that they cover. The list below gives the additional guideline standards that must be followed on all SRIWSM subprojects. If new standards are gazetted by the government during the project implementation period, then they shall take precedence if they are stricter.

Soil

- All bare surfaces (including roadsides and drains but excluding road running surfaces) shall be protected using bio-engineering measures that shall be implemented during the months of May to July each year. The SRIWSM bio-engineering guidelines will be followed.
- Agrichemicals shall only be used that are not on the Government of Lao PDR lists of prohibited substances under the Regulation on the Control of Pesticides in Lao PDR (Regulation No 2860/MAF, 11 June 2010) and the Decree on Pesticide Management: (Decree No. 258/GOV, 24 August 2017).

Vegetation

- No tree of more than 200 mm diameter at breast height (1.5 metres above the ground) shall be cleared unless the design drawings specifically require it.
- Other vegetation shall be cleared only within agreed site boundaries or in connection with agreed subproject activities.
- Fire shall not be used as a means of clearing vegetation or for the disposal of cleared vegetation.

Agrichemical Use

- Each cropping system shall be integrated within Lao Gap certification Systems
- Where required PRT provided by the crop protection centre staff of PAFO
- Where warranted IPM training programs provided by PAFO

Water

- The National Environmental Standard (2017) for water quality shall apply in every case.
- A vegetated band of at least 50 metres should be maintained between any areas of disturbance and any water course. Exceptions are made only where irrigation headworks and road crossings must necessarily be closer.
- Irrigation headworks shall utilise the minimum amount of cleared land. During and after construction, the surface drainage from all earthworks shall be directed via sediment traps to ensure that runoff water is clear at the point of discharge into a flowing watercourse.
- Road crossings shall be at 90 degrees to a water course. Properly designed and constructed culverts and bridges shall be used. Road drainage shall be provided and sediment traps shall be installed to ensure that road runoff water is clear at the point of discharge into a flowing water course. Alignments should be at 90 degrees to the water course within a band of 50 metres on each side unless the terrain or an obstruction prevents this.
- The minimum river flow in each calendar month shall not be lower than 30 percent of natural flow below offtakes in locations not defined by an IEE as having high value biodiversity, unless site-specific measurements and calculations have been used to

justify an alternative level.

- All weirs and other obstructions in rivers, streams and canal channels must have provision for native migratory fish to pass.

Animals

- All subproject staff, workers and beneficiaries shall be issued with a list of rare, threatened and endangered species in the area around the subproject, which shall not be hunted, traded or eaten. Such a list shall be included in each subproject IEE and shall be based on the regional data held by the International Union for the Conservation of Nature (IUCN) Red List.

Air

- The National Environmental Standard (2017) for ambient air quality shall apply in every case.
- On all unmetalled surfaces, construction traffic shall be limited to 30 kmh within 250 metres of habitation and 80 kmh elsewhere.
- Dust emissions shall be minimised by spraying water during dry weather and using other site-specific measures.
- Vehicle and machine engines shall be stopped when stationery.

Storage

- No storage of oil, fuel or chemicals is permitted within 50 metres of a water body.
- All stores shall be covered with full rain protection.
- Oil and fuel stores shall have impermeable bunds capable of retaining 150 percent of the stored volume indefinitely.

Hazardous Materials

- Fuels, oils, cement, fertilisers and pesticides shall be included in the category of hazardous materials.
- All hazardous materials shall be stored in secure compounds, with rain protection and bunding in case of spills and leakages.
- Every site where hazardous materials are stored or used shall have spill clean-up equipment and staff trained in its use.
- Fuel handling areas shall be bunded and all drainage water directed through oil traps. Sediment from oil traps shall be sent for disposal at a waste disposal facility authorised for the handling of hydrocarbon waste.

Solid Waste Management

- All work sites shall be provided with sanitary facilities. These may be pit latrines or water-based toilets with septic tanks and subsurface soakaways.
- Solid waste shall be recycled where facilities exist.
- Where solid waste cannot be recycled, it shall be sent to an approved landfill site.
- Fire shall not be used as a means of disposing of waste.

Society

- The National Environmental Standard (2017) for noise and vibrations shall apply in every case.
- There shall be no night-time working (i.e. between sunset and sunrise) within 500 metres of habitation.

Construction Site Safety

- All construction sites shall be delineated with barrier tape and non-project personnel excluded at all times.
- All staff and workers shall wear appropriate personal protective equipment (PPE) at all

times that they are on a work site.

- The minimum for all personnel is: reflective vest; safety helmet; and safety boots.
- Other PPE such as gloves, eye protection, ear protection, etc. shall be used according to the work performed or underway nearby in the site.