

# Initial Environmental Examination

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September 2014

## CAM: Urban Water Supply Project – Siem Reap 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 Safeguard Management Officer
PIU	Project Implementation Unit
PMU	Project Management Unit
PPTA	Project Preparation Technical Assistance
PWW	Provincial Water Works
REA	Rapid Environmental Assessment (Checklist)
SRWSA	Siem Reap Water Supply Authority
SPS	Safeguard Policy Statement (2009)
UWSP	Urban Water Supply Project
WTP	Water Treatment Plant

## Units

cm	centimeter
km	kilometer
L	liter
m	meter
m <sup>3</sup> /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 Siem Reap 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 Siem Reap is located in the Northwest of Cambodia. It borders Oddar Meanchey Province to the North, Preah Vihear and Kampong Thom to the East, Banteay Meanchey to the west and the Tonle Sap Lake to the south.

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 Siem Reap water supply system utilizes groundwater as a source of supply and has undergone extensive improvements under previous projects. The current water supply system was largely constructed by JICA in 2006, with a treatment capacity 8,000 m<sup>3</sup>/day, the capacity in 2014 was assessed by MIH at 14,500 m<sup>3</sup>/day. Treatment consists of chlorination, aeration and filtration, and the current demand causes the system to exceed its design capacity. Continued groundwater pumping is lowering the groundwater table while the City faces a severe shortage of water to serve the rapidly growing tourism and allied industries. New wells will increase the existing plant capacity to 15,000 m<sup>3</sup>/day, and an additional 10,000 m<sup>3</sup>/day of water from the West Baray will be treated in a conventional sedimentation/filtration plant built next to the existing facility by 2015. These works in total will provide a total of 25,000 m<sup>3</sup>/day, or nearly three times the current capacity. In addition, JICA has conducted a feasibility study for use of surface water from the Tonle Sap Lake. Raw water would be extracted during high water periods (generally July – Dec) to offset groundwater extractions and augment supplies.

6. The reticulation network is divided into seven pressure zones. Improvements and extension for Zones 2-7 are included in the JICA proposal, whereas Zone 1 was omitted due to budget constraints. Zone 1 and a narrow section of ASPARA Zone 2 area will be provided piped water supply under the proposal. A 600 mm HDPE transmission pipe will be installed from the water treatment plant a distance of approximately 6.5 km along National Road (NR) No. 6 to connect to new and existing distribution piping in Zone 1. HDPE distribution piping up to 250 mm  $\phi$  will be installed to serve 8,000 households and businesses in Zone 1, and will extend to a strip of residential land in ASPARA Zone 2 that falls within Kouk Chak commune. Finally, necessary zone and household meters, valves and other appurtenances will be installed as needed to regulate the system.

## **Description of the Environment**

### **Physical Resources**

7. Siem Reap is located north of the Tonle Sap Lake. The climate is humid and tropical but with some variation over the period of a year. 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 that make up the Tonle Sap depression. There are no natural hazards such as steep slopes and unstable soils along distribution line routes that would affect success of the project.

9. The town is at 18 masl and is drained by the Siem Reap River that rises in a narrow valley of the Kulen Plateau about 38 km to the north-northeast. Internal drainage is hindered by lack of clear outlets, and local flooding occurs during heavy rains. Drainage is cut off with fill in some locations. Internal relief is seldom less than a few meters. Much of the surrounding area is under rain fed lowland rice cultivation. Groundwater pumped from wells and entering the treatment plant is generally of good quality, with low (zero) turbidity and color and low conductivity.

### **Ecological Resources**

10. Siem Reap and the lakeside landing of Chong Kneas provide access to the Lake and its extensive flooded forests and biodiversity within the Tonle Sap Biosphere Reserve (TSBR). None of these natural resources is affected by the project.

### **Economic Development**

11. Land use in the project area includes residential, commercial and institutional space, some agricultural fields in outlying areas from the City, and scrub forestland. Land use is undergoing rapid change in the vicinity of Siem Reap, especially along highways and in the direction of the Angkor Temple Complex. The main industry contributing to the provincial economy is tourism associated with the Angkor Temple Complex. Some 2-300,000 tourist arrivals annually have resulted in a burgeoning tourism industry with hotels, restaurants, service providers of all types, and the secondary commerce and industries to support tourism.

### **Social and Cultural Resources**

12. The people living within the project area are generally engaged in production and service sectors of the economy, with farming a secondary source of income. The province's poverty rate of 46% is somewhat higher than the national average of 32%. Data revealed through the project socioeconomic survey show that 42% of households within the project area consider themselves to be of average wealth, whereas another 42% consider themselves poor. The Angkor complex is a central feature throughout the area of Siem Reap. Ancient Angkorian and pre-Angkorian monuments and features cover a 600 sq km area. The oldest settlements are found near and parallel to the floodplain of the Tonle Sap Lake and at the base of the mountains to the north. Special provisions are necessary for any subsurface excavation work carried out in areas where archeological relics may be found.

## **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. The subproject is part of a system expansion undertaken by JICA and financed by the Japanese Government as reported in Sec. II. It is within this larger project context that planning and design considerations are being made. The JICA study recognizes the limits of groundwater and proposes a source of supply using surface water extracted from the Tonle Sap Lake. The added capacity is 60,000 m<sup>3</sup>/day, more than a 4 times increase in the current capacity of the system.

15. The subproject aims to provide transmission and distribution piping for a previously unserved area of the City. This area lies to the north and west of the town center and southwest of the main Angkor complex. Many hotels in the area have private wells, estimated to pump 25,000 m<sup>3</sup>/day, which lower the water table and have the potential to induce subsidence and cause damage to the world-famous archeological sites in the area.

16. The location and design of the works is dictated by the street layout and existing residences. All subproject improvements will take place in the public alignment of roadways. No involuntary land acquisition is anticipated under the subproject. 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.

#### Construction

17. Construction impacts are generally localized and of short duration. A high standard of project implementation by the contractor can minimize impacts. 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. All roadway surfaces, drives and footpaths should be repaired as construction progresses; bid packages should contain a unit bid price for repair of any 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. A comprehensive list of potential impacts and mitigation measures are provided in the IEE 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. These mitigation measures have been incorporated into a set of environmental specifications to be included in procurement documents, which will be binding on the contractor.

18. There is a potential for archaeological relics to be unearthed during trenching. In order to mitigate any adverse effect on cultural resources and to comply with the Law on the Protection of Cultural Heritage (1996), during the period of detailed design, the PIU should request that an Archeologist from the APSARA Authority (or other government approved Archeologist) make a visit to the area to assess the potential for significant archaeological finds within the pipe alignments and at depths that piping will be installed. Based on a detailed inspection, the archeologist can designate an area free of archaeological relics, or no eligible sites present due to loss of physical integrity or insufficient scientific data content. Work can commence once the PIU receives the designation. In the event artifacts are unearthed during construction, 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. Further details on the procedure can be found in the main text of the IEE.

#### Operations

19. Impacts during operations concern environmental or public health. 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. 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. New areas being served in Siem Reap are already settled, 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. Data obtained through the socioeconomic survey for the coverage area shows 68% of households equipped with pour flush toilets, a rather low percentage.

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 cumulative effect of discharges from many small urban drains on receiving water quality can be severe over the long term, and Siem Reap suffers from clogged and polluted surface drainage channels. Available solutions are inadequate to deal with the greater problem.

#### 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. Improvements proposed in Siem Reap increase the service area for the Water Supply Authority and provide a much preferred supply alternative for many households that currently rely on shallow wells, and businesses that use deep boreholes that progressively exhaust the deeper aquifers in the area.

25. The subproject is a component in a comprehensive program of rehabilitation that includes development of conjunctive use. To the extent that the community is lacking in piped water supply either from shortage of source quantities or due to inadequate distribution, recipient populations are benefited.

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.” Rapid environmental assessment was conducted at 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 human health or the environment have not been identified at the facility, nor are there any other environmental hazards connected with the facility. 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 Siem Reap Water Supply Authority (SRWSA) is the operator of the Siem Reap water supply system and implementation agency for the subproject. SRWSA will establish a Project Implementation Unit (PIU) to undertake construction of the Subproject in Siem Reap 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. During the detailed design, repeated samples of well water from any newly developed, test, or surrogate wells should be analyzed for standard parameters: temperature, color, turbidity, pH, total dissolved solids and conductivity; as well as for iron, manganese and arsenic. Data should be used to determine acceptability of the raw water source and be incorporated into the treatment system 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 SRWSA is a key stakeholder that holds the interests of the community to be its primary mission. The subproject concept and design are driven by SRWSA perceived needs within the context of its master plan as well as constraints imposed by the availa-

ble 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, people were told about the subproject in their area, and asked about conditions regarding water supply, sanitation and drainage. 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. A meeting was held in Siem Reap, combining resettlement and environmental components of project activity. Initial discussions were held with the SRWSA director and staff to understand the proposed system components and operational constraints. Following that, a meeting was held at the office of the SRWSA. About 15 persons attended the meeting representing commune leaders and ordinary citizens. A general description of the project was prepared in Khmer language, using visual means to provide some detail about the project proposal. A hand-out in Khmer was provided and used in the presentation. Responses were recorded on specially prepared forms, noting the name, age, sex and occupation of the respondent, and the nature of the response. These are provided in Appendix 3. Responses were positive, in favor of the project. People expressed concern about flooding, which is a local problem at Siem Reap, and wanted to know which areas of the community would benefit from the project. Some raised the issue of levels of compensation for property damage, especially when private property was built in public right-of-way. There was general all-round support and enthusiasm for the project.

