

Initial Environmental Examination

September 2014

CAM: Urban Water Supply Project – Pursat Subproject

Prepared by Ministry of Industry and Handicraft for the Asian Development Bank.

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ABBREVIATIONS

ADB	Asian Development Bank
CAP	Corrective Action Plan
CC	Construction Contractor
CEMO	Contractor Environmental Management Officer
DDR	Due Diligence Report
DEIA	Department of EIA
DPWS	Department of Potable Water Supply
DSC	Design and Supervision Consultant
ES	Environmental Specialist
GMS	Greater Mekong Subregion
IEE	Initial Environmental Examination
MIH	Ministry of Industry and Handicraft
MOE	Ministry of Environment
MOH	Ministry of Health
MPWT	Ministry of Public Works and Transport
PDOE	Provincial Department of Environment
PSMO	PMU Environmental Management Officer
PIU	Project Implementation Unit
PMU	Project Management Unit
PPTA	Project Preparation Technical Assistance
PWW	Provincial Water Works
REA	Rapid Environmental Assessment (Checklist)
SPS	Safeguard Policy Statement (2009)
UWSP	Urban Water Supply Project
WTP	Water Treatment Plant

Units

cm	centimeter
km	kilometer
L	liter
m	meter
m ³ /day	cubic meters per day
masl	meters above seal level
MCM	million cubic meters
mg/L	milligrams per liter
ROW	right of way
Φ	diameter

Summary IEE

Introduction

1. This report presents the findings of the Initial Environmental Examination (IEE) for the proposed Pursat Water Supply Subproject. The Subproject is part of the Urban Water Supply Project (the Project) financed by the Asian Development Bank (ADB), which provides improvements in infrastructure for nine provincial towns. The province of Pursat is located in Northwest Cambodia on the southern shore of the Tonle Sap Lake.
2. The Project is classified as Category B, thus subprojects require an initial environmental examination (IEE) to determine whether significant environmental impacts are likely. Also, Appendix I of the ADB SPS (2009) requires that, "when the project involves existing activities or facilities, . . . environmental audits [will be performed] to determine the existence of any areas where the project may cause or is causing environmental risks or impacts." The REA checklist includes a section in which the existing facilities have been audited to identify the presence of environmental risks or impacts.
3. Overall management of the environment in Cambodia lies with the Ministry of Environment (MOE). EIA policy has been extended through the Sub-decree on Environmental Impact Assessment Process passed by the Council of Ministers on 11 Aug 1999. Under the sub-decree an Initial Environmental Impact Assessment (IEIA) report is required from a project owner. All IEIAs and related documents are reviewed and approved by the Department of EIA in the MOE. A timeline for submittal and approval of the IEE during implementation is provided in the report.
4. The Department of Potable Water Supply (DPWS) under the Ministry of Industry and Handicraft (MIH) is responsible production and distribution of safe water throughout the country. Water Supply Authorities (WSAs) are active in the two municipalities (Phnom Penh and Siem Reap) while Provincial Water Works (PWWs) oversee water supply systems in provincial and district urban centers.

Description of the Project

5. The existing treatment plant uses water from the Pursat River to produce water by a conventional flocculation-sedimentation-rapid sand filtration process. The 5,760 m³/day capacity treatment system was commissioned in 2006, financed under an ADB loan, and is in good repair. Despite this, there are operational problems. Persistent raw water turbidity puts stress on filtration systems, and there are problems with delivery. Long shaft raw water lift pumps suffer from excessive vibration. Automatic controls on the isolation valves at the filter inlets are non-functional. Headloss in bends is excessive at points in the piping system. The proposed interventions are intended to provide operational improvements to the existing system, are mostly electro-mechanical in nature, and are not intended to increase overall plant capacity.
6. Improvements will be made to raw water pumping and improved valving and controls within the treatment plant area. Rehabilitation of a portion of the distribution involves providing 3 km of 110 mm dia parallel piping to improve pressure in part of the system. There is no land acquisition under the project.

Description of the Environment

Physical Resources

7. Pursat is located south of the Tonle Sap Lake at an elevation of around 20 masl. In the rainy season flooding of the Tonle Sap Lake raises water levels throughout the region. Monthly rainfall and temperature are summarized in the report. There are no predictions available on the effects of climate change on local rainfall or groundwater availability.
8. The local geology consists of unconsolidated sediments of Quaternary age under the geomorphology of swamps and deep soils of alternating sand and clay. There are no natural hazards such as steep slopes and unstable soils within the confines of the plant property or along distribution line routes that would affect success of the project.

9. The Pursat River courses through Pursat town. Pursat River rises in the Cardamom Mountains to the south of the Lake and flows some 85 km before reaching Pursat town. It is intermediate in size among the tributaries of the Tonle Sap. The main channel passing through Pursat is meandering and incised into the sedimentary materials making up the floodplain of the Lake. The Tonle Sap Lake is the main hydrological feature in the area and influences conditions within the town itself. Groundwater is variable in Pursat Province, though it serves as a source of supply for villages and homesteads throughout the province.

Ecological Resources

10. Aquatic ecosystems in Pursat Province have been documented extensively by the many projects aimed at maintaining biodiversity on the Tonle Sap. Two important biodiversity conservation areas associated with the Lake are found along the north shore of the Lake: Boeng Chmmar and Stung Sen. None of these natural resources are affected by the project.

Economic Development

11. Land-use in the project area includes residential space, commercial and institutional space, some agricultural fields in outlying areas from the City, and scrub forestland. Land use is undergoing some change in the vicinity of Pursat, especially along highways. The Pursat economy is primarily based in agriculture. The province is a significant producer of rice. Pursat is connected to Phnom Penh and to Battambang via National Road No. 5. Electricity is supplied by diesel powered generating units.

Social and Cultural Resources

12. The people living within the project area are generally engaged in the agriculture sector of the economy. Province-wide 34% of households are below the consumption poverty line and 64% of households in the province fall into the poorest two national quintiles of national consumption. There is no significant Angkorian site in Pursat Province, though Angkorian artifacts may be found in the area.

Potential Environmental Impacts and Mitigation Measures

13. The IEE presents a summary of the potential impacts for each phase of the project and each impact is then analyzed and necessary mitigation measures are proposed to reduce the overall magnitude of impact. Findings regarding preconstruction impacts have been incorporated into the planning under the PPTA.

Location Planning and Design

14. With some exceptions, the improvements under the subproject take place within the confines of the plant property. All of the improvements involve replacement of mechanical equipment, which do not entail hazardous operations, and will engage a limited number of skilled workers. The installation of parallel piping covers a distance of 3 km along a lightly traveled segment of roadway, with clear easements and access for installation of the lines.

15. The subproject aims at remedying deficiencies in the plant design and is not part of any larger plan to increase capacity or take on significant additional service area. With the exception of the improvement of a portion of the distribution system, the project takes place wholly on the existing site of the water treatment plant. Pursat seeks to correct operating problems with the plant, obtain a nominal standard in efficiency, and improve service to homes that are already in the service area. As a result there are no strategic planning and design considerations to be taken up by the present subproject.

16. All subproject improvements will take place on land already owned by the DPWS or, in the case of piping, in the public alignment of roadways. No involuntary land acquisition is anticipated under the subproject. The potential presence of unexploded ordnance (UXO) and mines has been evaluated within the subproject area based on survey

maps and discussion with provincial authorities. It has been determined that there is no basis for suspecting that UXO or mines are present.

Construction

17. The Pursat Water Supply Subproject involves mechanical installation of equipment within the site of the water treatment plant (WTP) and raw water pump station. Civil works are restricted to installation of distribution piping in public roadway easements, and construction of a sand drying bed on the plant property.

18. Site work at the WTP presents no potential impact to the public. Small amounts of materials and construction supplies will need to be hauled to the site, less than what is typically experienced during construction of a shop house at a provincial location. Noise levels and dust potentially generated in construction are negligible. The installation of water distribution pipe takes place along a linear alignment in the roadway. Potential impacts stem from the presence of workers carrying out their jobs and temporarily residing at the site and working along roadways. Noise and air emissions may extend beyond the site boundaries and cause a nuisance for adjacent land uses. Movement of materials to and off the site can affect traffic and conditions on roadways. Workers may be exposed to health and safety risks as a result of the work. None of these impacts is significant, and a high standard of project implementation by the contractor can minimize the effect. A comprehensive list of potential impacts and proposed mitigation measures are proposed to protect community health and safety; meet the needs of the work force, provide for worker camps, and ensure worker health and safety; protect air and water and mitigate noise impacts; and protect soils and dispose of excess materials as necessary. Construction impacts are mitigated by a set of environmental specifications to be included in procurement documents, which will be binding on the contractor. Specific procedures should be applied throughout pipe laying with particular emphasis on work conducted in congested areas. The contractor should conduct pipe laying in a manner that has minimum impact on the health, safety and convenience of businesses, residences and users of the street area; specific guidelines are provided in the IEE to accomplish this goal. All roadway surfaces should be repaired as construction progresses; bid packages should contain a unit bid price for roadway repair, and for repair of any other facility, structure or surface that is likely to be damaged in quantity during construction. Finally, commissioning requires that newly constructed or repaired water mains, tanks and reservoirs be disinfected through chlorination. Installation contracts should include a bid item for disinfection of installed piping.

Operations

19. Impacts during operations concern environmental or public health. Poorly operated treatment plants pass pathogens; failure to chlorinate allows pathogens to survive in distribution systems; broken pipes and low pressure allow cross-contamination from sewers and soil organisms. Modern, well-operated water treatment plants deliver a product water consistently free of coliform organisms and other pathogens, no matter how polluted the raw water may have been. Further, effective coagulation and sedimentation reduces turbidity to improve the effectiveness of chlorination. Regardless of the effectiveness of the treatment process, continuous chlorination at the head of the delivery system is necessary for delivery of safe water free of bacterial contamination, viruses and other pathogens. Broken lines and low pressure provide means for entry of pathogens into distribution systems. Maintaining chlorine residual in the system is one way to guard against cross-contamination, as is sustaining adequate pressure in the system. Capacity building is recommended during implementation in the safe handling of chlorine effective during the operations period.

Indirect, Cumulative and Induced Impacts

20. One type of cumulative impact stems from the effect of water supply systems on urban growth. Urbanization is accompanied by congestion with concomitant effects on air pollution and overall quality of life. Areas being served in Pursat are already part of the distribution system, so the aggravation of uncontrolled development does not occur.

21. An indirect impact of water supply expansion has to do with the disposal of increased quantities of wastewater from households and industrial/commercial users. Generally speaking, improved water supply should be accompanied by improvements in sanitation and drainage that mitigate the effect of increased discharges. Most households are equipped with pour flush toilets, and lack of sanitation should not be a constraining factor in advancing water supply coverage.

22. Increased flows enter drainage systems. Impacts occur if drainage increases pollution load to receiving waters. In general, drainage systems suffer from a lack of investment in infrastructure, limited cooperation between government departments, clogging with solid waste and infilling/blockage by property owners. The situation at Pursat is that most septic tank supernatants will percolate into the sandy soil and that which flows overland will receive some 'treatment' in the shallow wetlands that course through the town. The cumulative effect of discharges from many small urban drains on receiving water quality can be severe over the long term, and available solutions are inadequate to deal with the greater problem. The sanitation component of the present project aims to identify the needs and set out an implementation plan for sector investment in sanitation and drainage.

Resilience to Climate Change Impacts

23. The quantities of water supplied "at source" and the extent of water supply distribution to a recipient population provides the base case for comparison with future conditions under which the subproject is implemented and climate change effects take place. The subproject either improves, or is neutral with respect to, climate change resilience. A further issue concerns the exacerbation of health impacts due to climate change in the absence of effective sanitation and drainage in urban and peri-urban communities. Finally, whether subproject infrastructure is vulnerable to weather conditions brought about by climate change may be considered.

24. As of December 2012, downscaling of the general circulation models (GCMs) to determine regional climate conditions under global climate change had not been accomplished for Cambodia. Thus predictions related to the effects of climate change on hydrometeorological parameters in Cambodia are uncertain and generally qualitative. Long range effects on water supply, especially groundwater availability and reserves, are not known. The subproject improves climate change resilience by increasing the supply of water at-source; and by extending the reach of the distribution system to areas within the community that lack piped water supply. To the extent that the community is lacking in piped water supply either from shortage of source quantities or due to inadequate distribution, the recipient populations are benefited.

25. The subproject is vulnerable to the effects of climate change and sources of supply could become depleted. The Pursat River may be vulnerable to extended drought and extremely low water levels could occur. This is a significant concern for the Stung Sen waterworks but is not one that can be addressed adequately under the present project. An auxiliary well that would be available during periods of extended drought might provide a reasonable solution to this problem.

26. Drainage conditions are worsened under climate change scenarios, whether stagnant and still water bodies during periods of drought that breed mosquitoes and harbor high numbers of enteric disease bacteria, or flooding conditions where drainage systems are overwhelmed and polluted water enters human living spaces.

Existing Facilities Audit

27. Appendix I of the ADB SPS (2009) requires that, "when the project involves existing activities or facilities, relevant external experts will perform environmental audits to determine the existence of any areas where the project may cause or is causing environmental risks or impacts." An assessment was conducted of the facility to identify the presence of waste, spent, out-of-spec and discarded water treatment chemicals, oils, cleaning fluids and solvents, as well as contaminated soils that have or have the potential for causing environmental impacts or risks. Waste materials that pose a hazard to hu-

man health or the environment have not been identified at the facility, nor are there any other environmental hazards connected with the facility.

On inspection of the facility it was noted that a latrine and soakaway are located on the bank of the Pursat River on property adjacent to the pump house and upstream of the water supply intake. The Pursat PWW has been concerned about the location of the latrine, which originally discharged directly to the river. The property owner responded by constructing a soakaway to contain effluent from the latrine. Still, it is appropriate to analyze the situation to determine if further actions are necessary. The analysis is contained in an appendix to the report. The result of the analysis is that the leachate percolating into the soil of the riverbank does not pose a threat to human health and therefore there is not a cause for further action. It is important to note that the latrine and soakaway are on private property and their relocation would require forcible removal, when there is no good alternative location for the latrine on the owner's property. There is no need to prepare a corrective action plan for purposes of reducing environmental impact and risk.

Environmental Management Plan

28. Impacts are presented in a tabular form along with summaries of the required mitigation measures, institutional responsibilities for assuring the mitigation action is carried out and costs, which are in all cases included in previously identified budgets for design, construction and operation of the systems.

Institutional Arrangements

29. The Department of Potable Water Supply (DPWS) at central level under Ministry of Industry and Handicraft (MIH) is the executing agency and will establish the Project management Unit (PMU) to execute the Project. The PMU will assign responsibility for environmental aspects to a particular individual as staff PMU Safeguard Management Officer (PSMO) who is engaged full time with implementation of the project to oversee work related to monitoring. The Provincial Water Works (PWW) is the operator of the Pursat water supply system and implementation agency for the subproject. PWW will establish a Project Implementation Unit (PIU) to undertake construction of the Subproject in Pursat Province.

30. The PMU will engage Contractors for specific works, based on the subcontract packages considered most suitable for execution. Legal clauses regarding mitigation measures are required to be included in construction contract bidding documents and become part of contract agreements; a typical set of specifications are provided in Appendix 2. For the main construction contracts, the Contractor will be required to appoint a staff Construction Environmental Management Officer (CEMO) responsible for supervising implementation of mitigation measures during the execution of the contract. The contractor will be required to prepare a Construction Management Plan (CMP) to ensure construction, demolition and excavation that take place at building sites do not adversely affect health, safety, amenity, traffic or the environment in the surrounding area.

