

Draft Initial Environmental Examination

October 2011

BHU: Urban Infrastructure Project–Thimphu Wastewater Treatment Subproject

Prepared by the Royal Government of Bhutan for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 5 October 2011)

Currency unit	–	ngultrum (Nu)
Nu1.00	=	\$ 0.020239
\$1.00	=	Nu 49.4075

ABBREVIATIONS

ADB	-	Asian Development Bank
BOD	-	biochemical oxygen demand
CCC	-	construction complaints committee
CEMP	-	contractor's environmental management plan
COD	-	chemical oxygen demand
DMSC	-	design management supervision consultant
EIA	-	environmental impact analysis
EMP	-	environmental management plan
GRM	-	grievance redress mechanism
IDEAL	-	intermittent decanted aerated lagoon
IEE	-	initial environmental examination
MLD	-	million liters per day
MWHS	-	Ministry of Works and Human Settlement
NEC	-	National Environment Commission
PIU	-	project implementation unit
PMO	-	project management office
PMU	-	project management unit
PPE	-	personal protective equipment
PPTA	-	project preparation technical assistance
REA	-	rapid environmental assessment
SPS	-	Safeguard Policy Statement
TDM	-	Thimphu District Municipality
UIDP	-	urban infrastructure development project
WWTP	-	wastewater treatment plant

WEIGHTS AND MEASURES

dB	–	decibels
ha	–	hectare
km	–	kilometer
km ²	–	square kilometer
l	–	liter
m	–	meter
m ²	–	square meter
m ³	–	cubic meter
MT	–	metric tons
MTD	–	metric tons per day

NOTE

In this report, "\$" refers to US dollars.

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EXECUTIVE SUMMARY

1. An environmental assessment was made for the proposed wastewater treatment subproject of Thimphu District Municipality (TDM). It is one of the three subprojects to be funded by the Asian Development Bank (ADB) under the Urban Infrastructure Project of the Ministry of Works and Human Settlement (MWHS). Thimphu is the capital of Bhutan. Relative to the significance of impacts and risks, this subproject is deemed environmental category B based on ADB's environmental categorization, and the assessment warranted only the preparation of an initial environmental examination (IEE) report. This IEE was carried out under ADB's TA 7630-BHU and in accordance with ADB's Safeguards Policy (2009) and government laws, including (i) the National Environmental Protection Act of 2007, (ii) the Environmental Assessment Act of 2000, and (iii) the Regulation for Environmental Clearance of 2002.

2. The overall institutional setup follows the existing implementation arrangement of an ongoing project, the Urban Infrastructure Development Project (UIDP) supported by ADB, where the Ministry of Works and Human Settlement (MWHS) is the executing agency, with a project management unit operating under MWHS's Department of Urban Development and Engineering Services (DUDES). The participating Thimphu District Municipality (TDM) is the implementing agency with a respective project implementation unit (PIU), which is already implementing another ADB urban project.¹

3. **Subproject description.** Presently, almost all the wastewater from central and southern Thimphu is conveyed to its sole wastewater treatment plant (WWTP) in Babesa, southern Thimphu. Its design capacity is already exceeded by the capacity of the available sewerage network in the city. In addition, the odor generated by this existing WWTP has become a source of frequent complaints. Consequently, the government is prioritizing the construction of a new WWTP that will also address the issues related to space constraints, aesthetic problems, and odor nuisance in the surrounding areas.

4. The proposed WWTP is designed for a treatment capacity of 14 million liters per day (mld) to serve the 2020 wastewater flow. This is based on the proposed service area, population projections, and projected wastewater production. WWTP's service area includes the central core area, the UIDP-supported developments in Babesa, Simtokha, Lungtenphu, and Chang Bangdu, and other southern and central local areas such as Changzamtog, Changangkha, and upper and lower Motithang and Zilukha. The treatment capacity of 14 mld assumes that: (i) all houses in the new development areas in south Thimphu will be connected by 2020; (ii) 75% of buildings in the core area will be connected by 2020; and (iii) there will be an infiltration rate of 5%. By 2020, the served population is projected to be nearly 132,000.