**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 SRWSA 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 negative impacts that have been identified are associated with installation of the proposed transmission and distribution piping. 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. Public consultation has been conducted to make clear to the directly affected communities the potential social and environmental impacts as identified by the environmental and social reviews. No significant issues were raised during the public consultation that have not been addressed in the IEE. A proposal has been described for continuing the process of 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.

43. 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.

44. 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

45. The environmental impacts of the proposed improvements in water supply infrastructure for Siem Reap 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 Siem Reap Water Supply Subproject. The Subproject is part of the Urban Water Supply Project (the Project)<sup>1</sup> financed by the Asian Development Bank (ADB), which provides improvements in infrastructure for nine provincial towns in Cambodia under the 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;<sup>2</sup> and supports Cambodia's millennium development goal for 80% of urban access to improved water supply by 2015.<sup>3</sup>

2. The province of Siem Reap is located in the Northwest of Cambodia. It borders Oddar Meanchey Province to the North, Preah Vihear and Kampong Thom to the East, Banteay Meanchey to the west and the Tonle Sap Lake to the south. The town of Siem Reap has 13 sangkats (communes) and estimated 2012 population of 141,187. The subproject affects six villages in the two communes of Kouk Chak and Tuek Vil in the northwest sector of the City (Water supply Zone 1). Siem Reap is the center of a burgeoning tourist industry focused on the Angkor World Heritage Site.

### 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.

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

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

<sup>3</sup> 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. 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.<sup>4</sup> 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.

8. The APSARA Authority will also be engaged in review of the IEE because the sub-project takes place partially within the APSARA Zone 2 area. As defined by the 1994 Royal Decree establishing Protected Cultural Zones at Angkor, Zone 2 covers "areas rich in archaeological remains which need to be protected from damaging land use practices and inappropriate development." APSARA Zone 1 covers the core areas of Angkor, and other zones are defined successively up to Zone 5, which covers the whole of the province including the municipality of Siem Reap. During the loan phase prior to initiation of work the IEE will undergo a review among government agencies that will include the APSARA Authority. In the process of pipe laying and installation, a chance find procedure will be in force that complies with Articles 37-39 of the Law on the Protection of Cultural Heritage (1996) and such finds should not be disturbed until assessed by an expert from the APSARA Authority or other expert as approved by the APSARA Authority.

9. The Department of Potable Water Supply (DPWS) under the Ministry of Industry and Handicraft (MIH) is responsible for the 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 other provincial and district urban cen-

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

ters. The Siem Reap Water Supply Authority (SRWSA) is the implementing agency for the subproject.

### **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, project background sources provided by the project management unit (PMU) and field observations.

## **II. DESCRIPTION OF THE PROJECT**

### **A. Scope**

11. The Siem Reap water supply system utilizes groundwater as a source of supply and has undergone extensive improvements under previous projects. The current water supply system was largely constructed by JICA in 2006, with a treatment capacity today of 14,500 m<sup>3</sup>/day. Treatment consists of chlorination, aeration and filtration, and the current demand causes the system to exceed its design capacity. Continued groundwater pumping is lowering the groundwater table while the City faces a severe shortage of water to serve the rapidly growing tourism and allied industries. Many hotels have private wells, estimated at 25,000 m<sup>3</sup>/day, which further lower the water table and have the potential to induce subsidence and cause damage to world-famous archeological sites in the area.

12. New wells will increase the existing plant capacity to 15,000 m<sup>3</sup>/day, and an additional 10,000 m<sup>3</sup>/day of water from the West Baray will be treated in a conventional sedimentation/filtration plant built next to the existing facility by 2015. These works in total will provide a total of 25,000 m<sup>3</sup>/day, or nearly three times the current capacity. In addition, JICA has conducted a feasibility study for use of surface water from the Tonle Sap Lake. Under the proposal, raw water would be extracted during high water periods (generally July – Dec) to offset groundwater extractions and augment supplies. The reticulation network is divided into seven pressure zones. Improvements and extension for Zones 2-7 are included in the JICA proposal, whereas Zone 1 was omitted due to budget constraints. Zone 1 and a narrow section of ASPARA Zone 2<sup>5</sup> area will be provided piped water supply under the proposal.

### **B. Interventions**

13. The following interventions are proposed for the Siem Reap Subproject:
- A. A 600 mm HDPE transmission pipe will be installed from the water treatment plant a distance of approximately 6.5 km along National Road (NR) No. 6 to connect to new and existing distribution piping in Zone 1.
  - B. HDPE distribution piping up to 250 mm  $\phi$  will be installed to serve 8,000 households and businesses in Zone 1. The same distribution system will extend to a strip of residential land in ASPARA Zone 2 that falls within Kouk Chak commune.
  - C. Necessary zone and household meters, valves and other appurtenances will be installed as needed to regulate the system.

### **C. Location**

14. The location for the project is shown in Figure 1. The existing water treatment plant is located at UTM coordinates (Zone 48P) 369800 E X 1481900 N along NR 6 near the airport. A 300 mm HDPE pipe transmission main will be installed parallel to NR 6 toward the southeast a distance of 6.5 km and terminating before the main intersection at

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<sup>5</sup> APSARA zones (1-5) and water supply zones 1-7 have no relation to one another, being different zoning systems. The bulk of work under the project takes place in APSARA Zone 5.

Charles De Gaulle Avenue. Zone 1 extends to the north of the transmission main alignment, and covers a nominal area of 12.5 sq km. Most of the area covered falls under the jurisdiction of the Municipality of Siem Reap (APSARA Zone 5); however some of the area is in APSARA Zone 2, which restricts the type of dwellings and other structures.

#### **D. Capacity and Performance**

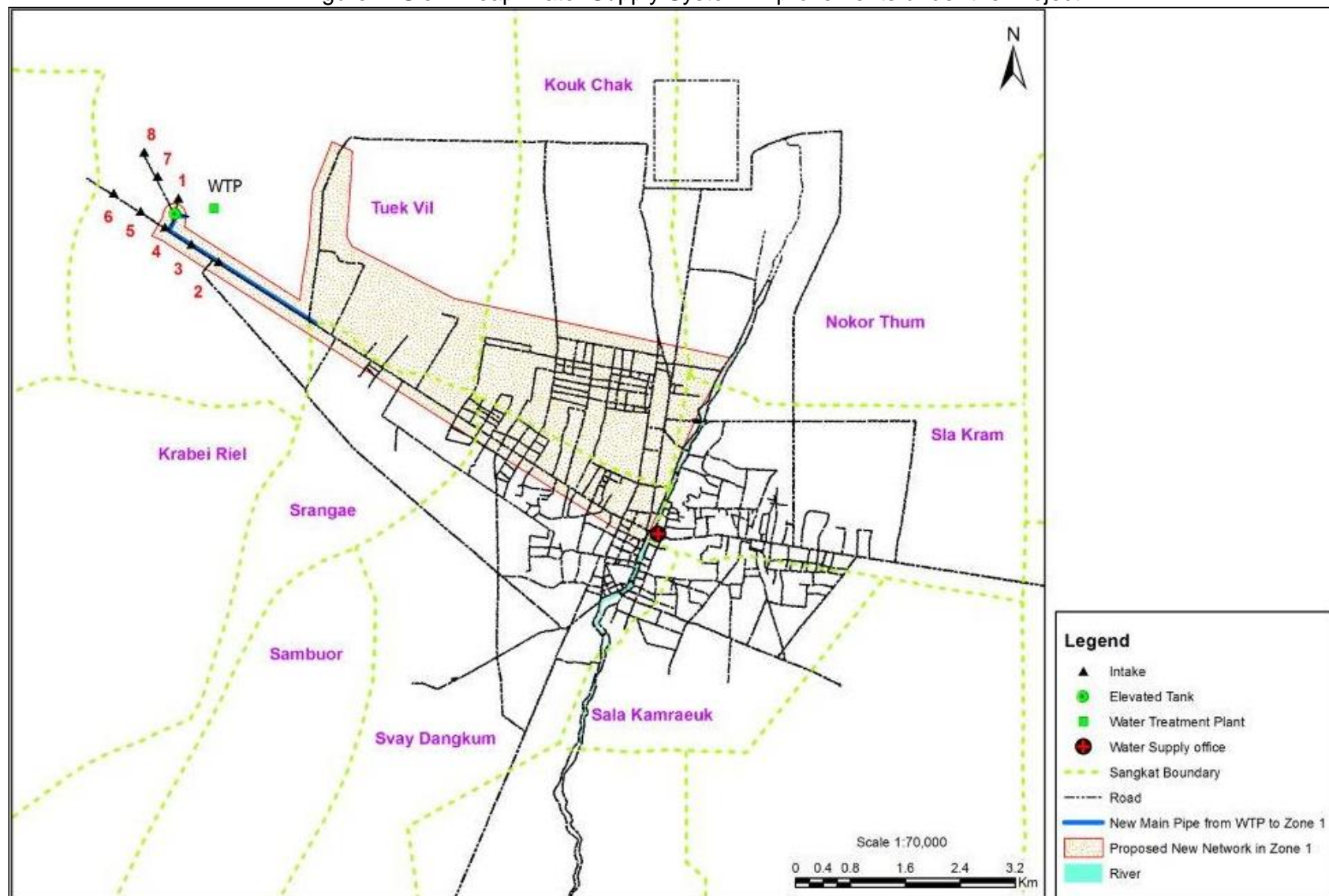
15. System capacity and performance are being addressed under ongoing JICA loan to the SRWSA, and the ADB subproject supplements this effort by financing transmission and distribution piping that is outside the JICA loan budget. The JICA loan financed the construction of the water treatment plant and the current expansion, as well as the proposed surface water treatment plant. Within the context of the ADB subproject, the transmission main is sized for peak flow to the extended service area that covers some 1,250 ha. The distribution piping line size is designed to maintain pressure in the system at one atmosphere (33 ft, 10 m, or 14 PSI). A total of 6,608 new connections are anticipated, to be subsidized under the loan.