31. The PMU will be assisted by the Environmental Specialists (ES), consultants who are part of the Design and Supervision Consultant (DSC) and support all the subprojects undertaken through the loan. The ES will update and finalize the IEE, submit the plans on behalf of MIH to the Ministry of Environment, incorporate legal clauses regarding mitigation measures into construction contract bidding documents, and assist the PSMO in monitoring the implementation of those measures during the progress of construction. The ES also will provide training to PMU and PIU staff.

32. The ES will revise and update the IEE based on final designs, and the document will be translated into Khmer prior to submittal to MOE DEIA, which will engage in the review process the provincial PDOE where the subproject takes place. Once DEIA approves the EMP for the subproject, implementation can proceed with construction mitigation measures mostly in the hands of the contractor, and the ES, PDOE, PIU and PSMO working together to perform monitoring and reporting. It will be the job of the PIU supported by the ES to compile quarterly reports, which then are compiled into semi-annual safeguard monitoring reports by the PMU and DSC, supported by the ES. The PSMO and PMU Project Director will be responsible for submittal of reporting to ADB.

33. A table summarizing monitoring requirements is provided in the IEE. The PIU and ES are responsible for the bulk of the monitoring being undertaken during the design and construction periods. During operations, the Provincial Water Works is responsible. No specific water quality monitoring is needed prior to detailed design. Recommended protocols for monitoring raw water quality used in production operations (the raw water source) and finished water quality are already in place by DPWS in which a number of parameters are monitored.

Public Consultation and Information Disclosure

34. The Provincial Water Works (PWW) is a key stakeholder that holds the interests of the community to be its primary mission. The subproject concept and design are driven by PWW perceived needs for rehabilitation of system elements within the constraints of the available budget. Furthermore the IEE has been reviewed by DPWS and concurrence has been reached on the contents of the EMP.

35. Consultation: During field work on environmental and social components, informal public consultation was held along the route of the piping, and some information was gained on current access to water supply. The social component combined focus group discussions with socioeconomic survey work, and conducted random sampling surveys that focused on local experience and perceptions of thematic issues like sanitation practice and water supply quantity and quality. No public consultation meeting was held in Pursat since the original thinking on this subproject was that it would be covered by a due diligence review. It was not thought that public consultation would be necessary during the site visit by the environmental and social teams. Formal public consultation will need to be conducted at the outset of the loan implementation.

36. Disclosure: MIH shall provide the relevant environmental information for this subproject, including information from the IEE to affected people in a timely manner, in an accessible place, and in a form and language(s) understandable to them by providing a copy of the IEE in Khmer language at the PWW office for review by interested parties. In addition, ADB will post on its website the subproject IEE, updates prepared during the project implementation period, and environmental monitoring reports prepared during the implementation period.

37. Grievance Redress: Grievances related to both environmental and resettlement issues are addressed through the Grievance Redress Mechanism (GRM). In order to ensure that complaints from all affected persons (APs) on any aspect of environment, land acquisition, compensation and resettlement are addressed in a timely and satisfactory manner, and that all possible avenues are available to APs to air their grievances, a well defined grievance redress mechanism will be established. All APs can send any questions to the implementing agency about their rights in relation with redress of environmental problems and entitlements. APs are not required to pay any fee in order to file a complaint at any level. The GRM is explained in detail in the IEE and in the public information booklet distributed to all APs.

Findings, Recommendations and Conclusions

Findings

38. The Initial Environmental Examination for this Category B subproject provides a review of the proposed infrastructure and its interactions with the surrounding environment, and analyzes potential impacts. The review and analysis shows that these are unlikely to occur. Because water supply is an important infrastructure improvement that runs concurrently with – and are essential for – economic development, the main impact is expected to be beneficial. Furthermore, good engineering practice in the design, installation and operations of water supply systems mitigate substantially the environmental impacts noted herein.

39. There are ways in which the environmental performance of the project can be improved, and the IEE provides recommendations in regard to these opportunities. The majority of negative impacts that have been identified are associated with construction and installation of the proposed works. These are short term and localized, hence are impacts of minor significance that are minimized by application of safeguards that are

common in the construction industry. Environmental criteria for construction are recommended to mitigate construction impacts, and are included as a separate appendix.

40. Negative environmental impacts occurring during the operation of the project are few. These are mainly concerned with maintaining water supply systems so that safe water, free of pathogens, can be delivered. Monitoring treated water quality and chlorine residual in the distribution lines is necessary for assuring safe supply, and is already a routine activity by government water supply agencies.

41. Formal public consultation has not been conducted during the PPTA due to exigencies involving project preparation. However it is expected that no significant issues would have been raised during the public consultation that have not been addressed in the IEE. A proposal has been described for public consultation during construction that includes mechanisms for disclosure and for redress of grievances that arise during the construction phase.

Recommendations

42. Environmental safeguards involve mitigation of construction impacts by means of environmental requirements placed on the construction contractor, and operations and maintenance of the completed system to guarantee high quality of potable water. Sanitation and drainage have been addressed in terms of indirect and cumulative impacts.

44. Mitigation measures to be undertaken during construction cover hiring of workers, provision of facilities for worker housing and sustenance, site work and pipe laying, temporary suspension of water supply and pipeline commissioning. Recommendations are aimed at maintaining access to residences and businesses, reducing dust, noise pollution and congestion at the site and along roadways and haul routes, provision of alternative services for water supply when the system needs to be shut down, disinfecting completed distribution mains prior to commissioning, provisions for worker housing, sanitation and waste management, and worker safety and health.

45. Mitigation measures for implementation during operations include chlorination of water supplies, periodic testing to assure good bacteriological quality, and maintenance of system pressures to prevent cross-contamination in distribution systems.

Conclusions

46. The environmental impacts of the proposed improvements in water supply infrastructure for Pursat have been assessed by the Initial Environmental Examination reported in this document, conducted according to ADB guidelines. Issues related to involuntary resettlement were assessed by a parallel process of resettlement planning and determined to be insignificant, in that no involuntary land acquisition will occur within the scope of the subproject.

47. The overall conclusion of both processes is that providing the mitigation, compensation and enhancement measures are implemented in full, there should be no significant negative environmental impact as a result of location, planning, design, construction and operation of the project. There are benefits stemming from recommended mitigation and enhancement measures, and major improvements in quality of life and individual and public health once the project is in operation.

48. Further work on the IEE will be required prior to implementation to update the mitigation proposals and identify any associated costs, to be performed by the Environmental Specialist working with the Design Supervision Consultant.

I. INTRODUCTION

A. Purpose of the Report

1. This report presents the findings of the Initial Environmental Examination (IEE) for the proposed Pursat Water Supply Subproject. The Subproject is part of the Urban Water Supply Project (the Project)¹ financed by the Asian Development Bank (ADB), which provides improvements in infrastructure for nine provincial towns in Cambodia. The ADB's sector strategy for Cambodia, currently being formalized, seeks alignment with the Government's action plan to facilitate public-private partnerships, strengthen management of publicly owned water supply facilities and integrate urban waters supply and urban environmental management;² and supports Cambodia's millennium development goal for 80% of urban access to improved water supply by 2015.³

2. Pursat is one of the nine towns targeted under the Project. The province of Pursat is located in the Northwest of Cambodia. It borders Preah Vihear Province to the North, Kratie and Stung Treng to the East, Siem Reap to the west and the Tonle Sap Lake to the south. Much of the province lies within the floodplain of the Great Lake. The town of Pursat has eight sangkats (districts), with a population of 45,947 in 5,543 households.

B. Institutional and Regulatory Framework

3. The Project is classified under ADB rules as a Category B project. According to the ADB Safeguard Policy Statement (2009), such projects are judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects. An initial environmental examination (IEE) is required for subprojects to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report. A Rapid Environmental Assessment Checklist for the subproject is found in Appendix 1.

4. Appendix I of the ADB SPS (2009) requires that, "when the project involves existing activities or facilities, relevant external experts will perform environmental audits to determine the existence of any areas where the project may cause or is causing environmental risks or impacts." The rapid environmental assessment checklist (Appendix 1) includes a section in which the existing facilities have been audited to identify the presence of waste, spent, out-of-spec and discarded water treatment chemicals, oils, cleaning fluids and solvents, as well as contaminated soils that have or have the potential for causing environmental impacts or risks.

5. Overall management of the environment in Cambodia lies with the Ministry of Environment (MOE), which was created in 1993 with a wide set of responsibilities. At provincial and city levels, there are corresponding Provincial/City Environment Departments. Local departments have the responsibility of enforcing environmental legislation coming under the competence of the MOE.

¹ ADB, 2013; "Project Data Sheet"; Project Number 41403-013; Urban Water Supply and Sanitation Project; at . <http://www.adb.org/projects/41403-013/main>.

² Cambodia: Water Supply and Sanitation Sector Assessment, Strategy, and Road Map; ADB Manila, 2012.

³ Overview of the Urban Water Supply Sector in the Kingdom of Cambodia, Sub -Technical Working Group for Urban Water Supply, Department of Potable Water Supply, Ministry of Industry, Mines and Energy, January 2012.

6. The hierarchy of legislation in Cambodia includes the Constitution, laws issued by the National Assembly, decrees/sub-decrees/implementing regulations issued by the Council of Ministers, implementing legislation (prakas) issued by ministries and decree laws, which are legal instruments issued prior to the 1992 Constitution. Article 59 of the Cambodian Constitution provides for the protection of the environment. In November 1996, the Cambodian National Assembly passed the Law on Environmental Protection and Natural Resource Management (the framework law). The objectives of this law are to protect environmental quality through the prevention, reduction and control of pollution, to establish an Environmental Impact Assessment (EIA) system, to ensure sustainable use of natural resources, to encourage public participation and to suppress acts which are harmful to the environment. The law calls for EIAs to be conducted for every private or public project, to be reviewed by the Ministry of Environment before submission to the Government for a final decision. All proposed as well as existing activities are to be covered under this requirement.

7. Other articles of the law prescribe sustainable use of natural resources, and anticipate the establishment of natural resource protected areas by decrees. Another article provides that the MOE shall collaborate with other ministries to develop an environmental inventory which details the sources, types and quantities of wastes, toxic substances and noise disturbances which may exist in Cambodia.

8. EIA policy has been extended through the Sub-decree on Environmental Impact Assessment Process passed by the Council of Ministers on 11 Aug 1999. Under the sub-decree an Initial Environmental Impact Assessment (IEIA) report is required from a project owner either private, joint-venture or public sector.⁴ A Project Owner must apply to the MOE for reviewing the IEIA report or to the Provincial/Urban Environmental Office (PEO) if the investment value is less than \$2,000,000 and environmental impacts are not considered severe. In the case of a project that causes serious impact, the Project Owner must prepare a full EIA report and apply to the MOE for review. In practice, all IEIAs and related documents are reviewed and approved by the Department of EIA in the MOE. Declaration No. 49 *Guideline for EIA Reports* was issued in June 2000, and Declaration No. 745 *Determination of Service Charge for Environmental Impact Assessment Report Review and Follow-up and Monitoring of Project Implementation* was issued in October, 2000. For the present project, RGC/Client approval for Environment Clearance from the Ministry of Environment involves revision of the IEE during the design phase, coincident with detailed design preparation, and translation of the IEE into Khmer. The IEE is submitted to the Department of EIA within MOE, which has a period of 30 days to review and respond with comments, or approve, the IEE.

9. The Department of Potable Water Supply (DPWS) under the Ministry of Industry and Handicraft (MIH) is responsible production and distribution of safe water throughout the country; collecting information and preparing inventories of potential surface and groundwater supply; developing policies, rules and regulations to manage urban water supply; operating laboratories for control of water quality in line with National Drinking Water Standards; and issuing licenses for operation of water supply facilities in accordance with ministerial guidelines and principles. Water Supply Authorities (WSAs) are active in the two municipalities (Phnom Penh and Siem Reap) while Provincial Water Works (PWWs) oversee water supply systems in provincial and district urban centers.

C. Extent of IEE Study

10. The IEE was prepared as part of the ADB project preparation technical assistance (PPTA) TA 8125-CAM, with two months of international and three months of national consultant input. Data sources include government agencies, professional and academic reference materials, government publications and project background sources provided

⁴ The IEIA report is similar in scope and effort to an Initial Environmental Examination (IEE).

by the project management office (PMO). Field observations were conducted at the sites of proposed construction.

II. DESCRIPTION OF THE PROJECT

A. **Scope**

11. The existing treatment plant uses water from the Pursat River to produce water by a conventional flocculation-sedimentation-rapid sand filtration process. The 5,760 m³/day capacity treatment system was commissioned in 2006, financed under an ADB loan, and is in good repair. Despite this, there are operational problems. Persistent raw water turbidity puts stress on filtration systems, and there are problems with delivery. Long shaft raw water lift pumps suffer from excessive vibration. Automatic controls on the isolation valves at the filter inlets are non-functional. Headloss in bends is excessive at points in the piping system. The proposed interventions are intended to provide operational improvements to the existing system, are mostly electro-mechanical in nature, and are not intended to increase overall plant capacity.

B. **Interventions**

12. The following interventions are proposed for the Pursat Subproject:

In-plant Improvements:

1. Install one 300 KVA transformer
2. Replace two raw water pumps with submersible pumps
3. Install new 500 mm gate valve for upper inlet pipe
4. Install new manual gate valves for inlets and drains
5. Replace 500 mm filter block inlet gate valve
6. Replace old chlorination system
7. Install sludge drying bed

Distribution System Improvements

8. Install 3 km parallel DN 160 mm HDPE pipe in service area

C. **Location**

13. The general location for the project is shown in Figure 1. The water treatment works are located at UTM coordinates (Zone 48P) E 381900 X N 1385147 on the banks of the Pursat River some 0.8 km southeast of National Road 5 in Pursat. Most improvements take place within the property boundary of the water treatment works, and are mechanical in nature. Pipe replacement to improve pressure in the distribution system takes place in the public domain, along the edges of roadways. No land acquisition is required for installation of any of the works.