5. Three treatment options were developed, and the final treatment technology shall be decided during implementation by the design-build-operate (DBO) contractor.² The possible treatment options are: (i) moving bed bioreactor (MBBR), (ii) intermittent decanted aerated lagoon (IDEAL), and (iii) biological aerated filter (BAF). These three treatment options can meet the NEC 2010 Environmental Discharge Standards for sewage treatment plants, provided adequate biomass separation is practiced. The effluent standards are BOD 30 mg/l, TSS 100 mg/l, and fecal coliforms 1000 MPN/100 ml. These treatment options will require much less land than the existing WWTP, but will require higher capital and operating costs.

¹ ADB. 2006. *Urban Infrastructure Development Project*. Manila.

² An environmental assessment and review framework (EARF) was prepared to guide detailed planning and design of the WWTP during implementation. The IEE will be updated and reviewed by ADB at time of detailed design.

6. The MBBR shall have the following components: (i) screen and grit removal system, (ii) two fluidized packing tanks, (iii) clarifier, (iv) anaerobic sludge digester, (v) solids dewatering system, and (vi) chlorination chamber. It uses fluidized packing material in which a fixed film of biomass forms. The IDEAL shall have the following components: (i) screen and grit removal system, (ii) two intermittent decanted aerated lagoons, (iii) flow balancing chamber, (iv) solids dewatering system, and (iv) chlorination chamber. BAF shall have the following components: (i) screen and grit removal system, (ii) primary clarifier, (iii) one aerated filter tank, (iv) secondary clarifier, (iv) anaerobic sludge digester, (v) solids dewatering system, and (vi) chlorination chamber.

7. **Environmental and socioeconomic conditions.** Project implementation will not pose significant problems to the environment, since the present ecological setting of the area for the proposed expanded WWTP in Babesa has been classified as institutional, while the immediate surrounding area is an agricultural landscape presently dominated by open grassland spaces. An important fact to consider is that the areas surrounding the WWTP site are not within undisturbed landscapes, but have already been touched by human activities over the years. In fact, the existing WWTP has been operating since 1996. The WWTP is well maintained. Influent and effluent analyses have been undertaken at various stages of the treatment process. However, laboratory tests done in July 2011 showed that the effluents from the existing WWTP had BOD 47 mg/l and TSS 135 mg/l, values that exceeded the NEC 2010 Environmental Discharge Standards of BOD 30mg/l and TSS 100 mg/l for sewage treatment plant. The new treatment plant constructed under the project will meet the government standards, including 30mg/l BOD.

8. Thimphu city contributes 40% of the nation's urban population and 12.5% of the national population. City limits cover a total area of about 27 km², with a population density of 3,046 persons per km². The city's structure plan projected a population of 162,327 for the year 2025 due to high population growth rate and carrying capacity of the city. Southern Thimphu (Chang Bangdu, Lungtenphu, Simtokha, Babesa, and Serbithang) is now experiencing rapid development with the provision of basic infrastructures.

9. **Impacts and EMP.** Screening for environmental impacts is made through a review of the parameters associated with projects for domestic wastewater treatment against the components of the proposed expanded WWTP subproject. An important consideration in analyzing the environmental impacts of the proposed subproject is the fact that these are improvements of an existing WWTP in an already altered environment. Presently, there is an ongoing reclamation activity close to the existing WWTP, which could be used for implementing the proposed WWTP, based on detailed engineering and feasibility study.

10. As the technology option for the WWTP in Thimpu will be selected after ADB Board approval, the following are required activities to be conducted by the PMC in coordination with the DMSC and overseen by the PMU and PIU during the planning and detailed design stage:

- (i) Conduct a flood and hydrology study (using statistical methods, if necessary) to confirm 50- to 100-year flood levels, and to confirm that the height of the existing gabion walls at the lagoon site and the proposed wall design of the new WWTP are adequate to ensure a 1-m freeboard during the maximum design flood height.
- (ii) Work with the government to ensure that there is no narrowing of the channel downstream through fill and reclamation activities which is less than the

- narrowest section of river within 2 km downstream from the new WWTP site, or other distance as recommended by the hydrological studies.
 - (iii) Ensure that the selected WWTP technology complies with Bhutan's effluent discharge standards.
 - (iv) Ensure that for any option requiring partial decommissioning of the existing WWTP, the government will obtain and submit to ADB prior to construction a written permission from the National Environmental Commission (NEC), granting temporary waiver of government effluent discharge standards during the time of construction, while ensuring existing effluent discharge levels, in particular biological oxygen demand, are not exceeded.
 - (v) Ensure that for any option requiring partial decommissioning of the existing WWTP, a water quality study on river water downstream of the lagoon site is conducted to project temporary impacts on water quality during construction, if any³.
 - (vi) Ensure that an EMP for decommissioning shall be prepared, addressing the following: proper disposal of sludge, proper disposal or reuse of the plastic liner, and proper disposal of any saturated/contaminated soils that may be unsuitable for use as fill.