#### **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. 0 on indirect and cumulative impact.



Figure 1: Siem Reap Water Supply System Improvements under the Project



### III. DESCRIPTION OF THE ENVIRONMENT

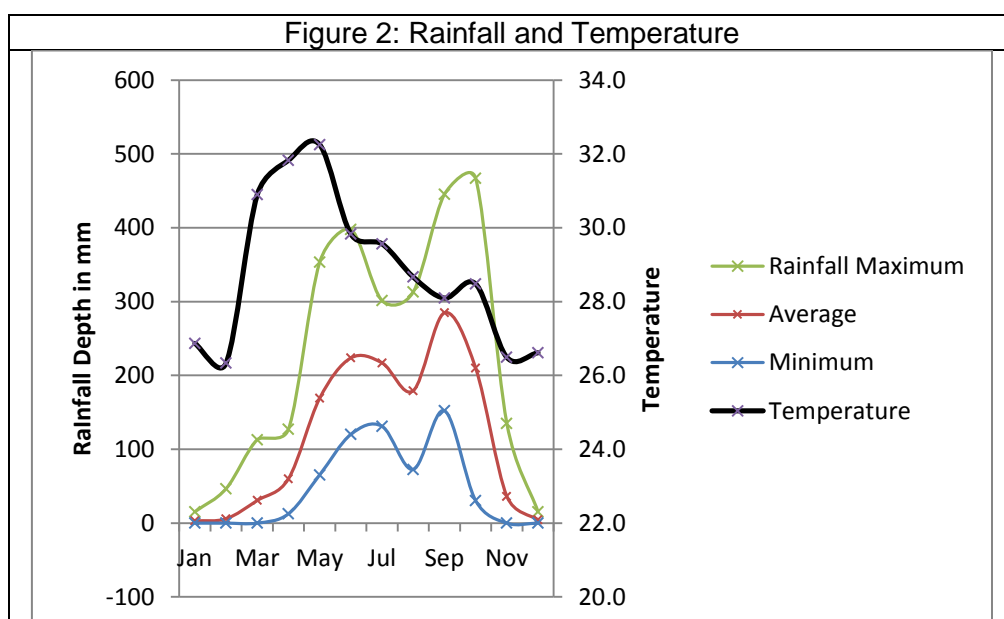
#### A. Physical Resources

##### 1. Climate and Air Quality

17. Siem Reap is located north of the Tonle Sap Lake at 13° 31' 40" N X 105° 57' E at an elevation of around 18 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. There are no predictions available on the effects of climate change on local rainfall or groundwater availability.

##### 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 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. There are no natural hazards such as steep slopes and unstable soils along transmission and distribution line routes that would affect success of the project.



##### 3. Topography and Drainage

19. The town is at 18 masl and generally poorly drained. Internal drainage is hindered by lack of clear outlets, and local flooding occurs during heavy rains. Drainage is cut off with fill in some locations. Internal relief is seldom less than a few meters. Much of the area is under rain fed lowland rice cultivation. Declining soil fertility affects rain fed lowland rice soils, whereas the soil fertility in other systems can be restored through yearly siltation or through the clearing of forest areas. The rain fed lowland agro-ecosystem is the most important in Cambodia due to its extensive coverage over about 85 per cent of the cultivated area of the country. The soils used for common rain fed lowland rice cultivation are sandy, acidic, extremely infertile and low in organic carbon and cation exchange capacity. Rain fed lowland areas are badly degraded, especially where land settlement has been continuously present over hundreds of years, as is the case around Siem Reap.

##### 4. Surface Water

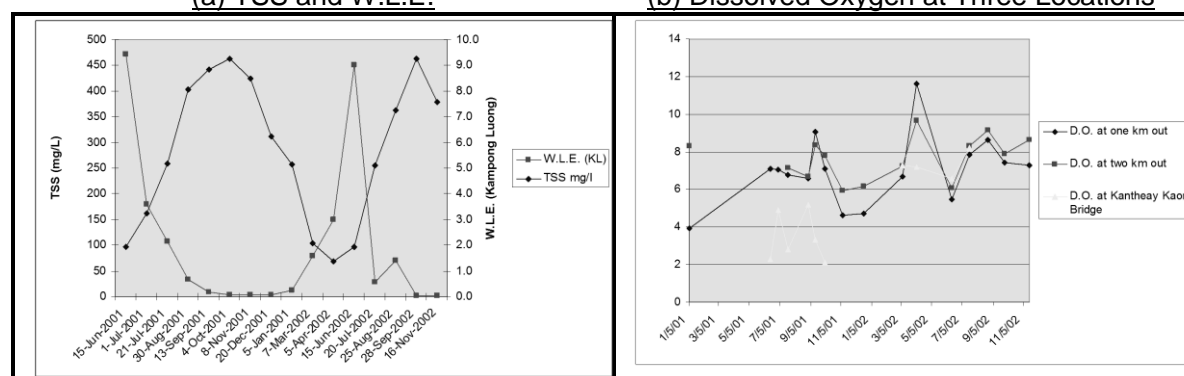
20. The Siem Reap River rises in a narrow valley of the Kulen Plateau about 38 km to the north-northeast of Siem Reap that reaches a maximum elevation of 450 m MSL. The main channel is incised into the hard rock of the hills and receives fast-flowing tributaries

from the area, particularly from the high rainfall eastern area of the Kulen National Park. The river reaches an elevation contiguous with the surrounding lowland rice cultivation area, about 45 masl, within 45 km from the low water edge of the Tonle Sap Lake, which is the dominant surface water feature in the area, flowing thereon with a surface gradient of about 0.1% (1:1,000 or one m/km). The River is used for paddy irrigation during the dry season above the inundated floodplain of the Tonle Sap. The drainage area is small compared to the main tributaries of the Tonle Sap to the east (Stung Sen) and west (Stung Sangkae and other rivers converging on Preak Toal).

21. 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 (vertical), 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.

22. Water quality in the Siem Reap River varies with the seasons, location and inflow factors. Excessive extractions through repeated damming and diversion of water for irrigation deplete the flow and cause static and eutrophic conditions. 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 aspects are factors for consideration in any plans for use of lake water for water supply at Siem Reap, and are depicted in Figure 3 a) and b).

Figure 3: Water Quality Time Series Relationships (2001-2002)  
(a) TSS and W.L.E. (b) Dissolved Oxygen at Three Locations



## 5. Groundwater

23. Groundwater has been the main source of supply for Siem Reap. The raw water pumped from wells and entering the treatment plant is generally of good quality, with low (zero) turbidity and color. Low pH of the raw water is neutralized in the treatment system. Conductivity of the groundwater is also low, about 40  $\mu$ S/cm, and increases to about 100 during treatment from addition of ionic coagulants and process buffering agents. Table 1 shows typical water quality for both raw and treated water.

## B. Ecological Resources

### 1. Aquatic Biology and Fisheries

24. Aquatic ecosystems in Siem Reap Province have been documented extensively by the many projects aimed at maintaining biodiversity on the Tonle Sap. Siem Reap and

the lakeside landing of Chong Kneas provide access to the Lake and its extensive flooded forests including Prek Toal Core Area within the Tonle Sap Biosphere Reserve (TSBR). None of these natural resources is affected by the project.