D. **Capacity and Performance**

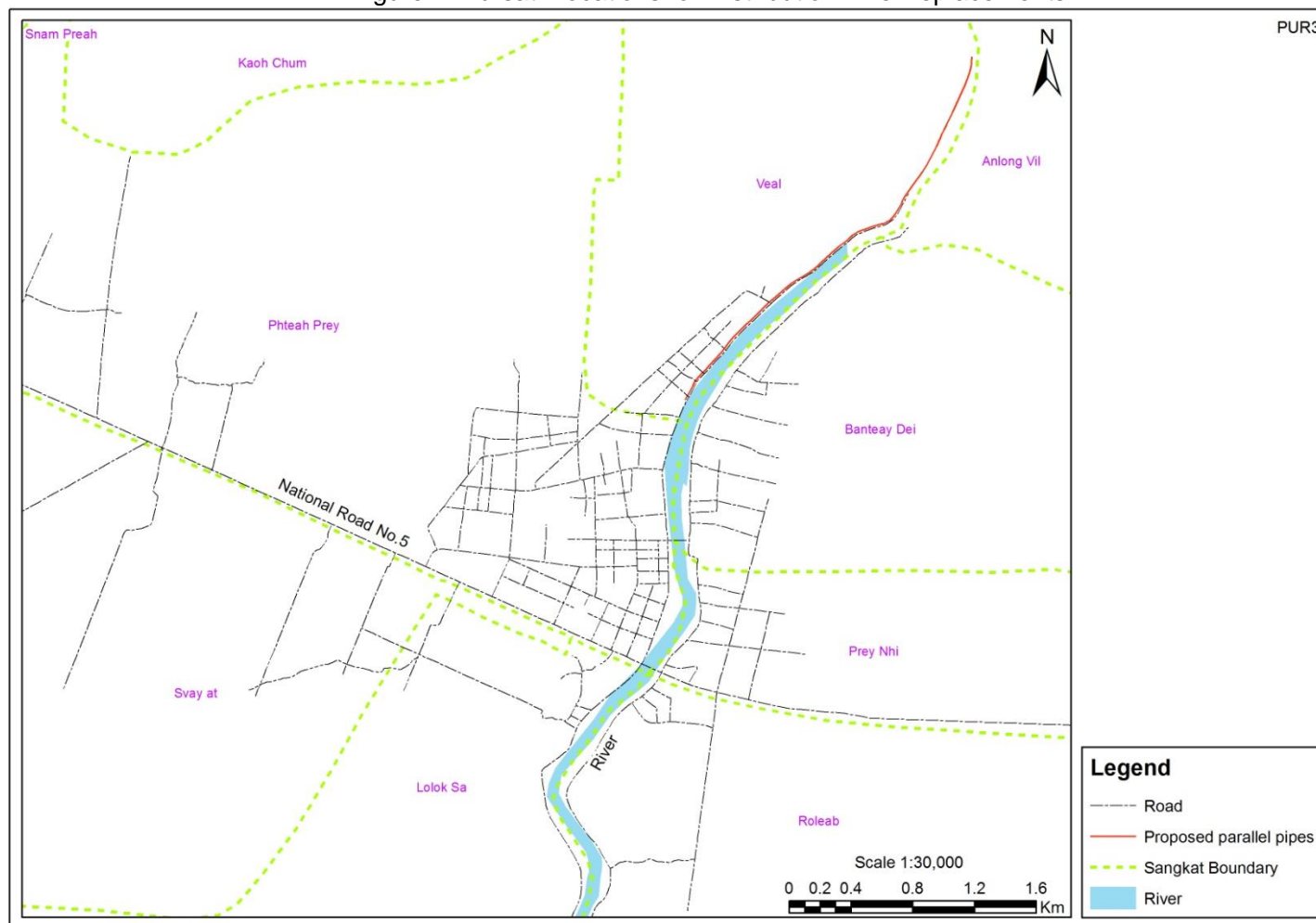
14. System capacity remains essentially equal to the present in nominal terms; however performance will be improved and hence delivery will be made more efficient and reliable. Raw water pumping efficiency will be improved with the installation of new pumps that are more resilient in the applications. Improved chlorination is essential for properly disinfected potable water. The addition of sludge drying beds will provide better handling of the material.

15. The additional piping is intended to improve pressure in a service area somewhat distant from the point of origin. The distribution piping line size is designed to maintain pressure in the system at one atmosphere (33 ft, 10 m, or 14 PSI).

E. Sanitation

16. Various ministries have overlapping responsibilities related to sewerage and sewage/wastewater treatment in urban sanitation, but in general urban sanitation remains the responsibility of the Ministry of Public Works and Transport (MPWT). The implications with respect to environmental issues of the approach to sanitation proposed under the project are taken up in Sec. IV.E on indirect and cumulative impact.

Figure 1: Pursat: Locations for Distribution Line Replacements



III. DESCRIPTION OF THE ENVIRONMENT

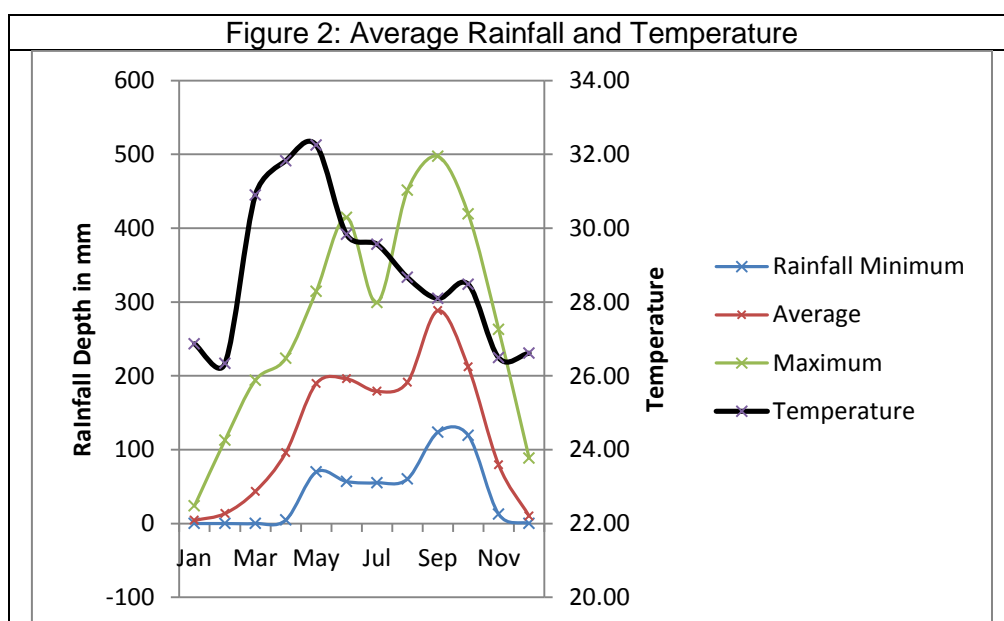
A. Physical Resources

1. Climate and Air Quality

17. Pursat is located on the south shore of the Tonle Sap Lake at an elevation of around 20 masl. The climate is humid and tropical but with some variation over the period of a year. Monthly average rainfall and temperature are summarized in Figure 2. Total annual rainfall is typically around 1,500 mm.

2. Soils, Geology and Seismology

18. The local geology consists of unconsolidated sediments of Quaternary age under the geomorphology of swamps and deep soils of alternating sand and clay. The overwhelming part of the Tonle Sap depression is covered with unconsolidated clay, silt, sand and gravel and a variety of soil types such as acidic lithosoils and lateritic clays which are typical soil types in a humid tropical region.



3. Topography and Drainage

19. The town is at 20 masl and fairly well drained, though areas within the town are subject to flooding both from high water levels in the Lake and incident rainfall. Internal drainage is hindered by lack of clear outlets in some locations, though there exists clear drainage paths to the river, which courses through the town. Internal relief is seldom less than a few meters, though during the dry season, when the water level elevation in the Lake is low, at ~1 masl, there is 6 + m of fall between the town and river.

20. The surrounding area is under rain fed rice cultivation, with some dry season irrigated rice grown in the flood plain of the Lake. These commercial rice growing operations use impounded water from the wet season.

4. Surface Water

21. The Pursat River rises some 85 km south of the Lake in the Cardamom Mountains. It is among the larger of the tributaries of the Tonle Sap. The main channel

passing through Pursat is heavily meandering and incised into the sedimentary materials making up the floodplain of the Lake.

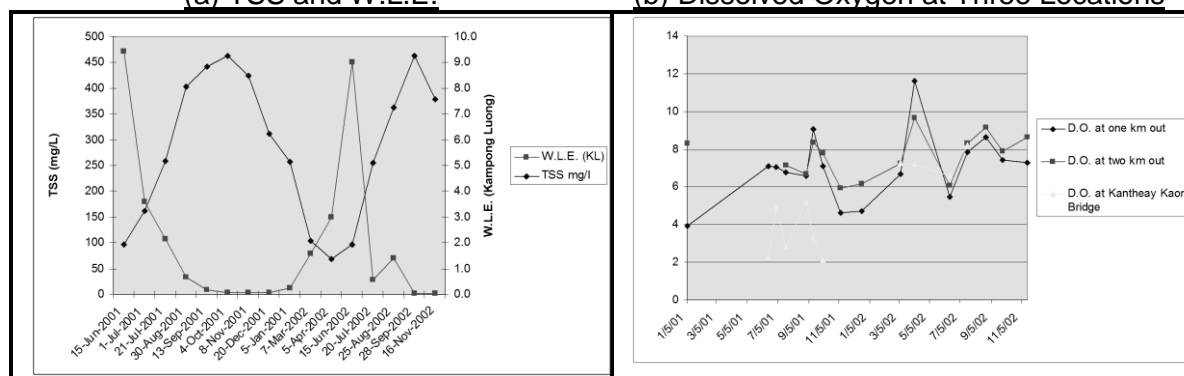
22. The Tonle Sap Lake is the main hydrological feature in the area and strongly influences conditions within the town itself. In turn, the hydrology of the Mekong river system is the determining factor for flooding and drying conditions on the Lake. The annual inundation commences in late June and reaches the maximum rate of change from 15 July to 15 August, advancing at an average rate of about 7 cm per day, to crest typically in October and remain at its peak for a period of two weeks, after which the declining rate is slower, normally about 6 cm per day over the months from November through December.

23. Water quality in the Pursat River varies with the seasons, location and inflow factors. The river is generally impassable except for small craft and low water levels exacerbate water quality problems, however there is not an excessive amount of human generated waste entering the river. Surface water quality is generally good on the Tonle Sap Lake, though turbidity is high during the low water period from interaction of wind with the surface of the lake. Dissolved oxygen is low or absent in the forests during flood periods, a natural condition brought about by inundation of organic matter that reduces the capacity to oxidize pollutant loads, which settle, undergo anaerobic degradation and produce methane and sulphide gas. Water quality in channels reaching inland from the lake are controlled by aeration, solar radiation, inputs of carbon, nitrogen and phosphorous from natural and human sources and the rise and fall of the Lake water level. These factors may affect raw water supply at Pursat, and are depicted in Figure 3 a) (Lake water level and TSS relationship) and b) (seasonal dissolved oxygen levels at three points in the Lake).

Figure 3: Water Quality Time Series Relationships (2001-2002)

(a) TSS and W.L.E.

(b) Dissolved Oxygen at Three Locations



5. Groundwater

24. Groundwater conditions are variable in Pursat Province, though used as a source of supply for villages and homesteads in places throughout the province. No data are available regarding groundwater quality.

B. Ecological Resources

25. Aquatic ecosystems in Pursat Province have been documented extensively by the many projects aimed at maintaining biodiversity on the Tonle Sap. Important biodiversity conservation areas are found within the Tonle Sap Biosphere Reserve (TSBR), including Boeng Chmmar and Stung Sen (both on the north shore of the Lake). None of these natural resources are affected by the project.

26. Pursat Province contains extensive flooded forests at elevations below 4 masl adjacent to the Lake. Protection of the seasonally flooded forests surrounding the lake was the objective of land use zoning efforts put in place through the establishment of the TSBR. These forests vary greatly in structure and diversity; the trees can grow to 30 m in height on seasonally flooded alluvial soils. None are affected by the subproject.

C. Economic Development

1. Land Use

27. Land-use in the project area includes residential space, commercial and institutional space, some agricultural fields in outlying areas from the City, and scrub forestland. Land use is undergoing some change in the vicinity of Pursat, especially along highways.

2. Agriculture, Industry and Tourism

28. The Pursat economy is primarily based on agriculture. Other types of commerce and local industry include handicrafts, animal husbandry, and fishing. Statistics available from the World Food Program⁵ regarding employment show higher proportions of the population engaged in agriculture, and fewer in secondary and tertiary sectors of the economy (industry and services), in comparison with other areas of the country (Table 1).

Table 1: Employment and Labor Force Indicators

Indicator	Pursat	National
Literacy Rate > 15 years % total population	64	67
Literacy Rate > 15 years % females	57	60
% of the labor force in the primary sector incl. Agriculture	71	60
% of the labor force in the secondary sector/ Industry	12	13
% of the labor force in the tertiary sector/ Services	17	25
% of the labor force economically active <=10 days/ mth	26	29

3. Infrastructure, Transport and Power Supply

29. Pursat is connected to Phnom Penh and to Battambang via National Road No. 5.
30. Electricity is supplied by diesel powered generating units.

D. Social and Cultural Resources

1. Population and Communities

31. The people living within the project area are generally engaged in the agriculture sector of the economy. Province-wide 34% of households are below the consumption poverty line and 64% of households in the province fall into the poorest two national quintiles of national consumption (Table 2), but this is not reflective of the situation among affected households. Data revealed through the project socioeconomic survey show the households of Pursat town to be significantly better off than the provincial average.

Table 2: Indicators of Consumption Poverty

Consumption Poverty Indicator	Pursat	National
Per capita consumption in riel	2795	3247
Consumption poverty line in riel	1794	1836
% of households below the poverty line	34	32

⁵ <http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Pursat>

The poverty line value as a percentage of total consumption	64	49
World Food Program, http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Pursat		

2. Health Facilities and Conditions

32. As in other provinces, there are government run health facilities at Pursat. Health indicators reported by WFP include the following on a province-wide basis: 52% of women suffering from Iron Deficiency Anemia (IDA), 88% of births occurring outside of a health clinic and 68% without a health professional in attendance. The social survey within the project area report significantly different results given the smaller population set and relative affluence in comparison with outlying areas.

3. Sites of Historical, Archaeological, Paleontological, or Architectural Significance

33. Angkorian sites are not generally present in Pursat, though some artifacts are seen in the boundaries of modern-day temples. It is possible that artifacts will be unearthed during excavation for pipelines, in which case special provisions are provided to reclaim archeological relics found in the progress of work.

IV. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

34. This section reviews potential environmental impacts in relation to location, planning and design; construction; and operations. A summary of the potential impacts is presented for each phase of the project. Each potential impact is then analyzed and necessary mitigation measures are proposed to reduce the overall magnitude of impact. Findings regarding preconstruction impacts have been incorporated into the planning under the PPTA.

35. The treatment plant is located about 800 m southwest of National Road (NR) 5 on the left bank of the Pursat River. There is a clear access road into the plant site and sparsely settled neighborhoods surrounding the property. The river is approximately 800 m from the plant site.

36. With one exception, the improvements under the subproject take place within the confines of the plant property and involve replacement of mechanical equipment, though one item of work will require installation of piping over a distance of 3 km and a sand drying bed will be constructed on the plant site. Mechanical improvements do not entail hazardous operations, and will engage a limited number of skilled workers. The installation of piping is in an isolated and lightly traveled segment of road-way, with clear easement and access for installation of the line.

- Only minor amounts of construction materials will be required at the site and impacts related to transport of materials is insignificant.
- There will be no significant amounts of noise or dust generated during the work activities at the site, nor in the installation of the 3 km of piping.
- Skilled workers required for mechanical installation will likely be housed at local guest houses. Construction workers needed for installing the pipeline are likely to be available locally.

37. The means by which safety and health risks may arise onsite are as follows:

- Direct injury of workers in the course of the work is highly unlikely. Still, use of cutting torches, working-at-height and lifting and removing/installing heavy equipment needs to be undertaken with due regard for the necessary safeguards.

A. Location, Planning and Design

38. The subproject aims at remedying deficiencies in the plant design and is not part of any larger plan to increase capacity or take on significant additional service area. With the exception of the replacement of a portion of the distribution system, the project takes place wholly on the existing site of the water treatment plant. Pursat seeks to correct operating problems with the plant, obtain a nominal standard in efficiency, and improve service to homes that are already in the service area.

39. As a result there are no strategic planning and design considerations to be taken up by the present subproject. Some tactical considerations may be present in the adjustment of alignments for distribution piping to avoid destruction of private property or trees in the public right-of-way. These are addressed in the following sections under construction impacts.

40. None of the facilities proposed under the project are subject to damage or failure due to natural disasters such as floods and earthquakes, a factor that was taken into consideration during the design of the project.

41. The potential presence of unexploded ordinance (UXO) and mines has been evaluated within the subproject area. It has been determined that there is no basis for suspecting that UXO or mines are present based on survey maps and discussion with provincial authorities. As a result, there is no need for further investigation of this factor in subproject preparation.

B. Construction

42. The Pursat Water Supply Subproject involves mechanical installation of equipment within the site of the water treatment plant (WTP) and raw water pump station, and installation of distribution piping in public roadway easements, along with valves, fittings, meter tie-in to homes and businesses, (installation of service connections), and other appurtenances necessary to complete the pipeline installation.

43. Site work at the WTP presents no potential impact to the public. Small amounts of materials and construction supplies will need to be hauled to the site, less than what is typically experienced during construction of a shop house at a provincial location. Noise levels and dust potentially generated in construction are negligible.

44. The construction effort at the WTP will involve a small crew of workers and a duration of around nine months. The crew is made up of domestic skilled and semi-skilled craftsmen. Housing for workers will likely be at onsite or given the small numbers, in guesthouses in the town.

45. To the extent necessary to accommodate the needs of the workforce, the contractor should provide suitable housing, adequate supplies of potable water, and toilet and bathing facilities. Onsite facilities for preparing food need to be provided, or food service contracted. Alternatively, since the size of the workforce is small, the Contractor may house workers at commercial guesthouses in the City. In the event a labor camp is set up, the contractor should provide means for disposing of wastewater from toilets, baths and food preparation areas either through a septic tank and soakaway, or holding tank with removal by vacuum truck. Solid waste should be collected at waste bins and disposed of properly offsite. The public should be barred from the site and children of workers should not be allowed within the work area.

46. For work crews installing piping, in the event a labor camp is required, it should be located away from place of actual work and the workers transported to the work site on a daily basis. Temporary lodging for workers should not be set up along the

alignments where piping is being installed. The labor camp should be set up at a selected and approved location for the duration of the contract, at a location that does not interfere with or cause a nuisance for the local community.

47. The Contractor should have a basic safety and health plan in place for workers, in which workers are required to wear personal protective gear suitable to the type of work being performed and a worker is suitably trained (or experienced) in the work he/she is assigned to do. Emergency care should be available on call. The Contractor should maintain a record of accidents, which should be reviewed on occasion with the supervising engineer.

48. There is unlikely to be significant disturbance of surface soils at the treatment plant site, hence the potential for erosion and soil loss is insignificant. Any excess earth should be used in landscaping at the site or used as fill offsite at locations agreed upon by the property owner. Construction debris should be stockpiled and removed from the site soon after completion of the work.

49. Dust emissions can be controlled using water sprays. Operation of high decibel emitting equipment should be limited to daylight hours, as with receipt of materials and supplies shipments.

1. Installation of Distribution Piping

50. The workplace should be kept orderly to reduce accidents. Deep excavations in unstable soils need to be shored, and below grade construction brought to grade quickly, then excavations closed. Surface soils should be temporarily graded-to-drain and protected as necessary to reduce erosion and sediment runoff. Silt fences may be required in locations where there are nearby bodies of water that could be affected by sediment.

51. Noise and dust emissions should be controlled along the pipeline routes to the extent practicable, depending on the presence of people, nearby homes or institutional buildings. Dust emissions can be controlled using water sprays. Operation of high decibel emitting equipment should be limited to daylight hours, as with receipt of materials and supplies shipments.

52. The placement of water distribution pipe takes place along linear alignments most typically the shoulders of roadways, along city streets (generally outside the curb line or pavement edge) and along other linear features such as irrigation canals or railway easements. In limited instances the installation will cut across or intersect the street or road alignment.

53. About 3 km of 160 mm diameter HDPE distribution pipes will be installed to replace existing pipes. Alignments for pipes where there are homes (Figure 4) and shops presents the potential for environmental impact, but the impact is of temporary duration and limited extent. Special precautions need to be taken in built up areas, for instance near markets, schools and other areas where the public is present in greater numbers. In areas congested during the day, construction work may be conducted during nighttime and cause less disruption to the community. The following procedures should be applied throughout pipe laying with particular emphasis where the work is conducted in congested areas.

Fig. 4: View of Pipeline Alignment Near Homes



54. The contractor should conduct pipe laying in a manner that has minimum impact on the health, safety and convenience of businesses, residences and users of the street area. This includes the following:

1. Minimize the period of time that a segment of excavation is kept open by not allowing trenching to outpace pipe-laying by more than a day or so. Trenches should be back-filled and ground leveled after installation of piping.
2. Place only bedding and pipe materials at the location that will be used within the next few days work, well out of the line of traffic. Clean up and remove from the site any excess spoil, wood used for shoring and construction materials upon completion of the segment. Compact soil in trench and clean surrounding pavement areas to reduce blowing dust.
3. Provide temporary bridging across the trench at entries to residences and businesses. Otherwise, provide tape barriers to reduce the possibility of an accident.
4. Once work is complete on a segment, pavement surfaces and masonry works (curbs, abutments, stairs, drains, drives, etc.) should be repaired and returned to original condition.

55. The construction approach should minimize the time that any one segment is under construction or roadway/walkway left un-repaired to reduce the construction impact, done by limiting the length of open trench to 100 m or less.

56. The contractor should minimize use of heavy equipment in congested areas, conduct activities during daylight hours and apply water to suppress dust as needed. In heavily trafficked areas such as tourist sites and markets, the contractor should increase

the work force to complete construction quickly, reduce dust by removal of excess earth, and avoid obstructing the paths of travel for pedestrians and vehicles.

57. The contractor should minimize downtime of existing water supply, limit shutdowns to less than four hours and notify the public in advance to store water as necessary.

58. The contractor should use tarpaulins to cover truck beds hauling sand, dirt or fill, avoid overfilling trucks and causing spillage along roadways, plan haul routes to avoid congested areas and narrow roads, and schedule transportation to avoid peak traffic periods. Excavated earth will be used for backfilling trenches; any excess should be minor.

59. The contractor should avoid trenching where damage might occur to buildings, and provide shoring and backfill with sand/cement admixture to prevent caving.

60. The public should be barred from construction areas, and excavations should be barricaded and marked. Workers should not be allowed to enter trenches deeper than waist height unless they are properly shored. Given that excavations will not be deep, pipe diameters relatively small, and that excavated materials will be used as backfill, the quantity of spoil will be minimal.

61. Movable sanitary facilities should be provided at the work site and kept clean, free of odors and usable. No materials should be stored onsite for longer than a day before their use. Excess materials should be removed after a segment is complete.

62. All roadway surfaces should be repaired as construction progresses; bid packages should contain a unit bid price for roadway repair, and for repair of any other facility, structure or surface that is likely to be damaged in quantity during construction.

2. Preservation/Cataloguing of Archeological Relics

63. There is a potential for archaeological relics to be found in the project area and some may be unearthed during trenching. Secs. 37-39 of the Law on the Protection of Cultural Heritage (1996) specifies a chance find procedure to be in place in the event that "cultural property such as monuments, ruins, ancient objects, remains of inhabited sites, ancient burial sites, engravings or any property likely to be of interest" is discovered. The law goes on to state that "the owner of the site is obliged to call a halt to the construction work at that location and immediately make a declaration to the local police, who shall transmit the information to the Governor of the province or a delegated representative. The Governor or representative shall take measures necessary to ensure the protection of the objects and the site." Such chance finds should not be disturbed until assessed by a government approved Archeologist.

64. The subproject could face unreasonable delay by encountering repeated work stoppages and the following procedure is intended to conform to the intent of the law while avoiding repeated stoppages:

- A. During the period of detailed design, the PIU should request that a government approved Archeologist make a visit to the area to assess the potential for significant archeological finds within the pipe alignments and at depths that piping will be installed.
- B. The pipe alignments will be walked at systematic intervals, and subsurface investigation techniques, such as shovel probing, will be used to explore areas of poor visibility. If necessary, test pits may be dug to resolve surface evidence.
- C. If the Archaeologist completes a survey and determines that no archaeological sites are present within the area of project impact, a management recommendation of "no archaeological sites present" would be appropriate. In addition, the Archaeologist would normally make a recommendation that no further archaeological investigations are needed. A recommendation of "no eligible archaeological sites present" can also be made if it can be demonstrated that artifacts or

sites are not eligible due to loss of physical integrity or insufficient scientific data content.

- D. Work can proceed once alignments receive the recommendation; in the event artifacts are unearthed, the Archeologist will be requested to visit the site to recover any artifacts present in already excavated materials and to record evidence that may be visible below ground.
- E. The contractor does not need to interrupt work progress; excavated materials containing slight archeological evidence may be used for refilling trenches; the contractor and its employees are enjoined to prevent any pilfering of artifacts from excavated earth or side walls of trenches upon penalty of law.

3. Disinfection of Installed Water Pipe

65. Newly constructed or repaired water mains, tanks and reservoirs contain pollutants that accumulate during construction. These units can be disinfected through chlorination. Initial chlorine concentrations are made high enough (about 50 mg/L) to overcome the chlorine demand of contaminants. Chlorination is repeated until residual chlorine is one mg/L, after which the structure is flushed out before being placed into use. Installation contracts should include a bid item for disinfection of installed piping.

C. Operations

66. Impacts during operations concern environmental or public health. Poorly operated treatment plants pass pathogens; failure to chlorinate allows pathogens to survive in distribution systems; broken pipes and low pressure allow cross-contamination from sewers and soil organisms.

67. Modern, well-operated water treatment plants deliver a product water consistently free of coliform organisms and other pathogens, no matter how polluted the raw water may have been. Data show that flocculation, settling and sand filtration coupled with chlorination can produce an effluent containing one coliform organism per 100 ml (the historical standard for these plants) when influent contains as many as 6,000 coliform/100 ml.

68. Effective coagulation and sedimentation reduces turbidity to improve the effectiveness of filtration. Effective removal of bacteria by filtration relies on influent turbidity in the range of 7-14 NTU, after which sand filtration is capable of high removal efficiency. Regardless of the effectiveness of the treatment process, continuous chlorination at the head of the delivery system is necessary for delivery of safe water free of bacterial contamination, viruses and other pathogens. Chlorine residuals of 0.2 – 1 mg/L after 15 to 30 min of contact will generally produce a decontamination factor of 1000 (99.9% destruction). A 15 min residual of 0.5 mg/L appears to be a safe average.

69. Broken lines and low pressure provide means for entry of pathogens into distribution systems. The mechanics of this phenomenon are difficult to trace; however most modern systems guard against low pressure, when cross-contamination is potentially more likely in systems with high rates of unaccounted for water (e.g. systems with broken and leaky mains). Maintaining chlorine residual in the system is one way to guard against cross-contamination, as is sustaining adequate pressure in the system. A proposed technical assistance aims to provide capacity building for PWW staff in all aspects of operations and maintenance, which will ensure that high quality drinking water is provided through provincial systems.

70. Capacity building in the occupational and public safety aspects of operational use of chlorine will need to be included in the Loan. Of particular concern is the provision/procurement of adequate safety equipment at the site, to include eye wash stands refitted under the project and correct use of personal protective gear. Training must include emergency procedures for response in the event of leaks and spills, and means for conducting regular training of staff under normal operations, as well as simulated drills.

71. A sludge drying bed is being installed at the treatment plant works for dewatering filter backwash generated during operations. The small amount of materials derived from the drying operation can be safely landfilled at facilities operated by the municipality.

D. Sanitation

72. There is no physical intervention related to sanitation on the Project; therefore there is no direct environmental impact associated with any physical works. The absence of sanitation interventions to offset or mitigate the adverse effects of increased household, commercial and (potentially) industrial waste flows is a form of indirect or cumulative impact that is taken up in the next section.

E. Indirect, Cumulative and Induced Impacts

73. Water supply is an essential component of human welfare, and is essential for urban growth, both in terms of population density and the spread, or extension, of settlements into new areas. Growth in many towns in Cambodia has been constrained by limitations on water supply; even where actual numbers and area coverage are not factors, human health impacts stemming from inadequate household supply may occur.

74. Indirect, cumulative and induced impacts stemming from development of water supply systems have to do with the effects of urban growth. Most generally, urbanization is accompanied by congestion with concomitant effects on air pollution and overall quality of life. More specifically, the introduction of water supply into an area can cause rapid changes in land value, and the conversion of peri-urban or rural land into areas ripe for development. If land ownership is not clearly established ahead of time, the potential for land grabbing and displacement of households exists. In short, in the absence of land use controls, expansion of water supply systems aggravate uncontrolled development and consequent impacts on environment. There are no new areas being served in Pursat by means of the project, so the aggravation of uncontrolled development does not occur.

75. The most clearly linked indirect impact of water supply expansion has to do with the disposal of increased quantities of wastewater from households and industrial/commercial users. Generally speaking, improved water supply should be accompanied by improvements in sanitation and drainage that mitigate the effect of increased discharges. Onsite sanitation is the norm throughout Southeast Asia, and many areas receiving water supply improvements also require improved onsite sanitation facilities, for homes not already equipped.

76. Septic systems may not function properly depending on local soil conditions; supernatants from septic systems installed for homes or commercial establishments may not percolate into the soil, and are routed to surface drains. Industrial and commercial wastewater discharges need more than simple removal from the living environment, requiring sufficient regulatory presence to insure that industries, hotels and markets install and consistently operate treatment systems. Improved drainage in areas newly served by water supply helps to alleviate some of the impact, but because these flows often concentrate partially treated effluents, the effect on a receiving stream can be injurious.

77. Impacts occur if drainage increases pollution load to receiving waters. In general, drainage systems suffer from a lack of investment in infrastructure, limited cooperation between government departments, clogging with solid waste and infilling/blockage by property owners. Drains receive urban run-off, solid waste and septic tank overflow, and contain high BOD, a measure of oxygen demand. These impacts may be alleviated by routing flows through constructed wetlands upstream (often along the boundaries) of receiving streams prior to final discharge.

78. The cumulative effect of discharges from many small urban drains on receiving water quality can be severe over the long term, and available solutions are inadequate to

deal with the greater problem. Since water quality may be degraded in any open water bodies in the project area due to drainage discharges originating from increased water supply, the sanitation component of the present project aims to identify the needs and set out an implementation plan for sector investment in sanitation and drainage. From the standpoint of environment, this is an appropriate and necessary response to the potential cumulative impact of added water supply and its effect on surface water pollution and public health.

F. Resilience to Climate Change Impacts

1. Framework

79. The quantities of water supplied “at source” and the extent of water supply distribution to a recipient population provides the base case for comparison with future conditions under which the subproject is implemented and climate change effects take place. The subproject either improves, or is neutral with respect to, climate change resilience. A further issue concerns the exacerbation of health impacts due to climate change in the absence of effective sanitation and drainage in urban and peri-urban communities. Finally, whether subproject infrastructure is vulnerable to weather conditions brought about by climate change may be considered.