## 2. Forests and Wildlife

25. There is no natural forest located close to the project area; however Siem Reap 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 is affected by the subproject.

## 3. Rare and Endangered Species

26. Wildlife is prevalent on the Lake which is known for the diversity of its fish, birdlife and reptiles. None of these resources is affected by the subproject.

## 4. Protected Areas

27. The nearest natural protected area is the Prek Toal Core Biodiversity Conservation Area that is some 60 km east-southeast of the Chong Kneas landing near Siem Reap. The area is unaffected by the subproject. Physical cultural resources are addressed in Sec. D.3.

Table 1: Summary of Treated and Raw Water Quality 1<sup>st</sup> Quarter 2013

Items		DWQS Maximum	Date:	
			Raw Water	Treated Water
Q D u r a i l n i k t i y n g S t W a n t d e a r r d s	Taste	Acceptable		Acceptable
	Odor	Acceptable		Acceptable
	Color	5 TCU	0.002	0.003
	Turbidity	5 NTU	0.06	0.06
	Residual Chlorine	0.2-0.5 mg/L		0.45
	pH	6.5-8.5	5.58	6.63
	Total dissolved solids	800 mg/L	16.15	30.95
	Manganese (Mn)	0.1 mg/L	0.4	0.03
	Zinc (Zn)	3 mg/L	0.03	0.03
	Sulfate (SO <sub>4</sub> )	250 mg/L	0	0
	Copper (Cu)	1 mg/L	0.14	0.08
	Hydrogen Sulfide (H <sub>2</sub> S)	0.05 mg/L	0	0
	Hardness	300 mg/L	0.37	1.56
	Aluminum (Al)	0.2 mg/L	0.027	0.011
	Chloride (Cl)	250 mg/L	5.4	6.5
	Iron (Fe)	0.3 mg/L	0.980	0.122
	Ammonia (NH <sub>3</sub> -N)	1.5 mg/L	0.036	0.036
other	E.Coli	0		0
	Total coliform	0		0
	Alkalinity	mg/L (as CaCO <sub>3</sub> )	7	27
other	Conductivity	µs/cm	32.30	61.90
	Organic Carbons	mg/L	0	0

## C. Economic Development

### 1. Land Use

28. 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 rapid change in the vicinity of Siem Reap, especially along highways and in the direction of the Angkor Temple Complex.

## 2. Agriculture, Industry and Tourism

29. Other types of commerce and local industry include handicrafts, agriculture, animal husbandry, and fishing. Statistics available from the World Food Program<sup>6</sup> regarding employment show higher proportions of the population engaged in secondary and tertiary sectors of the economy (industry and services), and fewer in agriculture, in comparison with other areas of the country (Table 2).

Table 2: Employment and Labor Force Indicators

Indicator	Siem Reap	National
Literacy Rate > 15 years % total population	56	67
Literacy Rate > 15 years % females	48	60
% of the labor force in the primary sector incl. Agriculture	63	60
% of the labor force in the secondary sector/ Industry	15	13
% of the labor force in the tertiary sector/ Services	21	25
% of the labor force economically active <=10 days/ month	19	29

## 3. Infrastructure, Transport and Power Supply

30. Siem Reap is connected to Phnom Penh and to the Thai Lao border via National Road No. 6.

31. Since November 2007, electricity in Siem Reap has been supplied from Thailand. Prior to that, electricity was supplied by diesel powered generating units.

## D. Social and Cultural Resources

### 1. Population and Communities

32. The people living within the project area are generally engaged in production and service sectors of the economy, with farming a secondary source of income. The province's poverty rate of 46% is somewhat higher than the national average of 32% (Table 3). Data revealed through the project socioeconomic survey show that 42% of households within the project area consider themselves to be of average wealth, whereas another 42% consider themselves poor.

Table 3: Indicators of Consumption Poverty

Consumption Poverty Indicator	Siem Reap	National
Per capita consumption in riel	3193	3247
Consumption poverty line in riel	1796	1836
% of households below the poverty line	46	32
The poverty line value as a percentage of total consumption	56	49

World Food Program, <http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Siem-Reap>

### 2. Health Facilities and Conditions

33. There are government run health facilities at Siem Reap and numerous private and charitable clinics, including Pur Meanchey (near Psar Kraom market in Siem Reap Commune) and the Kunthak Bopha Children's Hospital, or, for adults, the Provincial Hospital. Health indicators reported by WFP include the following on a province-wide basis: 56% of women suffering from anemia, 80% of births occurring outside of a health clinic and 71% 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

34. The Angkor complex is a central feature throughout the area of Siem Reap. Pre-historic remains dating from 2,500 years B.P. have been found in Siem Reap Province, and archaeological sites dating from the 7th century ce. (Ak Yum, Kach Ho) are located to the south and west of the West Baray, which was built later and partially obscures

<sup>6</sup> <http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Siem-Reap>

these monuments. Bakheng, to the east of Ak Yum some 8 km, was constructed by the 8th century and linked by causeway to Anuradhapura (Rolous) and Bakong. These and other features are among the earliest monuments of Angkorian civilization. Ancient Angkorian and pre-Angkorian monuments and features cover a 600 sq km area. The oldest settlements are found near and parallel to the floodplain of the Tonle Sap Lake and at the base of the mountains to the north. Some sites reveal settlements that are 3,000 yrs old, with remains found often that are 2,000 yrs old. These monuments are part of the world's cultural patrimony and are extensive throughout the area of Siem Reap. Special provisions are necessary for any subsurface excavation work carried out in areas where archeological relics may be found.

#### **IV. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

35. This section reviews potential environmental impacts in relation to location, planning and design; construction; and operations. Most of the findings regarding preconstruction impacts have been incorporated into the planning under the PPTA. 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.

##### **A. Location, Planning and Design**

36. The subproject is part of a system expansion undertaken by JICA and financed by the Japanese Government as reported in Sec. II. It is within this larger project context that planning and design considerations are being made. These are reported in the three volume report "Preparatory Study on the Siem Reap Water Supply Expansion Project" performed under JICA funding.<sup>7</sup> The JICA study recognizes the limits of groundwater as a continuous source of water supply for Siem Reap and proposes a source of supply using surface water extracted from the Tonle Sap Lake. The added capacity is 60,000 m<sup>3</sup>/day, nearly a 10X increase in the current capacity of the system, allowing the many hotels in Siem Reap to cease use of individual wells and reduce the potential for ground subsidence in the area.

37. 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.

38. 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.

##### **B. Construction**

###### **1. Installation of Transmission/Distribution Piping**

39. The Siem Reap Urban Water Supply Subproject involves installation of main and secondary water supply piping (transmission and distribution mains) in public roadways and along established easements within semi-urbanized areas of the City. This is the main item of work, along with valves, fittings, installation of service connections and meters for homes and businesses, and other appurtenances needed to complete the pipeline installation.

40. The typical construction effort will involve a crew of perhaps 30 workers and a duration of around nine months. The crew is made up of domestic laborers, though likely

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<sup>7</sup> NJS Consultants and Kokusai Kogyo, January 2011.

not local. Housing for workers will be at a site provided by the contractor. Impacts and related mitigation measures are related to the workforce and the work area along the alignments of proposed piping.

41. To accommodate the needs of the workforce, the contractor should provide suitable housing, adequate supplies of potable water, and toilet and bathing facilities within the housing area. Onsite facilities for preparing food need to be provided, or food service contracted. 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 labor camp 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 an approved location for the duration of the contract where it does not interfere with or cause a nuisance for the local community.

42. 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, to be reviewed on occasion with the supervising engineer.

43. The site 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.

44. 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.