2. Predicted Regional Climate Conditions due to Climate Change

80. As of December 2012⁶, downscaling of the general circulation models (GCMs) to determine regional climate conditions under global climate change had not been accomplished for Cambodia. Thus predictions related to the effects of climate change on hydrometeorological parameters in Cambodia are uncertain and generally qualitative. Extreme events at different times of the year, different years, and variable frequencies of both flooding and drought are anticipated, with main impacts on agriculture and public infrastructure, but the extent and seasonality of flooding or drought in any particular area are unknown. Long range effects on water supply, especially groundwater availability and reserves, are not known.

3. Prioritization of Urban Water Supply under Climate Resilience Regimes

81. According to Cambodia’s National Adaptation Programme of Action (NAPA), water availability and accessibility, and water quality, are two of 14 ranking criteria to be applied to non-health projects aimed at improving resilience. Among agriculture and water resource projects, only one – “Safer Water Supply for Rural Communities” – deals specifically with water supply, and received a ranking in importance of 10 out of 14 points. Among coastal zone projects, one addresses water supply for communities located in coastal provinces (“Community and Household Water Supply in Coastal Provinces”), which received a ranking of 12 out of 14 points. No projects identified through the NAPA participatory process target resilience of urban water supplies.

4. Subproject Interactions with Climate Change

82. The subproject improves climate change resilience by improving operational efficiency of the treatment system and enhancing storage capacity. To the extent that the community is lacking in piped water supply either from shortage of source quantities or due to inadequate distribution, the recipient populations are benefited. Drought conditions brought on by climate change exacerbate problems related to water shortages among communities not served by centralized supply. In other words, inadequate or

⁶ This is reported under “POLICY BRIEF 4: Improving Hydro-Meteorological Information and Downscaling of Climate Predictions for Better Climate Change Adaptation Planning in Cambodia”, prepared by Hatfield Consultants for The Royal Government of Cambodia (RGC) through the Climate Change Department of the Ministry of Environment (CCD-MoE) under the project entitled “Preparation of a Strategic Pilot Program for Climate Resilience (PPCR) Project” – Phase I (November 2010 to January 2013).

paucity of supply is made worse when long periods of drought exhaust storage in tanks, onsite tube wells, ponds and streams and replenishment comes infrequently and too late. Drought conditions are made worse as a result of climate change, either from the length of drought periods or from lack of intermittent rains of quantity or duration to relieve drought conditions. The subproject has a beneficial impact on the community by providing alternative water supply in the face of drought brought on by climate change, and improves the resilience of the community both in terms of operational efficiency as well as distribution.

83. The subproject is vulnerable to the effects of climate change in the following manner:

- Sources of raw supply could become depleted. The Pursat River may be vulnerable to extended drought and extremely low water levels could occur. This is a significant concern for the Stung Sen waterworks but is not one that can be addressed adequately under the present project. An auxiliary well that would be available during periods of extended drought might provide a reasonable solution to this problem.
- Ground heave due to excessive drying (and potentially wetting) could cause breakage of pipes in roadway shoulders and other locations. The use of high density polyethylene pipe (HDPE) in preference to PVC offsets this impact. HDPE is more flexible and will yield and deform rather than break.

84. Drainage conditions are worsened under climate change scenarios, whether stagnant and still water bodies during periods of drought that breed mosquitoes and harbor high numbers of enteric disease bacteria, or flooding conditions where drainage systems are overwhelmed and polluted water enters human living spaces. Well-built and durable sanitation and drainage appurtenances, drainage easements, clear, open flow channels, and downstream extensive systems for pollution abatement such as constructed wetlands provide the means to offset impacts from climate change and make communities more resilient.

85. No other aspects of the subproject appear affected by climate change.

G. Existing Facilities Audit

86. Appendix I of the ADB SPS (2009) requires that, “when the project involves existing activities or facilities, relevant external experts will perform environmental audits to determine the existence of any areas where the project may cause or is causing environmental risks or impacts.” The existing facilities have been audited to identify the presence of waste, spent, out-of-spec and discarded water treatment chemicals, oils, cleaning fluids and solvents, as well as contaminated soils that have or have the potential for causing environmental impacts or risks. Waste materials that pose a hazard to human health or the environment have not been identified at the facility. The director of the water supply agency confirms the absence of any such materials within the water supply system buildings or on property under the control of the water supply agency.

87. On inspection of the facility it was noted that a latrine and soakaway are located on the bank of the Pursat River on property adjacent to the pump house and upstream of the water supply intake. The Pursat PWW has been concerned about the location of the latrine, which originally discharged directly to the river. The property owner responded by constructing a soakaway to contain effluent from the latrine. Still, it is appropriate to analyze the situation to determine if further actions are necessary. The analysis is contained in Appendix 3. The result of the analysis is that the leachate percolating into the soil of the riverbank does not pose a threat to human health and therefore there is not a cause for further action. It is important to note that the latrine and soakaway are on private

property and their relocation would require forcible removal, when there is no good alternative location for the latrine on the owner's property.

88. The conclusion is that there is no need to prepare a corrective action plan to dispose of materials, remediate soils or structures, or relocate the latrine and soakaway for purposes of reducing environmental impact and risk. The visual impact of the latrine and soakaway can be minimized by erecting a screen or fence around the facility. The PIU is enjoined to support this as a matter of expediency.

89. The potential presence of unexploded ordinance (UXO) and mines has been evaluated within the subproject area based on survey maps and discussion with provincial authorities. It has been determined that there is no basis for suspecting that UXO or mines are present.

H. Summary

90. The subproject has no significant impacts under the planning phase since the proposed works are aimed at remedying current deficiencies in the operation of the existing system. Impacts during design and preconstruction occur if adequate funds are not provided for repair of road surfaces following installation of distribution piping. Mitigation requires allocation of funds and inclusion of road repair as well as other elements of work as a payment item in the bid price for construction contracts. Impacts during construction are mitigated through application of environmental guidelines during construction, which act to limit the extent of fugitive air emissions and water quality impacts, and the degree to which access, egress and passage are afforded to the public and adjacent landholders during construction. Impacts during operation are mitigated by properly maintaining and operating the water treatment system and assuring a chlorine residual is present in the distribution system.

91. Indirect, cumulative and induced impacts have been found to be insignificant with the exception of increased sanitation and drainage flows. The project enhances climate change resilience among the communities served by improving distribution system pressure; the system is vulnerable to climate change impacts arising through extended drought and depletion of flow in the Pursat River. An existing facilities audit did not reveal the existence of any areas where the project may cause or is causing environmental risks or impacts, hence there is no need for preparation of a corrective action plan.

V. ENVIRONMENTAL MANAGEMENT PLAN

A. Review of Impacts

92. Table 3 summarizes the impacts in the approximate order that they have been discussed in the previous section. The table also summarizes the required mitigation measures, institutional responsibilities for assuring the mitigation action is carried out and costs, which are in all cases included in previously identified budgets for design, construction and operation of the systems.

B. Institutional Arrangements

93. The Department of Potable Water Supply (DPWS) at central level under Ministry of Industry and Handicraft (MIH) is the executing agency and will establish the Project management Unit (PMU) to execute the Project. The PMU will assign responsibility for environmental aspects to a particular individual as staff PMU Safeguard Management Officer (PSMO) who is engaged full time with implementation of the project to oversee work related to monitoring.⁷ The Provincial Water Works (PWW) is the operator of the Pursat water supply system and implementation agency for the subproject. PWW will establish

⁷ While the PSMO is engaged fulltime with subproject execution, duties related to environmental management may constitute only a portion of his/her responsibilities.

a Project Implementation Unit (PIU) to undertake construction of the Subproject in Pursat Province.

94. The PMU will engage Contractors for specific works, based on the subcontract packages considered most suitable for execution. Legal clauses regarding mitigation measures are required to be included in construction contract bidding documents and become part of contract agreements; a typical set of specifications are provided in Appendix 2. For the main construction contracts, the Contractor will be required to appoint a staff Construction Environmental Management Officer (CEMO) responsible for supervising implementation of mitigation measures during the execution of the contract. The contractor will be required to prepare a Construction Management Plan (CMP) to ensure construction, demolition and excavation that take place at building sites do not adversely affect health, safety, amenity, traffic or the environment in the surrounding area. The CEMO working with the Contractor's Site Manager is responsible for preparing this plan prior to the start of construction and receiving approval for the plan from the PMU before the start of construction. The CEMO will serve as a point of contact that is accountable for environmental aspects of the construction work. For smaller construction contracts or subcontracts, the (sub-) contractor will still be held accountable for implementation of mitigation measures through a system of quality assurance supervised by the PMU⁸.

95. The PMU will be assisted by the Environmental Specialists (ES), consultants⁹ who are part of the Design and Supervision Consultant (DSC) and support all the subprojects undertaken through the loan. Work will commence with updating and finalizing the IEE and its respective environmental mitigation measures and monitoring plan, submitting the plans on behalf of MIH to the Ministry of Environment, incorporating legal clauses regarding mitigation measures into construction contract bidding documents, assisting the PSMO in monitoring the implementation of those measures during the progress of construction, and preparing the environmental sections of semi-annual reports to be provided to ADB. The ES also will provide training to PMU and PIU staff, focusing on ADB safeguard policies and procedures, and use of verification checklists for monitoring environmental safeguards during construction. Table 4 describes the functions of various agencies engaged in the project, and a diagram illustrating the institutional arrangement is provided in Figure 5.

96. A timeline for updating the IEE as well as for inclusion of the EMP and special conditions in contract and/or bidding documents is as follows:

- Project design proceeds over a period of 5 months (anticipated)
- Monitoring of water quality over first two months
- Concurrently, IEE is updated with new design data
- By end of month 2, expected that issues related to design are resolved
- IEE undergoes translation (2 weeks)
- IEE submitted to DOE by mid-month 3 of design period
- DOE has 30 days to review/approve IEE
- IEE approved by mid-month 4 of design period
- ADB review runs concurrently with DOE review
- Final approval from ADB and the Government obtained before detailed design finalized in time for inclusion in procurement package

⁸ Subcontractors hired by the general contractor, or minor contracts undertaken at the site are required to be managed under the provisions of the main contract and in conformance with the CMP.

⁹ Both international and national ES will be engaged. It is recommended that the international ES be engaged for four months over the project duration, and the national ES be engaged fulltime, to provide support to the PSMO for this and other subprojects.

97. The Ministry of Environment (MOE) and the provincial Departments of Environment (PDOEs) play a role in submittal, review, and approval of the IEE, and monitoring and reporting. This work takes place during the implementation phase. The ES will revise and update the IEE based on final designs, and the document should be translated into Khmer prior to submittal to MOE DEIA, which will engage in the review process the provincial PDOE where the subproject takes place. Only after the DEIA approves the EMP for the subproject can a contract be signed between the IA and the contractor for the works. Following that, implementation can proceed with construction mitigation measures mostly in the hands of the contractor, and the ES, PDOE, PIU and PSMO working together to perform monitoring and reporting. It will be the job of the PIU supported by the ES to compile quarterly reports, which then are compiled into semi-annual safeguard monitoring reports by the PMU and DSC, supported by the ES. A sample environmental monitoring reporting form is shown in Appendix 4. The PSMO and PMU Project Director will be responsible for submittal of reporting to ADB.

Table 3: Potential Environmental Impacts and Mitigation Measures

Project Activity	Potential Negative Impact	Proposed Mitigation Measure	Institutional Responsibility	Cost Estimates
Construction				
Movement of construction materials to the site	Dust and roadside grit hazardous to pedestrians and motorcyclists	<ul style="list-style-type: none"> - Movement of construction materials and demolition debris restricted to daylight hours - Trucks to be equipped with fully functioning exhaust mufflers - Trucks hauling aggregate and demolition debris to be covered, or surface of materials wetted - Trucks to observe traffic rules and travel at safe speeds, especially in congested areas 	Construction Contractor (CEMO)	Included in bid price for work
Onsite construction works	Noise and dust generated during construction activity	<ul style="list-style-type: none"> - Work limited to daylight hours, or to conform to the preference of surrounding users - Dust generated during demolition to be suppressed with water - Use of jack hammers confined to short time periods - Use of explosives is prohibited. 	Construction Contractor (CEMO)	Included in bid price for work
Onsite construction works	Runoff from rainfall incident on the plant site can transport sediment	<ul style="list-style-type: none"> - Sediment loss controlled with silt fences formed from woven polyethylene fabric or from bunched hay 	Construction Contractor (CEMO)	Included in bid price for work
Installation of distribution piping and fixtures	Inconvenience and damage to property	<ul style="list-style-type: none"> - Complete a segment of piping no longer than 100 m before beginning the next segment - Provide bridging across trenches for pedestrian and vehicle access; barricade construction - Materials should not be stockpiled in the line of traffic, and no more materials than are necessary brought to the site in advance - Trench must be backfilled, brought to original grade, and any damage to drives, walkways and street surfaces repaired to original condition - Excess spoil from excavations will be minimal, but should be removed from site and either reused or disposed of appropriately with other construction wastes. 	Construction Contractor (CEMO)	Included in bid price for work
Construction worker offsite housing	Community social and sanitation impacts	<ul style="list-style-type: none"> - Location for offsite housing approved by the PMU - Signed consent from the owner of the property, to set out terms of payment, if any, for use. - Suitable temporary housing, bathing and sanitation facilities, and canteen for preparation of food erected at site and rudimentary site drainage and access in place before occupancy 	Construction Contractor (CEMO)	Included in bid price for work

Project Activity	Potential Negative Impact	Proposed Mitigation Measure	Institutional Responsibility	Cost Estimates
		<ul style="list-style-type: none"> - Sufficient distance from markets, schools, temples, and neighborhoods to avoid impact - Housing of workers at commercially available guest houses is a suitable option. 		
Onsite construction works	Direct injury of workers in the course of demolition of existing structures	<ul style="list-style-type: none"> - Personal protective equipment (PPE) provided for workers - Workers not required to perform hazardous tasks which could result in injury and exposure - External means of preventing exposure to be pursued wherever possible, including alternative means of performing similar work. - Workers-at-height equipped with and required to wear safety harnesses. - Entry of workers into enclosed spaces such as vacated tanks or sumps to be preceded with and accompanied by forced air ventilation. 	Construction Contractor (CEMO)	Included in bid price for work
Onsite construction works	Chronic injury from prolonged exposure to persistent noise, fumes, dust and heat	<ul style="list-style-type: none"> - Tasks requiring use of high decibel equipment to be performed over short stretches by alternating workers. 	Construction Contractor (CEMO)	Included in bid price for work
Onsite construction works	Dehydration and fatigue and lack of sufficient onsite sanitation facilities	<ul style="list-style-type: none"> - Workers to be provided with easy access to clean drinking water and modern sanitation facilities at the construction site, given suitable work breaks, and time for midday meals. 	Construction Contractor (CEMO)	Included in bid price for work
Operations				
Water system operations	Property damage, water quality impact	Operate and maintain facilities to treat filter backwash and sedimentation tank underflow. Remove solids and dispose of according to approved means.	DPWS/PWW	Part of operations cost
Water system operations	Negative health impact.	Chlorinate water supplies.	DPWS/PWW	Part of operations cost
Water system operations	Accident/Injury to workers	Provide capacity building for emergency response to chlorine gas leaks and spills; assure sufficient PPE and onsite emergency response equipment is included in the loan	DPWS/PWW, DE	Part of loan implementation
Water system operations	Negative health impact.	Detect and repair leaks and maintain sufficient pressure to prevent cross-contamination.	DPWS/PWW	Part of operations cost

Table 4: Roles and Responsibilities

Agency	Role
MIH—DPWS Project Management Unit (PMU)	Supervision and guidance; assist to appoint staff of PMU including Project Safeguard Management Officer (PSMO); recruit competent environmental specialists (ES) as part of the DSC to assist design team and PMU; submit IEE to Ministry of Environment (MOE) for approval; consolidate and submit semi-annual reports to ADB, ensure EMPs are satisfied in the design and construction of the subproject.
Provincial Water Works (PWW) PIU (Pursat)	Assist the ES to monitor mitigation measures and implement grievance mechanism, prepare and conduct public consultations, monitor subproject activities and prepare quarterly environmental reporting at the subproject level.
Design and Supervision Consultant (DSC) National Environmental Specialist (ES)	Assist the PMU to review, update and submit IEE for approval by MOE; incorporate EMP requirements into design, specifications and construction contract; co-ordinate with other government agencies regarding environmental issues; organize and implement public consultation and grievance redress mechanism; monitor activities of design engineer and construction contractors to assure mitigation measures are implemented; incorporate environmental reporting into semi-annual progress reports.
Construction contractors	Implement environmental requirements related to construction; incorporate environmental costs into bid estimate; prepare a Construction Management Plan (CMP); appoint the Construction Environmental Management Officer (CEMO); assure all environmental requirements are followed.
MOE DEIA and PDOE	Review IEE and provide comment and approval; PDOE assists in monitoring implementation of mitigation measures
DPWS/MIH Lab	Implement water quality monitoring of raw and treated water supplies during operations

C. Environmental Monitoring Plan

98. Environmental monitoring extends during the implementation of the loan and engages the previously identified groups. Table 5 identifies the monitoring to be undertaken in respect to the mitigation measures previously identified. The PIU and ES are responsible for the bulk of the monitoring being undertaken during the design and construction periods. During operations, the Provincial Water Works is responsible.

Figure 5: Organization for Environmental Management on Pursat Subproject

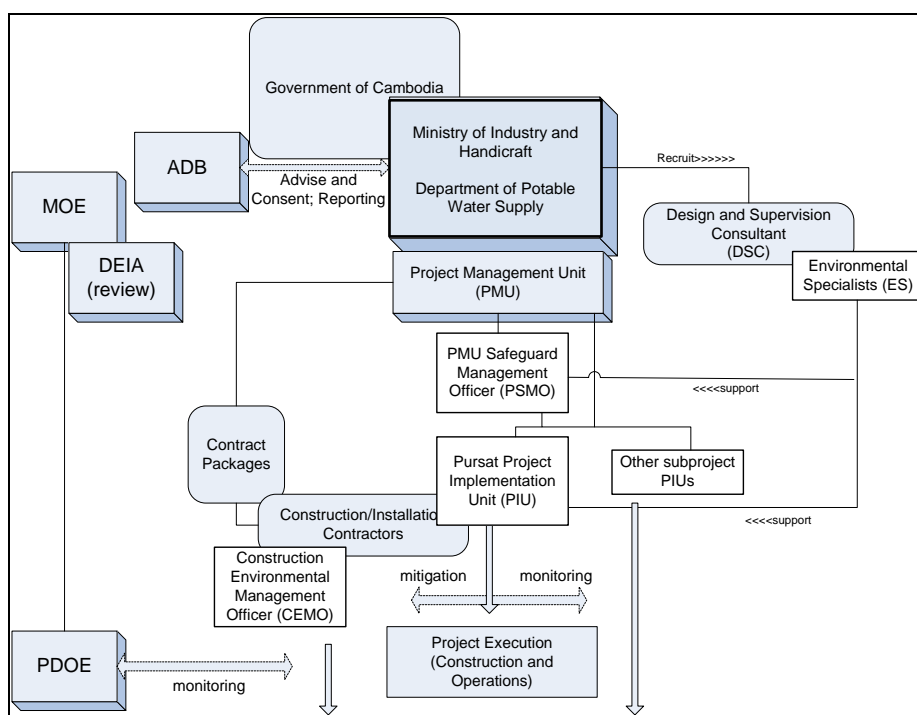


Table 5: Environmental Monitoring Plan

Mitigation Measure	Parameters to be Monitored	Location	Measurements	Monitoring Frequency	Responsibility for Monitoring	Cost to Monitor
Construction						
<ul style="list-style-type: none"> - Movement of construction materials restricted to daylight hours - Trucks to be equipped with fully functioning exhaust mufflers - Trucks hauling aggregate and demolition debris to be covered, or surface of materials wetted - Trucks to observe traffic rules and travel at safe speeds, especially in congested areas 	Field Conditions	Pursat roadside environment	Visual inspection	Over duration of work	PSMO, ES, PDOE	No extra cost.
<ul style="list-style-type: none"> - Work limited to daylight hours, or to conform to the preference of surrounding users - Dust generated during demolition to be suppressed with water - Use of jack hammers confined to short time periods - Use of explosives is prohibited. 	Field Conditions	Construction site and environs	Visual inspection	Over duration of work	PSMO, ES, PDOE	No extra cost.
<ul style="list-style-type: none"> - Sediment loss controlled with silt fences formed from woven polyethylene fabric or from bunched hay 	Field Conditions	Construction site and environs	Visual inspection	Over duration of work	PSMO, ES, PDOE	No extra cost.
<ul style="list-style-type: none"> - Complete a segment of piping no longer than 100 m before beginning the next segment - Provide bridging across trenches for pedestrian and vehicle access; barricade construction - Materials should not be stockpiled in the line of traffic, and no more materials than are necessary brought to the site in advance - Trench must be backfilled, brought to original grade, and any damage to drives, walkways and street surfaces repaired to original condition 	Field Conditions	Locations for installation of distribution piping and appurtenances	Visual inspection	Over duration of work	PSMO, ES, PDOE	No extra cost.
<ul style="list-style-type: none"> - Location for offsite housing approved by the PMU - Signed consent from the owner of the property, to set out terms of payment, if any, for use. - Suitable temporary housing, bathing and sanitation facilities, and canteen for preparation of food erected at site and rudimentary site drainage and access in place before occupancy - Sufficient distance from markets, schools, temples, and neighborhoods to avoid impact - Housing of workers at commercially available guest houses is a suitable option. 	Field Conditions	Labor Camps	Visual inspection	At start of contract; quarterly	PSMO, ES, PDOE	No extra cost.

Mitigation Measure	Parameters to be Monitored	Location	Measurements	Monitoring Frequency	Responsibility for Monitoring	Cost to Monitor
<ul style="list-style-type: none"> - Personal protective equipment (PPE) provided for workers - Workers not required to perform hazardous tasks which could result in injury and exposure - External means of preventing exposure to be pursued wherever possible, including alternative means of performing similar work. - Workers-at-height equipped with and required to wear safety harnesses. - Entry of workers into enclosed spaces such as vacated tanks or sumps to be preceded with and accompanied by forced air ventilation. 	Field conditions	Construction site	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
<ul style="list-style-type: none"> - Tasks requiring use of high decibel equipment to be performed over short stretches by alternating workers. 	Field conditions	Construction site	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
<ul style="list-style-type: none"> - Workers to be provided with easy access to clean drinking water and modern sanitation facilities at the construction site, given suitable work breaks, and time for midday meals. 	Field conditions	Construction site	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
OPERATIONS						
Operate and maintain facilities to treat filter backwash and sedimentation tank underflow. Remove solids and dispose of according to approved means.	Effluent TSS	Water Treatment Plant	TSS in effluent	Quarterly	DPWS/PWW	\$200/yr
Chlorinate water supplies.	Chlorine residual	Treatment plant	Chlorine residual	Weekly	DPWS/PWW	\$600/yr
Detect and repair leaks and maintain sufficient pressure to prevent cross-contamination.	System Pressure	Distribution system	System pressure	Weekly	DPWS/PWW	None

D. Water Quality Monitoring

1. Types, Frequency and Timing

99. Concerns about surface water quality impacts during construction will be met by observing site conditions and no direct water quality monitoring of surface water is needed. No data are needed regarding the source of supply for the subproject, since the subproject does not address augmented supplies or treatment. Hence there is no water quality monitoring necessary on the project preliminary to construction.

100. Recommended protocols for monitoring raw water quality used in production operations (the raw water source) and finished water quality are already in place by DPWS in which a number of parameters are monitored (Table 6). Treated water quality should be within the limits set by the DPWS/MIH. It is important to consistently monitor raw and finished water quality, produce consistent data outputs, and analyze data for the purpose of maintaining and improving operations.

101. Other operations monitoring may be required. For instance, some operators measure select parameters downstream of the sedimentation tank in order to track performance of flocculation and settling in response to adjustments in chemical addition rate. Sampling and analysis may be performed at greater or lesser frequencies than specified herein to adjust performance. Actual parameters may differ depending on the source of supply (ground or surface water). The monitoring proposed herein is part of the operating unit's protocols, and is supported by MIH's Water Quality Lab, hence there is no additional cost associated with the proposal.

Table 6: Drinking Water Quality Parameters and Frequency

<i>Parameter</i>	<i>Raw Water</i>	<i>Treated</i>	<i>Notes</i>
<u>Essential Items (Analyze Daily)</u>	✓		
-Color	✓	✓	
-Turbidity	✓	✓	
-pH	✓	✓	
-TDS	✓	✓	Or conductivity
-Residual Chlorine		✓	Multiple locations in pipeline
<u>Important Items (Analyze every 3 months)</u>			
-Taste		✓	
-Odor		✓	
-Mn	✓	✓	
-Zn	✓	✓	
-SO ₄	✓	✓	
-Cu	✓	✓	
-H ₂ S	✓	✓	
-Hardness	✓	✓	
-Al	✓	✓	
-Cl ⁻	✓	✓	
-Fe	✓	✓	
-NH ₃ -N	✓	✓	
-E. Coli	✓	✓	
-Total Coliform	✓	✓	
<u>Other possible analyses</u>			
-Alkalinity	✓	✓	Some ops measure daily
-Organic carbon content	✓	✓	Permanganate test (COD)
-arsenic	✓	✓	Until satisfied none is present exceeding 50 µg/L

2. Sampling Locations

102. The location of raw water quality sampling is at the raw water intake. Treated water quality monitoring takes place at the end of the treatment plant. Monitoring chlorine residual is done at various locations in the distribution system.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

103. The primary stakeholders are the citizens of Pursat who will benefit from improved water supply. Among this group, outlying communities that have previously not been connected to community water supply see the greatest change in their circumstance, whereas others will experience improved service, including higher quality water and increased quantities.

104. The Provincial Water Works (PWW) is a key stakeholder that holds the interests of the community to be its primary mission. The subproject concept and design are driven by PWW perceived needs for rehabilitation of system elements within the constraints of the available budget, and the PPTA team consulted regularly with the PWW to achieve good alignment of the subproject elements and current system needs. Furthermore the IEE has been reviewed by DPWS and concurrence has been reached on the contents of the EMP.

B. General Awareness of Project

105. During field work on environmental and social components, informal public consultation was held along the route of the piping, and some information was gained on current access to water supply. The social component combined focus group discussions with socioeconomic survey work, and conducted random sampling surveys that focused on local experience and perceptions of thematic issues like sanitation practice and water supply quantity and quality.

C. Formal Public Consultation regarding Environmental and Social Issues

1. Meetings

106. No formal public consultation meeting was held in Pursat since the original thinking on this subproject was that it would be covered by a due diligence review. It was not thought that public consultation would be necessary during the site visit by the environmental and social teams. Formal public consultation will need to be conducted at the outset of the loan implementation.

2. Further Public Consultation

107. Consultation will need to be held at the outset of procurement for the construction of civil works under the project. This is in order to notify the community that work will commence on the project, to review environmental issues of concern, and to inform the public of the grievance redress mechanism established under the project.

D. Disclosure

108. Details of the subproject were disclosed through a process of public consultation described above. Further to that, MIH shall provide the relevant environmental information for this subproject, including information from the IEE to affected people in a timely manner, in an accessible place, and in a form and language(s) understandable to them by providing a copy of the IEE in Khmer language at the PWW office for review by interested parties. In addition, ADB will post on its website the subproject IEE, updates prepared during the project implementation period, and environmental monitoring reports prepared during the implementation period.

VII. GRIEVANCE REDRESS MECHANISM

109. Grievances related to both environmental and resettlement issues are addressed through the Grievance Redress Mechanism (GRM). In order to ensure that complaints from all affected persons (APs) on any aspect of environment, land acquisition, compensation and resettlement are addressed in a timely and satisfactory manner, and that all possible avenues are available to APs to air their grievances, a well defined grievance

redress mechanism will be established. All APs can send any questions to the implementing agency about their rights in relation with redress of environmental problems and entitlements. APs are not required to pay any fee in order to file a complaint at any level. The GRM has been explained in the public information booklet distributed to all APs, and is explained here in relation to complaints related to environmental impacts.

110. Stage 1 - Complaints from APs on any aspect of environmental impacts or the resettlement program shall first be lodged verbally or in written form to the commune leader. The commune leader along with the members of the provincial resettlement subcommittee working group (PRSC-WG) will meet to decide on a course of action within 15 days from the day it is lodged.

111. Stage 2 - If no understanding or amicable solution can be reached, or if no response from the commune chief is received by the AP within 15 days of registering the complaint, he/she can appeal directly to the PRSG-WG. APs will be heard in person by the vice chairman of the PRSC-WG and APs will be invited to produce documents which support his/her claim. The complaint must be settled within 60 days of registering the original complaint. The PRSC-WG will provide a decision within 30 days of the registering of the appeal.

112. Stage 3 - If the AP is not satisfied with the decision of the PRSC-WG, or in the absence of any response, the AP can appeal to the Interministerial Resettlement Committee-Resettlement Department (IRC-RD). The IRC-RD has 30 days to provide a resolution of the problem from the day it is lodged.

113. Stage 4 - If the AP is still not satisfied with the decision of the IRC-RD on appeal, or in absence of any response from the IRC-RD within the stipulated time, the AP, as a last resort, may submit his/her case to court of law, whose judgment is final. APs may also ask for resolution from ADB's responsible project officer consistent with the provision of the ADB's accountability mechanism. They can file their complaint through the ADB resident mission in Phnom Penh for transmittal to the ADB headquarters in Manila.

114. At each stage the governing official is responsible for recording the minutes of meetings, maintaining files on all complaints, and for distributing copies of all decisions to the PMU and lower level bodies, including commune/village officials and affected parties and households.

VIII. FINDINGS AND RECOMMENDATION

A. Findings

115. The Initial Environmental Examination for this subproject provides a review of the proposed infrastructure and its interactions with the surrounding environment, and analyzes potential impacts due to design, construction and operations, with the objective of determining the timing, scale and intensity of impacts. The review and analysis shows that significant negative impacts are unlikely to occur. Because water supply is an important infrastructure improvement that runs concurrently with – and are essential for – economic development, the main impact is expected to be beneficial. Furthermore, good engineering practice in the design, installation and operations of water supply systems mitigate substantially the environmental impacts noted herein.