45. The placement of water transmission and 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.

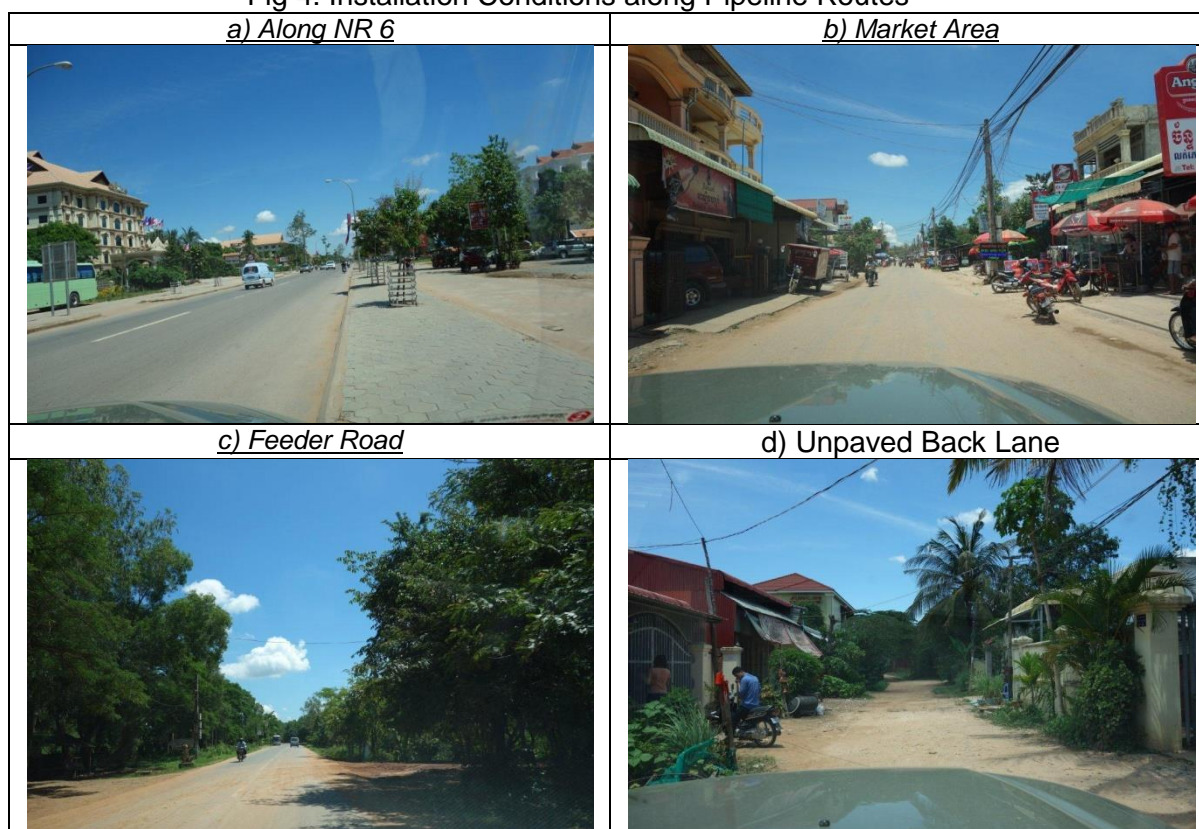
46. Alignments for pipe where there are homes and shops presents the potential for environmental impact, but the impact is of temporary duration and limited extent. Special precautions need to be taken in built up areas, for instance near markets, schools and other areas where the public is present in 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.

47. NR 6 where the main transmission line will be installed is a broad thoroughfare consisting of 2-4 express lanes separated by a paved median strip from local access lanes on both sides. Tourist hotels line both sides of the roadway over much of the length. The transverse location of the pipe in relation to the roadway will be determined during the design. Already the roadway holds a 250 mm transmission pipe; the detailed design will determine the best means for making tie-in's to other piping and the branching mains that distribute water to the new service area. Figure 4 (a) shows the arrangement of roadway, median strip and set back buildings where the pipe will be installed.



48. Distribution piping will be installed under a variety of local conditions including in front of market areas (Figure 4 (b)), along newly constructed feeder roads (c) and along unpaved back lanes (d). Piping will be installed in the shoulders of paved roads, often on both sides to avoid making cuts in road pavements. The actual size and location of distribution piping will be determined based on a hydraulic analysis during the detailed design. General guidelines for the construction contractor are applicable.

Fig 4: Installation Conditions along Pipeline Routes



49. 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.



50. 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.

51. 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.

52. 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.

53. 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.

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

55. 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.

56. 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. Any excess earth should be used for backfilling trenches or as fill offsite at locations agreed upon by the property owner.

57. 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**

58. 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."

59. 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 engineering design, the PIU should request that an APSARA Archeologist (or one approved by the APSARA Authority) 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.

60. The proposed approach needs to be reviewed by the APSARA Authority, which together with the SRWSA is best positioned to arrive at a satisfactory approach for protection of archeological finds in the process of excavating for the water lines. APSARA retains authority over all construction works undertaken in Siem Reap and will review the IEE with this objective in mind.

### **3. Disinfection of Installed Water Pipe**

61. Newly constructed water mains 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**

62. 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.

63. 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.

64. 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.

65. 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.

66. 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.

67. 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**

68. There is no physical intervention or actual investment related to sanitation on the Project; therefore there is no direct environmental impact that can be associated with any physical works. The absence of sanitation interventions to offset or mitigate the impact 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**

69. 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.

70. 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. New areas being served in Siem Reap are already settled, so the aggravation of uncontrolled development does not occur.

71. 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. As of 2011, approximately 87% of urban Cambodians have improved toilets.<sup>8</sup> Data obtained through the socioeconomic survey for the coverage area shows 68% of households equipped with pour flush toilets, a rather low percentage.

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<sup>8</sup> NIS at [http://www.nis.gov.kh/download.php?file=nis/CSES/Data/CSES\\_Housing.xls](http://www.nis.gov.kh/download.php?file=nis/CSES/Data/CSES_Housing.xls)

72. Functioning of septic systems can be a problem. 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 effluents, the effect on a receiving stream can be injurious.

73. 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. Access/use of suitable low-lying state-owned land should be secured for temporary use, requiring engagement of the Provincial Department of Land Management (DLM) and the custodial authority over the state-owned land.<sup>9</sup> The hydraulic features of the system should be based on an estimate of seasonal flows and biological features (plant types and density) incorporated. A maintenance budget needs to be allocated that will assure that the facility gets the minimum of attention required to function.

74. The cumulative effect of discharges from many small urban drains on receiving water quality can be severe over the long term, and Siem Reap suffers from clogged and polluted surface drainage channels. 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, an appropriate and necessary response to the potential cumulative impact of added water supply and its effect on surface pollution and health.

## **F. Resilience to Climate Change Impacts**

### **1. Framework**

75. 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**

76. As of December 2012<sup>10</sup>, 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

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<sup>9</sup> The Fisheries Administration, for instance, is the custodial authority over seasonally submerged state-owned land in Cambodia.

<sup>10</sup> 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).

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**

77. 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 are aimed at improving resilience of urban water supplies.

### **4. Subproject Interactions with Climate Change**

78. Improvements proposed in Siem Reap increase the service area for the Water Supply Authority and provide a much preferred supply alternative for many households that currently rely on shallow wells, and businesses that use deep boreholes that progressively exhaust the deeper aquifers in the area. The subproject is a component in a comprehensive program of rehabilitation that includes development of conjunctive use: surface water from the Tonle Sap Lake, and use of the Boray Reservoir as sources of surface supply; alongside current groundwater use. The subproject also introduces more energy efficient operations through better transmission and distribution system design, and replacement of individual deepwells with a collective system. 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 paucity of supply is made worse when long periods of drought exhaust storage in shallow wells, tanks, 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. Some 7,000 households will be served by the Siem Reap extension. The subproject has a beneficial impact by providing alternative water supply in the face of drought brought on by climate change, and improves the resilience of the community in terms of coverage.

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

## **G. Existing Facilities Audit**

80. 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. Waste materials that pose a hazard to human health or the environment have not been identified at the facility. The director of the wa-

ter 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. There is no need to prepare a corrective action plan to dispose of materials of this nature or remediate soils or structures for purposes of reducing environmental impact and risk.

## **H. Summary**

81. Planning impacts may occur in the event sources of raw water supply are not adequate to meet sustainable yield requirements, which is not the case under the present subproject. Impacts during design and preconstruction occur if adequate funds are not provided for repair of road surfaces following installation of water and drainage 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.

## **V. ENVIRONMENTAL MANAGEMENT PLAN**

### **A. Review of Impacts**

82. Table 4 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.

Table 4: Potential Environmental Impacts and Mitigation Measures

Project Activity	Potential Negative Impact	Proposed Mitigation Measure	Institutional Responsibility	Cost Estimates
<b>Design and Preconstruction</b>				
Detailed Design and Preparation of Bid Documents	Hazardous road conditions, dust during/after construction.	Include unit cost for road repair as a bid item in the construction contract for water line installation.	DE, PIU	Design Office
<b>Construction</b>				
Provision of worker facilities	Inconvenience to communities due to presence of workers	Provide suitable housing, adequate supplies of potable water, and toilet and bathing facilities within the housing area. Onsite facilities for preparing food need to be provided, or food service contracted.	Contractor	Part of contract cost
Provision of worker facilities	Solid waste and sanitary discharges from worker camps.	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.	Contractor	Part of contract cost
Site access	Accident or injury to public.	The public should be barred from the site and children of workers should not be allowed within the work area.	Contractor	Part of contract cost
Labor hiring	Unsafe working conditions and injury.	Basic safety and health plan in place for workers; personal protective gear; suitable training or experience in the work; emergency care available on call; contractor to maintain a record of accidents.	Contractor	Part of contract cost
Site work	Accidents, injury.	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.	Contractor	Part of contract cost
Site work	Sediment runoff	Surface soils should be graded-to-drain and protected 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.	Contractor	Part of contract cost
Site work	Air pollution and noise.	Restrict use of heavy equipment and material receipts to daylight hours. Apply water to suppress dust where needed.	Contractor	Part of contract cost
Pipe laying.	Sediment runoff	Exercise caution to prevent erosion losses, close excavations rapidly and stabilize soils once the pipeline is in place.	Contractor	Part of contract cost
Pipe laying.	Damage to private property.	Compensate property damage under the Resettlement and Compensation Plan. Return land to the original condition on completion.	PIU	Part of Resettlement Plan cost
Pipe laying.	Congestion and blockage of access to homes, buildings, shops and roadways	Complete work on a segment according to a progressive sequence of activity. Provide access by bridging trenches.	Contractor	Part of contract cost
Pipe laying.	Dust hazard and impediment to traffic flow.	Store bedding materials outside trafficked areas. Cover materials and/or suppress dust with water. Excess spoil from excavations will be minimal, but should be removed from site and either reused or disposed of appropriately with other construction wastes.	Contractor	Part of contract cost
Pipe laying.	Damage to buildings, walls and existing buried piping.	Avoid trenching in locations where damage might occur. If needed, provide shoring to assure no subsidence occurs.	Contractor	Part of contract cost