116. Still there are ways in which the environmental performance of the project can be improved, and the IEE provides recommendations in regard to these opportunities. The majority of negative impacts that have been identified are associated with construction and installation of the proposed works. These are short term and localized, hence are impacts of minor significance that are minimized by application of safeguards that are common in the construction industry. Environmental criteria for

construction are recommended to mitigate construction impacts, and are included as a separate appendix.

117. Negative environmental impacts occurring during the operation of the project are few. These are mainly concerned with maintaining water supply systems so that safe water, free of pathogens, can be delivered. Recommendations are made regarding chlorination and prevention of cross-contamination in the distribution system, to be carried out by the DPWS. Monitoring treated water quality and chlorine residual in the distribution lines are necessary means for assuring safe supply, and are already routine activities by government water supply agencies.

118. No public consultation meeting was held in Pursat since the original thinking on this subproject was that it would be covered by a due diligence review. It was not thought that public consultation would be necessary during the site visit by the environmental and social teams. Formal public consultation will need to be conducted at the outset of the loan implementation.

119. No residual chemicals, waste oil or contaminated earth has been identified at the site, so there is no need for preparing a corrective action plan (CAP) for the facility.

B. Recommendation

120. Environmental safeguards involve enhancing performance of the water treatment system, mitigation of construction impacts by means of environmental requirements placed on the construction contractor, and operations and maintenance of the completed system to guarantee high quality of potable water. Sanitation and drainage have been addressed in terms of indirect and cumulative impacts.

121. Mitigation measures to be undertaken during construction cover hiring of workers, provision of facilities for worker housing and sustenance, site work and pipe laying, temporary suspension of water supply and pipeline commissioning. Recommendations are aimed at maintaining access to residences and businesses, reducing dust, noise pollution and congestion at the site and along roadways and haul routes, provision of alternative services for water supply when the system needs to be shut down, disinfecting completed distribution mains prior to commissioning, provisions for worker housing, sanitation and waste management, and worker safety and health. An archeological chance find procedures has been incorporated into the EMP in the event items of importance are unearthed during construction.

122. Mitigation measures for implementation during operations include chlorination of water supplies, periodic testing to assure good bacteriological quality, and maintenance of system pressures to prevent cross-contamination in distribution systems.

IX. CONCLUSIONS

123. The environmental impacts of the proposed improvements in water supply infrastructure for Pursat have been assessed by the Initial Environmental Examination reported in this document, conducted according to ADB guidelines. Issues related to involuntary resettlement were assessed by a parallel process of resettlement planning and determined to be insignificant, in that no involuntary land acquisition will occur within the scope of the subproject.

124. The overall conclusion of both processes is that providing the mitigation, compensation and enhancement measures are implemented in full, there should be no significant negative environmental impact as a result of location, planning, design, construction and operation of the project. There are benefits stemming from recommended mitigation and enhancement measures, and major improvements in quality of life and individual and public health once the project is in operation.

125. Further work on the IEE will be required prior to implementation to update the mitigation proposals and identify any associated costs, to be performed by the Environmental Specialist working with the Design Supervision Consultant. There is no additional environmental assessment work required at this stage to comply with ADB policy or national law.

Appendix 1: Rapid Environmental Assessment (REA) Checklist

Country/Project Title:	Cambodia / Urban Water Supply Project (Pursat)
Sector Division:	Urban Development and Water

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area...			
▪ Densely populated?		✓	
▪ Heavy with development activities?		✓	
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		✓	
• Protected Area		✓	
• Wetland	✓		Adjacent bodies of water not affected by the subproject.
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area		✓	
• Special area for protecting biodiversity		✓	
• Bay		✓	
B. Potential Environmental Impacts Will the Project cause...			
▪ pollution of raw water supply from upstream wastewater discharge from communities, industries, agriculture, and soil erosion runoff?		✓	
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		✓	
▪ hazard of land subsidence caused by excessive ground water pumping?		✓	
▪ social conflicts arising from displacement of communities ?		✓	
▪ conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		✓	
▪ unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		✓	
▪ delivery of unsafe water to distribution system?		✓	
▪ inadequate protection of intake works or wells, leading to pollution of water supply?		✓	

Screening Questions	Yes	No	Remarks
▪ over pumping of ground water, leading to salinization and ground subsidence?		✓	
▪ excessive algal growth in storage reservoir?		✓	
▪ increase in production of sewage beyond capabilities of community facilities?		✓	
▪ inadequate disposal of sludge from water treatment plants?		✓	
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		✓	
▪ impairments associated with transmission lines and access roads?		✓	
▪ health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		✓	
▪ health and safety hazards to workers from handling and management of chlorine used for disinfection, other contaminants, and biological and physical hazards during project construction and operation?	✓		Capacity building plan for handling chlorine; prior experience of workers (existing system has chlorine gas delivery system)
▪ dislocation or involuntary resettlement of people?		✓	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		✓	
▪ noise and dust from construction activities?	✓		Moderate effects; mitigated through standard means
▪ increased road traffic due to interference of construction activities?		✓	
▪ continuing soil erosion/silt runoff from construction operations?	✓		Moderate effects; mitigated through standard means
▪ delivery of unsafe water due to poor O&M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?		✓	
▪ delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		✓	
▪ accidental leakage of chlorine gas?	✓		Capacity building in safe handling of chlorine gas provided under the project
▪ excessive abstraction of water affecting downstream water users?		✓	
▪ competing uses of water?		✓	
▪ increased sewage flow due to increased water supply		✓	
▪ increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant		✓	

Screening Questions	Yes	No	Remarks
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		✓	
▪ social conflicts if workers from other regions or countries are hired?		✓	
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		✓	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		✓	

Preliminary Climate Risk Screening Screening Questions		Score	Remarks ¹⁰
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	1	Design to consider sustainable river levels
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): Medium

¹⁰ If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Appendix 2: Environmental Specifications for Contract Tender Documents

General

1. The contractor will post a public notice regarding the nature, extent and cost of the project at the start of the construction zone; and post notices announcing the grievance redress mechanism in local government offices and in strategic places of the subproject's area of influence.

Worker Provisions

2. GOC criteria for minimum age, wage and living provisions, benefits, hours of work, overtime arrangements and overtime compensation, and leave for illness, maternity, vacation or holiday should be met for all workers. The Contractor will conform to national law in relation to hiring and employment; and will comply with the principle of equal opportunity, fair treatment, and nondiscrimination with respect to the employment relationship; except that hiring of project-affected persons, residents of project-affected administrative units and disadvantaged groups is encouraged.
3. The contractor shall implement a safety and accident prevention program involving provision, training and use of safety equipment; minimum skills qualifications for operators and drivers; and record keeping related to accidents.
4. The Contractor will provide Personal Protective Equipment (PPE) to workers that offer adequate protection to the worker without incurring unnecessary inconvenience in its use¹¹. Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out; and proper use of PPE should be part of training programs, as appropriate.
5. The contractor will maintain first aid kits onsite along with instructions for use, and personnel trained in basic first aid emergency response measures; and emergency care should be available on call.
6. Laborers and others resident at the site will be provided with lodging in a camp setting, potable water supply, food service facilities, adequate means for maintaining personal hygiene and solid/liquid waste disposal, and onsite facilities for preparing food, or food service contracted.
7. The contractor will provide means for disposing of wastewater from toilets, baths and food preparation areas either through a septic tank and soakaway, or holding tank with removal by vacuum truck. Solid waste should be collected at waste bins and disposed of properly offsite.
8. The public should be barred from the site as well as from worker housing areas.
9. HIV/AIDS awareness should be incorporated into the contractor's policy and outreach toward workers.

¹¹ Depending on the application PPE may include safety glasses with or without side-shields, and protective shades; plastic helmets with top and side impact protection; hearing protectors (ear plugs or ear muffs); safety shoes and boots for protection against moving & falling objects, liquids and chemicals; gloves made of rubber or synthetic materials; facemasks with appropriate filters for dust removal and air purification; single or multi-gas personal monitors; portable or supplied air; on-site rescue equipment, and insulating clothing, body suits and aprons of appropriate materials.

Use of Land for Construction Purposes

10. The contractor will obtain approval from landowners for temporary use of land for labor camps and construction yards. Local authorities will be consulted on locations, which will in no case be close to sensitive receptors such as hospitals, schools and residential communities.
11. The contractor will not encroach upon vacant land or cause damage to adjacent properties. The Contractor will execute a plan for preventing firewood gathering in the project area and prohibit among workers possession of instruments or poisonous substances for killing or capturing fish or wildlife.
12. Cutting trees is prohibited except inside the construction zone. Trees to be removed must be specified in the Project plans and specifications.
13. No fuel, oil, or parts cleaning fluids shall be spilled, wasted or disposed of at the project site. Secondary containment (earth or concrete berm) at least equal to the capacity of the fuel storage tank shall be provided at fueling stations.
14. After completion of occupancy, all affected areas within the general project boundary shall be graded to their original elevation that allows positive drainage. Machinery, equipment, structures, contaminated earth, plant matter and waste or unused materials shall be removed and disposed of properly.

Conduct of Work

15. The workplace should be kept orderly to reduce accidents. Deep excavations in unstable soils need to be shored, and below grade construction brought to grade quickly, then excavations closed. The contractor will:
 - a. Restrict use of heavy equipment and material receipts to daylight hours. Apply water to suppress dust where needed.
 - b. Exercise caution to prevent erosion losses, close excavations rapidly and stabilize soils once the pipeline is in place.
 - c. Return land to the original condition on completion.
 - d. Complete work on a segment according to a progressive sequence of activity. Provide access by bridging trenches.
 - e. Store bedding materials outside trafficked areas. Cover materials and/or suppress dust with water. Remove excess.
 - f. Avoid stockpiling materials, equipment and supplies at the site.
 - g. Avoid trenching in locations where damage might occur. If needed, provide shoring to assure no subsidence occurs.
 - h. Excavations should be barricaded and marked. Workers should not be allowed to enter trenches greater than waste deep unless they are properly shored.

- i. Use tarpaulins to cover truck beds or avoid overfilling and spillage along roadways, plan routes to avoid congested areas and narrow roads, and schedule transportation to avoid peak traffic periods.
- j. Plan construction to avoid repeated excavation in roads and easements.
- k. Provide movable sanitary facilities at the work site and maintain the site clean, free of odors and usable.
- l. Plan work to minimize duration of shutdown. Limit shutdown to less than four hours. Notify public in advance and advise to store water as necessary.
- m. Increase work force to complete construction quickly in affected areas. Minimize dust / avoid obstruction of pedestrians and vehicles

Sediment Controls

- 16. Areas to be cleared and excavated are limited to areas where construction will take place. Areas will be protected from flowing water including sheet runoff. The contractor will limit sediment loss from exposed surfaces. Existing drainage patterns should be maintained during construction.
- 17. Discharge of wastewater into water bodies is prohibited as is the discharge of wash water from concrete trucks to waterways. . Land clearing activity will be suspended during rains to limit sediment loss.

Community Values

- 18. Vehicles will operate within the legal speed limits in populated areas. The operation of moving equipment in locations accessible to the public will be done in a manner so as to prevent the occurrence of incidents and accidents.
- 19. The contractor is responsible for regular spraying of roadway surfaces in use as haul routes and of sites under construction where these locations are accessed by the public. The contractor will remove excess debris during construction and after completion of the item of work.
- 20. The Contractor will post flagmen at intersections of transit paths for construction vehicles and local traffic, and along traffic lanes where work is in progress. Traffic detours will be clearly marked.
- 21. The contractor will provide a path for transit of pedestrians and vehicular traffic through the construction area; and barricade open excavations to prevent injury to the public.
- 22. The contractor will provide temporary access to affected properties and reinstate permanent access on completion of work; minimize the area under construction at any one time and the duration of works at any one location; and minimize impacts on infrastructure, access and services.
- 23. The contractor will install signs and lighting, where there is nighttime traffic, in the vicinity of works on public roads, and restrict access to the construction site to the public.

Site Conditions and Haul Routes

24. At the start of construction, the contractor will provide a Construction Management Plan for development of the construction zone, worker camps, equipment yards, and haul roads.
25. Haul routes will minimize interference with ongoing activity in the area. Routes shall be approved by the PIU. Haul roads and transport/equipment routes shall be kept within the construction zone, unless authorized by the PIU.

Disinfection of Pipes, Tanks and Equipment

26. The Contractor will disinfect water mains, tanks and reservoirs by chlorination and include a bid item for disinfection in piping installation contracts.

Archeological and Cultural Relics

27. The Contractor will conform to the following procedures for protection of cultural artifacts potentially unearthed during construction:
 - a. Prior to initiation of pipe laying, a government approved Archeologist will be requested to make a visit to the area to assess the potential for significant archeological finds within the pipe alignments and at depths that piping will be installed.
 - b. The pipe alignments will be walked at systematic intervals, and subsurface investigation techniques, such as shovel probing, will be used to explore areas of poor visibility. If necessary, test pits may be dug to resolve surface evidence.
 - c. If the Archaeologist completes a survey and determines that no archaeological sites are present within the area of project impact, a management recommendation of "no archaeological sites present" would be appropriate. In addition, the Archaeologist would normally make a recommendation that no further archaeological investigations are needed. A recommendation of "no eligible archaeological sites present" can also be made if it can be demonstrated that artifacts or sites are not eligible due to loss of physical integrity or insufficient scientific data content.
 - d. Work can proceed once alignments receive the recommendation; in the event artifacts are unearthed, the Archeologist will be requested to visit the site to recover any artifacts present in already excavated materials and to record evidence that may be visible below ground.
 - e. The contractor does not need to interrupt work progress; excavated materials containing slight archeological evidence may be used for refilling trenches; the contractor and its employees are enjoined to prevent any pilfering of artifacts from excavated earth or side walls of trenches upon penalty of law.

Appendix 3
Analysis of Latrine and Soakaway adjacent to Pursat PWW Intake

Coliform bacteria serve as an indicator of fecal contamination in raw water sources and finished water supplies. Measured in terms of most probable number (MPN) per 100 ml, values range over orders of magnitude depending on the sample source. While many types of bacteria and viruses are present in water contaminated by human waste, coliform serves as a universal indicator.

A family of six persons lives on a small property to the south of the pump house and intake for the Pursat PWW. The Pursat River flows north, hence the property is upstream of the intake. There are three wooden dwellings on the property that take up nearly all the available space (see Figure 1). A latrine and soakaway (L/S) are located on the top of the bank of the river approximately 12 m from the water line at the time of the visit (mid-August), when the elevation of the water was approximately 8 masl. Water level can exceed 11 masl at which time the water's edge is at or near the soakaway. Water level elevations vary greatly and at times through the year are controlled by the water level elevation in the Tonle Sap Lake. A photo of the L/S is shown in Figure 2.

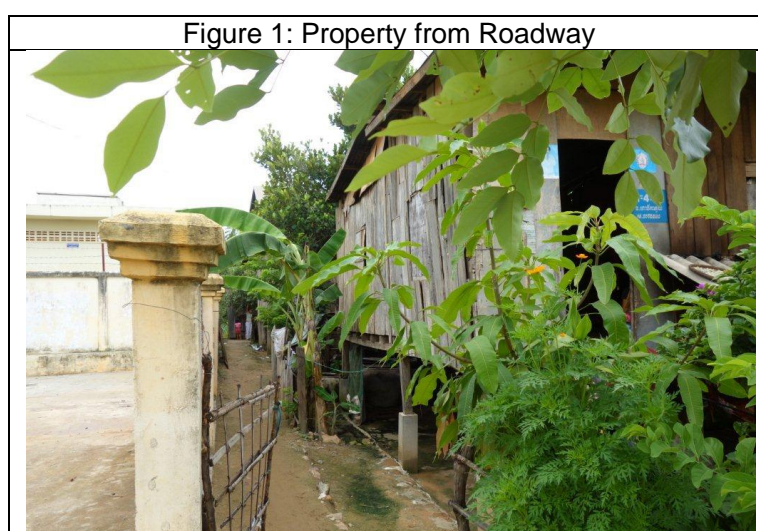
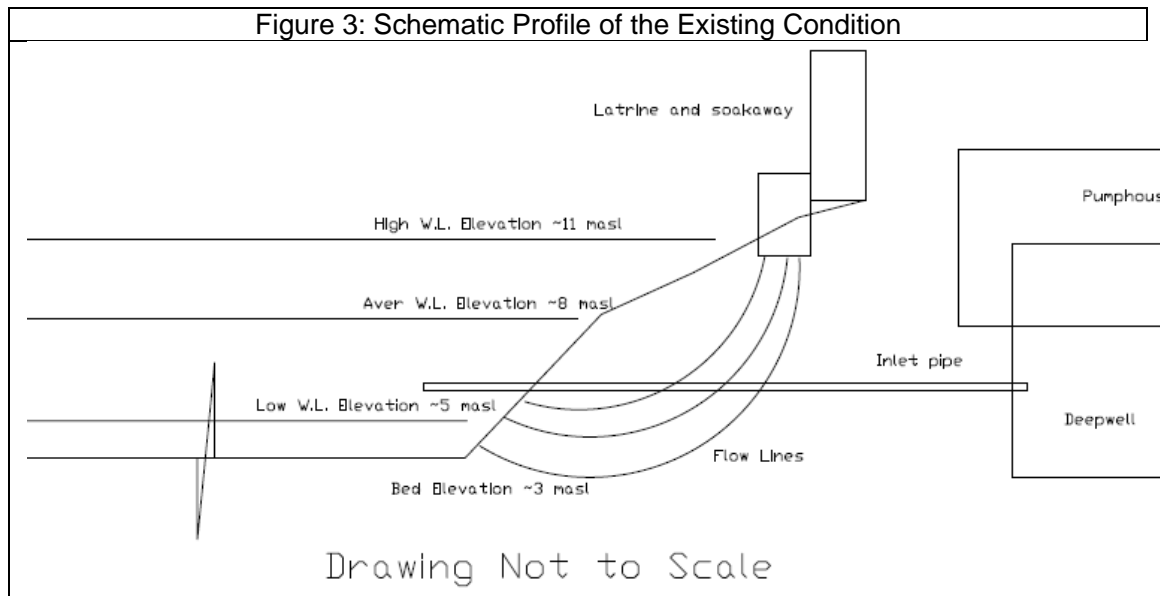


Figure 2: Latrine and Soakaway Adjacent to the Pursat PWW Intake



A rough schematic of the profile of the river bank and the L/S is shown in Figure 3. Note while this drawing shows all features in the same plane, whereas the L/S is 15—20 m upstream of the intake pipe.



The effluent from the L/S seeps into the ground and flows via unsaturated and saturated flow through the sandy matrix in the down-gradient direction to the river. Flow lines are shown on the schematic to depict this flow.

Dry weather conditions present the greatest risk for contamination of water supplies, when river water level is lowest, at approximately 5 masl, and flow rate in the river is a minimum. At other times, while the river is closer to the L/S, the flow velocity and volume of water passing the location is great and dilutes the seepage. During the low water period, the seepage follows a path through the sandy matrix over a distance of some 20 m.

Six people use the latrine for taking care of bodily functions and occasional bathing, estimated to use 40 lpcd, or 240 lpd entering the soakaway. Since all numbers in this analysis are good to only one significant figure, we use 100 lpd as the amount passed through the soakaway.

The soakaway is sealed except for a sand base (see Figure 2.b). We estimate the sand under the soakaway to have a permeability of 10^{-4} cm/sec. With a bottom area of one sq m and unsaturated conditions (unit head), the flow from the bottom of the soakaway is calculated as follows:

$$Q = k(dh/dl)A$$

$$Q = 10^{-4} \text{ cm/sec} * 10^5 \text{ sec/day} * 1 \text{ m/m} * 1 \text{ sq m} * 10^{-2} \text{ m/cm}$$

$$Q = 10^{-1} \text{ m}^3/\text{day}, \text{ or } 100 \text{ lpd}$$

, which agrees with the estimated generation amount.

Removal of pathogens (coliform) occurs as the effluent from the L/S flows through the soil for a distance of some 20 m before seeping into the river. Sand is an excellent filter medium for bacteria, and slow sand filtration (such as occurs in a natural setting along a river bank) is most effective at removal. One article available in the literature gives a value of 96-98% removal of pathogens in sand filtration through wetlands:¹²

¹² PATHOGEN AND PATHOGEN INDICATOR REMOVAL CHARACTERISTICS IN TREATMENT WETLANDS SYSTEMS By S. J. Jillson, M. F. Dahab, W. E. Woldt, and R. Y. Surampalli at <http://www.pcwp.tamu.edu/docs/lshs/end-notes/pathogen%20and%20pathogen%20indicator%20removal%20characteristics%20->

“Firethorn demonstrated effective removal of fecal coliforms with 96.3% removal in the wetland cell and 98% by the wetland system, which included a sand filter. Rogers Farm had an average fecal coliform removal of 99.3%. Although *Salmonella* spp. was not detected at Firethorn, reduction of other bacteria was observed through the wetland system. In general, fecal coliform removal was excellent through the wetland system and no distinct difference in removal efficiency was observed with changes in season and temperature at either facility.”

Another article¹³ states that “coliform bacteria exhibited a high degree of attenuation [on passage through soil] with concentrations at or near background levels.” Finally a third article¹⁴ states that wastewater with coliform counts of greater than 10^5 per 100 ml when applied to sandy soils were virtually undetectable at 100 cm below the ground surface. The amount of attenuation is significant; we estimate herein that 0.1% of coliforms (99.9% attenuation) is likely over the distance from the soakaway to the river.

Use 100 lpd containing 100,000/100 ml and 99.9% attenuation

=100,000 coliform per day reaching the river

Dilution is accomplished water seeps slowly into the river. The average flow of the Pursat River is 24 m³/sec¹⁵, providing a dilution factor of over 20 million. Even at minimum flow, say 1/10th average flow (see hydrograph in Figure 4), the dilution effect is 2 million. We use 10^6 as a conservative factor. The amount of coliform reaching the inlet pipe from the L/S source is therefore estimated to be less than one organism per day, whereas coliform *already present* in the river from other sources (animal and human waste entering the river upstream) is likely to exceed 500/100 ml. Hence the river itself poses a greater risk than the L/S discharge.

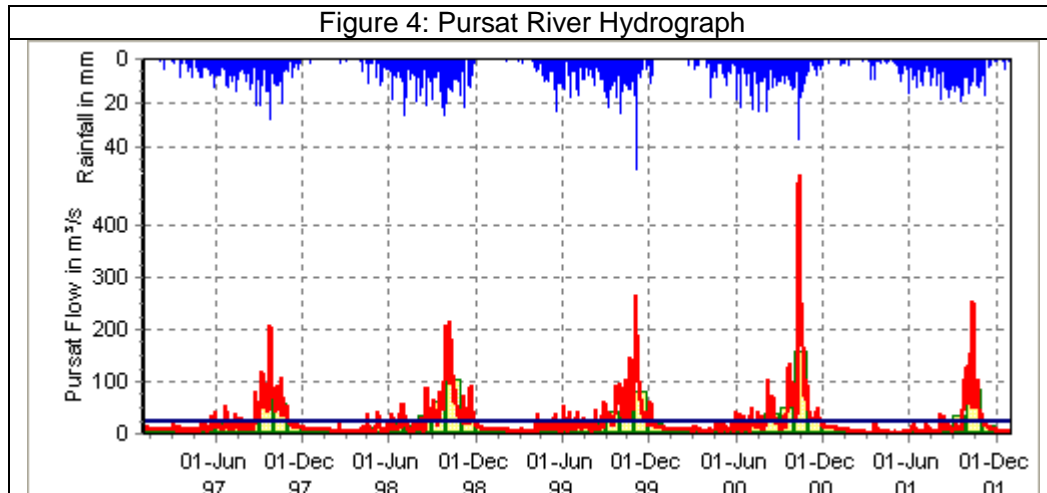
The river is the raw water for the water treatment plant (WTP). The conventional treatment approach is flexible enough to accommodate a range of turbidities as well as to remove pollutants that would cause the water to be unusable as a drinking source. The US Environmental Protection Agency considers conventional treatment appropriate for raw water sources containing coliforms up to 20,000/100 ml. Data show that flocculation, settling and sand filtration coupled with chlorination can produce an effluent containing one coliform organism per 100 ml (the historical standard for these plants) when influent contains as many as 6,000 coliform/100 ml, a factor 10^3 to 10^4 reduction.

1827730458/pathogen%20and%20pathogen%20indicator%20removal%20characteristics%20in%20treatment%20wetland%20systems.pdf

¹³ Septic Tank Impacts on Ground Water Quality and Nearshore Sediment Nutrient Flux, by William G. Reay, at <http://info.ngwa.org/gwol/pdf/042979923.pdf>.

¹⁴ Converse and Tyler, 1998; at www.soils.wisc.edu/sswmp/pubs/6.22.pdf.

¹⁵ http://www2.adb.org/Projects/Tonle_Sap/atlas/profile.asp?sub=5



In short, both natural processes ongoing at the site (attenuation and dilution) and the human-built treatment system provide many orders of removal for coliform, with potential reduction by a factor of 10^{12} . There is an extremely low level of risk posed by the L/S. We conclude therefore that no corrective action is needed to relocate the latrine and soakaway (L/S).

TEMPLATE/FORMAT

Safeguard Monitoring Report

Summary:

(to be included as part of the *main Report*)

- **Summary of EMP/RP Implementation**
- **Description of monitoring activities** carried out (e.g. field visits, survey questionnaire, public consultation meetings, focus group discussions, etc)
- **Key issues**, any **corrective actions** already taken, and any **grievances**
- Recommendations

Safeguards Monitoring Report

(to be included in the annex/appendix of the *main Report*)

1. Introduction and Project Overview

Project Number and Title:		
Safeguards Category	Environment	
	Indigenous Peoples	
	Involuntary Resettlement	
Reporting period:		
Last report date:		
Key sub-project activities since last report:	This section can include, among others, the following: <ul style="list-style-type: none"> • Activities of Proponent • Progress of Work (% physical completion) • Changes of Surrounding Environment • Status of Permits / Consents 	
Report prepared by:		

2. Environmental Performance Monitoring

a. Summary of Compliance with EMAP Requirements (Environmental Performance)

EMAP Requirements	Compliance Status (Yes, No, Partial)	Comment or Reasons for Non-Compliance	Issues for Further Action
Use environmental impact as main heading and EMAP as listing (see example below)	Use EMoP list as basis for rating/evaluating compliance (see example below)		
Rise of employment opportunities: <ul style="list-style-type: none"> • Job openings of the project should give priority to local communities. • Recruitment of local laborers should be stipulated in the 	<ul style="list-style-type: none"> • Field inspections and interviews with communities - DONE • Note each complaint case in the field – 3 COMPLAINTS RECEIVED 		

contract for construction	<ul style="list-style-type: none"> Set up grievance centre and report as part of monitoring action plan – NOT DONE 		

b. Issues for Further Action

Issue	Required Action	Responsibility and Timing	Resolution
Old Issues from Previous Reports			
List of EMoP measures or activities not completed (last column of previous table)			
New Issues from This Report			

c. Other activities

- Other issues not covered by EMAP/EMoP
- Environmental monitoring as required by GOI (e.g., air quality, water sampling)

3. Involuntary Resettlement Performance Monitoring

a. Summary of Compliance with RP Requirements

RP Requirements	Compliance status Yes/No/Partial	Comment or Reasons for Compliance, Partial Compliance/Non-Compliance	Issues for Further Action ¹⁶
Establishment of personnel in PMU/PIU			
Public consultation and socialization process		Provide information on: <ul style="list-style-type: none"> Public consultation, participation activities carried out Inclusive dates of these activities To be elaborated on in Item 5	

¹⁶ To be elaborated further in table 3.b (Issues for Further Action)

Land area to be acquired is identified and finalised			
Land acquisition completed			
Establishment of Resettlement Site(s)		<p>Please state:</p> <ul style="list-style-type: none"> • Number of AHs to be relocated as per agreed RP • Number of AHs already relocated • Number of houses built • Status of installation of community facilities to be provided as per agreed RP 	
Compensation payments for affected assets is completed		<p>Please state:</p> <ul style="list-style-type: none"> • Total Number of Eligible AHs and APs (as per agreed RP) • Number of AHs and APs compensated as of this monitoring period • Total Budget allocation as per agreed RP • Total budget disbursed to AHs as of this monitoring period 	
Transport assistance for relocating affected households		As above	
Additional assistance to vulnerable affected household		<p>Please state:</p> <ul style="list-style-type: none"> • Total Number of vulnerable AHs and APs (as per agreed RP) • Agreed forms of assistance as per RP • Number of AHs and APs assisted as of this monitoring period 	
Income Restoration Program		Please state progress per income restoration feature/activity and actual period of implementation	
Temporary impacts have been addressed (affected properties restored to at least pre-project conditions)		<p>Please state:</p> <ul style="list-style-type: none"> • Total Number of AHs affected by temporary impacts as per agreed RP • Actual Number of AHs and total area affected by temporary impacts (if this differs from the projected number, such as in cases of unforeseen project impacts) • Status of restoring affected property 	
Capacity building activities			

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b. Issues for Further Action

Issue	Required Action	Responsibility and Timing	Resolution
Old Issues from Previous Reports			
List of RP activities not completed (last column of previous table)			
New Issues from This Report			

4. Occupational, Health and Safety (OHS) Performance Monitoring

a. OHS for worker

Issue	Required Action	Responsibility and Timing	Resolution
Old Issues from Previous Reports			
New Issues from This Report			

b. Public Safety

Issue	Required Action	Responsibility and Timing	Resolution
Old Issues from Previous Reports			
New Issues from This Report			

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5. Information Disclosure and Socialization including Capability Building

- Field Visits (sites visited, dates, persons met)
- Public Consultations and meetings (Date; time; location; agenda; number of participants disaggregated by sex and ethnic group, not including project staff; Issues raised by participants and how these were addressed by the project team)
- Training (Nature of training, number of participants disaggregated by gender and ethnicity, date, location, etc.)
- Press/Media Releases
- Material development/production (e.g., brochure, leaflet, posters)

6. Grievance Redress Mechanism

Summary:

- Number of new grievances, if any, since last monitoring period: _____
- Number of grievances resolved: _____
- Number of outstanding grievances: _____

Type of Grievance	Details (Date, person, address, contact details, etc.)	Required Action, Responsibility and Timing	Resolution
Old Issues from Previous Reports			
New Issues from This Report			

7. Conclusion

- Important results from the implementation of EMAP/EMoP and RP monitoring
- Recommendations to improve EMAP/EMoP and RP management, implementation, and monitoring

8. Attachments

- Consents / permits

- Monitoring data (water quality, air quality, etc.)
- Photographs
- Maps