<b>Project Activity</b>	<b>Potential Negative Impact</b>	<b>Proposed Mitigation Measure</b>	<b>Institutional Responsibility</b>	<b>Cost Estimates</b>
Pipe laying.	Accident and injury.	Excavations should be barricaded and marked. Workers should not be allowed to enter deep trenches unless they are properly shored.	Contractor	Part of contract cost
Pipe laying.	Traffic congestion and high dust levels.	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.	Contractor	Part of contract cost
Pipe laying.	Inconvenience to public	Plan construction to avoid repeated excavation in roads and easements	Contractor	Part of contract cost
Pipe laying.	Inconvenience to public	Provide movable sanitary facilities at the work site and maintain clean, free of odors and usable.	Contractor	Part of contract cost
Pipe laying/suspension of water supply service	Inconvenience and health risk.	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.	Contractor	Part of contract cost
Pipe laying.	Disturbance at schools, hospitals, tourism sites by noise, dust and impeded access	Increase work force to complete construction quickly in affected areas. Minimize dust / avoid obstruction of pedestrians and vehicles	Contractor	Part of contract cost
Pipe laying.	Land acquisition outside of public R.O.W.	Purchase land as described in Resettlement Framework	PIU	Part of resettlement and land acquisition cost
Pipe laying.	Loss/damage of archeological artifacts	Institute a chance find procedure as described in Sec. IV.B.2.		
Pipeline commissioning.	Negative health impact.	Disinfect water mains, tanks and reservoirs by chlorination. Include a bid item for disinfection in piping installation contracts.		Part of contract cost
<b>Operations</b>				
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/SRWSA	Part of operations cost
Water system operations	Negative health impact.	Chlorinate water supplies.	DPWS/SRWSA	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/SRWSA, DE	Part of loan implementation
Water system operations	Negative health impact.	Detect and repair leaks and maintain sufficient pressure to prevent cross-contamination.	DPWS/SRWSA	Part of operations cost



## **B. Institutional Arrangements**

83. The Department of Potable Water Supply 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.<sup>11</sup> The Siem Reap Water Supply Authority (SRWSA) is the operator of the water supply system and implementation agency for the subproject. SRWSA will establish a Project Implementation Unit (PIU) to undertake construction of the Subproject in Siem Reap Province.

84. 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, and 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 PIU 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 PIU<sup>12</sup>.

85. The PMU will be assisted by the Environmental Specialists (ES), consultants<sup>13</sup> 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 plans, 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 5 describes the functions of various agencies engaged in the project, and a diagram illustrating the institutional arrangement is provided in Figure 5.

86. 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)

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<sup>11</sup> While the PSMO is engaged fulltime with subproject execution, duties related to environmental management may constitute only a portion of his/her responsibilities.

<sup>12</sup> 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.

<sup>13</sup> 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 PSMOs for this and other subprojects.

- IEE submitted to DOE by mid-month 3 of design period
- DOE has 30 days to review/approve IEE
- Review by the APSARA Authority, also expected to take 30 days, will run concurrently with DOE review
- There is no review necessary by UNESCO, as the APSARA Authority serves as its agent in relation to the Angkor World Heritage Site.
- 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

87. 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. The APSARA Authority also has a role in review of the IEE, and will provide advice on the archeological chance find procedure currently proposed. 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 5: 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.
Siem Reap Water Supply Authority (SRWSA) PIU	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.
APSARA Authority	Review and approval of IEE; update of archeological chance find discovery; support for archeological survey and evaluation of spot finds
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 and MIH Lab	Implement water quality monitoring of raw and treated water supplies during operations

### C. Environmental Monitoring Plan

88. Environmental monitoring extends during the implementation of the loan and engages the previously identified groups. Table 6 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 Siem Reap Water Supply Authority is responsible.

Figure 5: Organization for Environmental Management on Siem Reap Project

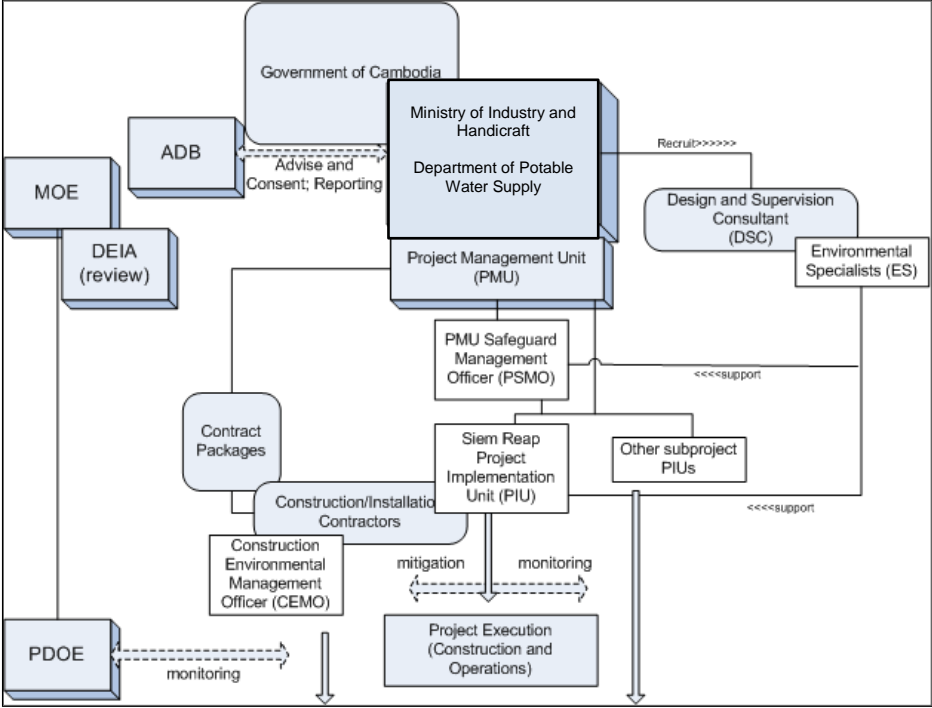


Table 6: Environmental Monitoring Plan

Mitigation Measure	Parameters to be Monitored	Location	Measurements	Monitoring Frequency	Responsibility for Monitoring	Cost to Monitor
<b>Design and Preconstruction</b>						
Include unit cost for road repair as a bid item in the construction contract for water line installation and for drainage pipe installation.	Components of Contract bid	Design Office; PIU	Review of Detailed Design Proposals.	At time of preparation	PSMO, ES, PDOE	No extra cost.
<b>Construction</b>						
Provide suitable housing, adequate supplies of potable water, and toilet and bathing facilities within the housing area. Onsite facilities for preparing food need to be provided, or food service contracted.	Field Conditions	Labor Camps	Visual inspection	At start of contract; quarterly	PSMO, ES, PDOE	No extra cost.
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.	Field Conditions	Labor Camps	Visual inspection	At start of contract; quarterly	PSMO, ES, PDOE	No extra cost.
The public should be barred from the site as well as from worker housing areas.		Site locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Basic safety and health plan in place for workers; personal protective gear; suitable training or experience in the work; emergency care available on call; contractor to maintain a record of accidents.	Worker Provisions	Contractor's field office	Review of records	At beginning and end of contract	PSMO, ES, PDOE	No extra cost.
Workplace should be kept orderly to reduce accidents. Deep excavations in unstable soils need to be shored, and below grade construction brought to grade quick-	Field Conditions	Site locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.

<b>Mitigation Measure</b>	<b>Parameters to be Monitored</b>	<b>Location</b>	<b>Measurements</b>	<b>Monitoring Frequency</b>	<b>Responsibility for Monitoring</b>	<b>Cost to Monitor</b>
ly, then excavations closed.						
Surface soils should be graded-to-drain and protected 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.	Field Conditions	Site locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Restrict use of heavy equipment and material receipts to daylight hours. Apply water to suppress dust where needed.	Field Conditions	Site locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Exercise caution to prevent erosion losses, close excavations rapidly and stabilize soils once the pipeline is in place.	Field Conditions	Site locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Compensate property damage under the Resettlement and Compensation Plan. Return land to the original condition on completion.	Terms of Compensation Plan	Pipe laying locations	Review of compensation claims and awards	Monthly	PSMO, ES, PDOE	No extra cost.
Complete work on a segment according to a progressive sequence of activity. Provide access by bridging trenches.	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Store bedding materials outside trafficked areas. Cover materials and/or suppress dust with water. Remove excess.	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Avoid trenching in locations where damage might occur. If needed, provide shoring to assure no subsidence occurs.	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Excavations should be barricaded and marked. Workers should not be allowed to enter trenches greater than waste deep unless they are	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.

Mitigation Measure	Parameters to be Monitored	Location	Measurements	Monitoring Frequency	Responsibility for Monitoring	Cost to Monitor
properly shored.						
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.	Field Conditions	Roadways and haul routes	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Plan construction to avoid repeated excavation in roads and easements	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Provide movable sanitary facilities at the work site and maintain the site clean, free of odors and usable.	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
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.	Community acceptance	Community	Visual inspection	Whenever shutdowns are needed	PSMO, ES, PDOE	No extra cost.
Increase work force to complete construction quickly in affected areas. Minimize dust / avoid obstruction of pedestrians and vehicles	Field Conditions	Pipe laying locations	Visual inspection	Weekly	PSMO, ES, PDOE	No extra cost.
Purchase land as described in Resettlement Framework	Terms of Compensation plan	PIU office	Review of compensation claims and awards	Monthly	PSMO, ES, PDOE	No extra cost.
Disinfect water mains, tanks and reservoirs by chlorination. Include a bid item for disinfection in piping installation contracts.	Terms of contract documents	PIU office	Review of bid documents and contractor performance	Draft contract stage; during performance	PSMO, ES, PDOE	No extra cost.
<b>OPERATIONS</b>						
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/SRWSA	\$200/yr
Chlorinate water supplies.	Chlorine residual	Treatment plant	Chlorine residual	Weekly	DPWS/SRWSA	\$600/yr

<b>Mitigation Measure</b>	<b>Parameters to be Monitored</b>	<b>Location</b>	<b>Measurements</b>	<b>Monitoring Frequency</b>	<b>Responsibility for Monitoring</b>	<b>Cost to Monitor</b>
Detect and repair leaks and maintain sufficient pressure to prevent cross-contamination.	System Pressure	Distribution system	System pressure	Weekly	DPWS/SRWSA	None

#### **D. Water Quality Monitoring**

89. Since the subproject is concerned solely with installation of new transmission and distribution mains, responsibilities for water quality monitoring are limited. Concerns about surface water quality impacts during construction will be met by observing site conditions. In any case, these are minor impacts, and no direct water quality monitoring of surface water is needed.

### **VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE**

#### **A. Project Stakeholders**

90. The primary stakeholders are the citizens of Siem Reap 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 may experience improved service, including higher quality water.

91. The SRWSA is a key stakeholder that holds the interests of the community to be its primary mission. The subproject concept and design are driven by SRWSA perceived needs within the context of its master plan as well as constraints imposed by the available budget. The PPTA team consulted regularly with SRWSA 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**

92. During field work on environmental and social components, people were told about the subproject in their area, and asked about conditions regarding water supply, sanitation and drainage. Individual informants provided valuable information on current access to water supply, their daily routines in obtaining water, seasonal conditions that affect availability, and requirements for household use. As part of the field work, individuals were informed about the proposed project and their responses noted. The social component combined focus group discussions with socioeconomic survey work, and conducted random sampling surveys; while the resettlement work included Inventory of Losses (IOL) surveys; environmental field work, conducted by two staffs at any given time, focused on local experience and perceptions of thematic issues like sanitation practice, water supply quantity and quality, and flooding.

#### **C. Formal Public Consultation regarding Environmental and Social Issues**

##### **1. Meetings**

93. A meeting was held in Siem Reap, combining resettlement and environmental components of project activity. Initial discussions were held with the WSA director and staff to understand the proposed system components and operational constraints. Following that, a meeting was held at the office of the SRWSA. About 15 persons attended the meeting representing key provincial agencies, commune leaders and ordinary citizens. The team obtained the support of the WSA in organizing the meeting and soliciting attendance from Sangkat leaders and other representative members of the community. The meeting was publicized in advance by word of mouth through commune/village and government leaders.

##### **2. Information Dissemination**

94. A general description of the project was prepared in Khmer language, using visual means to provide some detail about the project proposal. Hand drawn/lettered poster boards – and large scale prints of drawings – were used in the presentation. Environmental and social impacts identified by the project team were reviewed, as described in the IEE. Attendance lists were completed at the meeting and are included in Appendix 3.



### **3. Information Solicitation**

95. The public in attendance was informed about the general purpose of the meeting: to ascertain the public's views on the project, suggestions for improvement, and concerns about environmental and social impact. Questions and comments were solicited, and ample time provided for attendees to react and respond. Responses were recorded on specially prepared forms, noting the name, age, sex and occupation of the respondent, and the nature of the response. These are provided in Appendix 3.

### **4. Respondent Issues**

96. Responses were positive, in favor of the project. People expressed concern about flooding, which is a local problem at Siem Reap, and wanted to know which areas of the community would benefit from the project. Some raised the issue of levels of compensation for property damage, especially when private property was built in public right-of-way. No other specific issue of environmental concern was raised during the consultation. There was general all-round support and enthusiasm for the project.

### **5. Further Public Consultation**

97. Further consultation should 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**

98. 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 WSA 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**

99. 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 entitlement under the resettlement framework. 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.

100. 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.

101. 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.

102. 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.

103. 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.

104. 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 PIU and lower level bodies, including commune/village officials and affected parties and households.

## VIII. FINDINGS AND RECOMMENDATION

### A. Findings

105. 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.

106. 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.

107. 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 Siem Reap Water Supply Authority. 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.

108. Public consultation has been conducted to make clear to the directly affected communities the potential social and environmental impacts as identified by the environmental and social reviews. A Public consultation was held in Siem Reap to review the subproject. The public consultation is documented in the subproject IEE. No significant issues were raised during the public consultation that have not been addressed in the IEE, nor were there issues that pose a significant constraint on implementation of the proposed subproject. A proposal has been described for continuing the process of public

consultation during construction that includes mechanisms for disclosure and for redress of grievances that arise during the construction phase.

## **B. Recommendation**

109. 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.

110. 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.

111. 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**

112. The environmental impacts of the proposed improvements in water supply infrastructure for Siem Reap 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 will be compensated by measures set out in detail in the Resettlement Framework for the project.

113. 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.

114. 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

<b>Country/Project Title:</b>	Cambodia / Urban Water Supply Project (Siem Reap)
<b>Sector Division:</b>	Urban Development and Water

Screening Questions	Yes	No	Remarks
<b>A. Project Siting</b> Is the project area...			
▪ Densely populated?		✓	
▪ Heavy with development activities?		✓	
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site	✓		Approval by APSARA; chance find procedures incorporated into IEE
• Protected Area		✓	
• Wetland	✓		Adjacent bodies of water not affected by the subproject.
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area	✓		Approval by APSARA; chance find procedures incorporated into IEE
• Special area for protecting biodiversity		✓	
• Bay		✓	
<b>B. Potential Environmental Impacts</b> 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?	✓		Approval by APSARA; chance find procedures incorporated into IEE
▪ 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)?	✓		<b>Water is treated for iron and manganese removal.</b>
▪ 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?	✓		<b>Capacity building plan for handling chlorine; prior experience of workers (existing system has chlorine gas delivery system)</b>
▪ 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?	✓		<b>Moderate effects; mitigated through standard means</b>
▪ increased road traffic due to interference of construction activities?		✓	
▪ continuing soil erosion/silt runoff from construction operations?	✓		<b>Moderate effects; mitigated through standard means</b>
▪ 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?	✓		<b>Capacity building in safe handling of chlorine gas provided under the project</b>
▪ 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 <sup>14</sup>
<b>Location and Design of project</b>	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	New pipework only.
	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)?	0	New pipework only.
<b>Materials and Maintenance</b>	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	
<b>Performance of project outputs</b>	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): Low**

<sup>14</sup> 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 use<sup>15</sup>. 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.

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<sup>15</sup> 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, an APSARA 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 APSARA 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: Public Consultation at Siem Reap

#### ADB TA 8125-CAM Cambodia Urban Water Supply Project Environmental and Social Public Consultation Response Form

Province: Siem Reap	District: Siem Reap Town	Commune: Siem Reap
Date: 7/June/13	Time: 2:00– 3:30 pm	Attendance (no.): 15 (3 female )
<b>Statements and Inquiries Provided by Attendees:</b>		
No.1 Name: Tith Sokhen	Sex: Male      Age: <u>42</u>	Occupation: villager(Kork Chok)
Statement or Inquiry: Will project damage road? Will project excavate road? if project excavates road who will respond to make it good as before? because we had experiences, no one fixed road after connected pipe line before.		
<b>Response if any: Mr. Director answered:</b> it is right. We made contraction with Provincial Department of Public Works and Transport to fix after our work. However, they did not do some time; thus, we will not cooperate with them again for this project. We will do it ourselves. All the work places will be fixed and clean after finished.		
No.2 Name: Tain Sambour	Sex: Male      Age: <u>48</u>	Occupation: village chief (Teaksen Tbong)
Statement or Inquiry: He raised that the project is very useful for local communities. However, he mentioned the problem as Mr. Tith Sokhen. He suggested that Siem Reap Water Supply Authority should respond to fix road after construction and try to finish short time because when project excavates in front of our house will not be able to drive to house.		
<b>Response if any:</b>		
No.3 Name: Ko Horn	Sex: Male      Age: <u>60</u>	Occupation: villager (Teok Vil village Teok Vill commune)
Statement or Inquiry: He felt happy with the project of expansion; his villagers will have clean water to use, especially in dry season. Water was not enough in dry season; most wells were drought in his village. Thus, this project can provide safe water to his village; villagers will avoid or reduce getting sick. There are 6 villages in Teok Vil commune facing with this problem.		
<b>Response if any: Mr. Director answered:</b> He will prepare a location next to this commune in order that most of villagers in this commune are able to access temporarily the clean water from his Siem Reap Water Supply Authority.		
No.4 Name: Phat Thun	Sex: Male      Age: <u>35</u>	Occupation: villager (Kork Dong)
Statement or Inquiry: we did not know how to apply for using clean water from this network.		
<b>Response if any:</b> Mr. Director answered: it is good time that you come for this meeting. I will let my staff to introduce office for your information.		

#### **Note:**

On June 7, 2013 the environmental consultative meeting was conducted in Siem Reap Town. Fifteen (15) participants including villager and villager chief from Kork Chok and Toek Vil commune attended this consultative meeting. The meeting was going well and very friendly to talk.

Presentation Frames:

**Sheet 1:**

Construction Impacts:

Construction impacts during

- Construction of facilities
- Hiring of workers
- Transport of construction materials

Impacts affect

- workers
- surrounding community
- environmental resources (air and water)

Safeguards

- Community
- Workers
- Environmental resources (air and water)

**Sheet 2:**

To protect the community:

- Compensate damage.
- Complete work and repair roads quickly.
- Provide access for homes and shops.
- Minimize dust and obstruction of pedestrians and vehicles.
- Provide sanitary facilities.
- Disinfect completed water mains.

**Sheet 3:****To provide for workers health and safety:**

- Worker housing, water, toilet and bathing facilities
- Disposal of wastewater and solid waste
- Safety and health plan for workers
- Workplace kept orderly to reduce accidents.

**To protect air and water:**

- Reduce erosion and sediment runoff.
- Restrict noisy activities to daylight hours.
- Apply water along roadways to suppress dust.

**Sheet 4:****OPERATIONS IMPACTS**

Operations impacts affect community health and water quality.

- Limit waste from treatment operation.
- Chlorinate water supplies.
- Maintain system pressure to prevent cross-contamination.
- Dispose of septic tank sludge in controlled location

Attendant List:



ព្រះបរមរាជវាំង

ព្រះរាជាណាចក្រកម្ពុជា  
ជាតិ សាសនា ព្រះមហាក្សត្រ

០១/០៧/២០១២

តារាងបញ្ជីចំណូល

ចូលរួមប្រជុំរបស់ប្រជាជនសង្កាត់ភាគចក្រ និងសង្កាត់ព័ត៌មាន

ស្តីពីការប្រកាសប្រើប្រាស់ផ្ទះឈ្មោះសង្កាត់ (គ្រោងសំណាងរបស់រាជធានីភ្នំពេញ) ADB

ល.រ	ឈ្មោះ	សង្កាត់	លេខទូរស័ព្ទ	ផ្សេងៗ
១	វ៉ិ ឃុន	វ៉ិ វ៉ិ	០១២ ២៨ ៣២៣	
២	សាវ ឈុន	សាវ ឈុន	០១២ ៣០ ១៧២/៤	
៣	សាវ ឈុន	សាវ ឈុន	០១២ ៣៤ ៣០១	
៤	ឈុន ឈុន	ឈុន ឈុន	០១២ ៥៥ ០១៤/២	
៥	ឈុន ឈុន	ឈុន ឈុន	០១២ ៤៣ ៤៩៩	
៦	សាវ ឈុន	សាវ ឈុន	០១២ ២៨ ៧០៥៥	
៧	សាវ ឈុន	សាវ ឈុន	០១២ ៧៥ ៧៤៦	
៨	សាវ ឈុន	សាវ ឈុន	០១២ ៧០ ៣៩២៣	
៩	សាវ ឈុន	សាវ ឈុន	០១២ ៥៣ ៣៨៣	
១០	សាវ ឈុន	សាវ ឈុន	០១២ ៩២ ៦៥៦	
១១	សាវ ឈុន	សាវ ឈុន	០៨៩ ៨៦២ ០៤២	
១២	សាវ ឈុន	សាវ ឈុន	០១២ ៩៩៨ ៦០៧	
១៣	សាវ ឈុន	សាវ ឈុន	០១២ ៤៣ ២៧២៣	
១៤	សាវ ឈុន	សាវ ឈុន	០១១ ៦១ ១១៤	
១៥	សាវ ឈុន	សាវ ឈុន	០១២ ៩៦ ១៣៥	
១៦	Southernang You	Environmental Spelt	០១២ ៤៩ ៦៩២	
១៧	Angelito N. Corpuz	Social Safeguards	០៩៥ ៦៧ ១១៣	
១៨	Tim Wittington	Env. Spelt	០៩៦ ២២ ០២៧៤៦	
១៩	សាវ ឈុន	សាវ ឈុន	០១២ ៩៥ ៣៣៦	
២០	សាវ ឈុន	សាវ ឈុន		
២១	សាវ ឈុន	សាវ ឈុន	០១២ ៩៤ ០០៧	
២២	សាវ ឈុន	សាវ ឈុន	០១២ ២៥ ៦៤២	
២៣				
២៤				
២៥				
២៦				

សៀមរាប ថ្ងៃទី ០៧ ខែ មិថុនា ឆ្នាំ ២០១២

អគ្គនាយក

*[Signature]*  
គណៈកម្មាធិការ

Photos of Consultation Meeting:



## Appendix 4: Sample Environmental Monitoring Reporting Form

### 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

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

#### 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"> <li>• Job openings of the project should give priority to local communities.</li> <li>• Recruitment of local laborers should be</li> </ul>	<ul style="list-style-type: none"> <li>• Field inspections and interviews with communities - DONE</li> <li>• Note each complaint case in the field – 3 COMPLAINTS RE-</li> </ul>		



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

b. Issues for Further Action

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

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 <sup>16</sup>
Establishment of personnel in PMU/PIU			
Public consultation and socialization process		Provide information on: <ul style="list-style-type: none"> <li>Public consultation, participation activities carried out</li> <li>Inclusive dates of these activities</li> </ul> To be elaborated on in	

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

		Item 5	
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"> <li>• Number of AHs to be relocated as per agreed RP</li> <li>• Number of AHs already relocated</li> <li>• Number of houses built</li> <li>• Status of installation of community facilities to be provided as per agreed RP</li> </ul>	
Compensation payments for affected assets is completed		<p>Please state:</p> <ul style="list-style-type: none"> <li>• Total Number of Eligible AHs and APs (as per agreed RP)</li> <li>• Number of AHs and APs compensated as of this monitoring period</li> <li>• Total Budget allocation as per agreed RP</li> <li>• Total budget disbursed to AHs as of this monitoring period</li> </ul>	
Transport assistance for relocating affected households		As above	
Additional assistance to vulnerable affected household		<p>Please state:</p> <ul style="list-style-type: none"> <li>• Total Number of vulnerable AHs and APs (as per agreed RP)</li> <li>• Agreed forms of assistance as per RP</li> <li>• Number of AHs and APs assisted as of this monitoring period</li> </ul>	
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"> <li>• Total Number of AHs affected by temporary impacts as per agreed RP</li> <li>• 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)</li> <li>• Status of restoring affected property</li> </ul>	

Capacity building activities			

b. Issues for Further Action

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

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

a. OHS for worker

Issue	Required Action	Responsibility and Timing	Resolution
<b>Old Issues from Previous Reports</b>			
<b>New Issues from This Report</b>			

b. Public Safety

Issue	Required Action	Responsibility and Timing	Resolution
<b>Old Issues from Previous Reports</b>			
<b>New Issues from This Report</b>			


## 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
<b>Old Issues from Previous Reports</b>			
<b>New Issues from This Report</b>			

## 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