11. The draft IEE prepared by the PPTA during the feasibility stage will be updated and reviewed by ADB at time of detailed design.

12. Adverse environmental impacts during construction are temporary, less than significant, and can easily be mitigated. There will be no massive construction activities that can damage the environment. WWTP construction activities shall be confined in a space already allocated for wastewater treatment facilities. Typical construction issues are manageable with the implementation of a site management plan for (i) erosion and sediment runoff, (ii) noise and dust, (iii) vehicular traffic, (iv) construction wastes, (v) oil and fuel spillages, (vi) construction camps, and (v) public safety and convenience.

13. Environmental problems due to operation of the proposed WWTP can be avoided by incorporating the necessary measures in the design and use of appropriate operational procedures. Public health risk can be addressed by keeping the public away from the facility. A written health and safety plan shall be prepared for the WWTP operation.

14. An environmental management plan is developed to effectively manage the environmental issues. The plan includes: (i) mitigating measures to be implemented; (ii) required monitoring associated with the mitigating measures; and (iii) implementation arrangement. Institutional set-up discusses the requirements and responsibilities during pre-construction, construction, and operation. The plan includes tabulated information on: (i) required measures for each environmental impact that requires mitigation; (ii) locations where the measures apply; (iii) associated cost; and (iv) responsibility for implementing the measures and monitoring.

15. **Consultation and participation.** Project planning and the subsequent IEE preparation for the proposed WWTP subproject recognized the need for public consultation and participation as central to effective environmental safeguarding. Within the context of "meaningful consultation," TDM initiated a process of consultation during project preparation, and intends to

³ It is noted that the assimilative capacity of the river is high, even during dry season, and no sensitive downstream impacts exist.

continue it during the construction phase. TDM conducted an initial public consultation and information disclosure last 20 August 2011 with the people's representative, business representative, and concerned individuals. Details of the subproject components were presented to the stakeholders, and their views on the proposed expanded WWTP were requested. Stakeholders expressed support for the proposed subproject. Project disclosure activities were also done during a socioeconomic survey last July 2011. The process of public consultation with various stakeholders shall continue during the detailed design stage.

16. **Grievance redress mechanism.** Implementation of the proposed WWTP subproject will be fully compliant to ADB's safeguards requirement on grievance redress mechanism. TDM shall disclose the proposed mechanism in public consultations during detailed design and in meetings during the construction phase. Complaints about the environmental performance of the subproject during the construction phase can best be handled by various levels, including the formation of an ad hoc construction complaints committee (CCC) for the expeditious resolution of the complaints, while complaints during the operation phase can be brought to the attention of the NEC. TDM shall address promptly, at no costs to the complainant and without retribution, any complaints and concerns. The CCC shall be chaired by the PIU head. Members shall include: (i) contractor's highest official at the site, such as construction manager or construction superintendent; (ii) the elected people's representative of the WWTP area, the Thuemi; and (iii) the PIU head. Creation of the ad hoc CCC and its operation shall be included in appropriate sections of the civil works contract. .

17. **Conclusion and recommendation.** The capacity of the existing WWTP has been exceeded and would be insufficient for future increase of sewage generation coming from the already constructed sewerage network. The proposed new WWTP will provide huge environmental benefits to the City of Thimphu by improving its sanitation infrastructure, and help protect Wang Chhu's water quality. It will address all the issues on adequate treatment capacity, space constraints, and odor nuisance in the surrounding areas. It is designed to comply with NEC 2010 Environmental Discharge Standards of BOD 30 mg/l and TSS 100 mg/l for sewage treatment plant.

18. Analysis of potential environmental impacts revealed no significant adverse impacts to people and environment from the proposed WWTP subproject. The IEE concludes that adverse environmental impacts arising from the location, design, construction, operation, and maintenance of the proposed subproject can be mitigated to less significant levels and the corresponding mitigation measures are doable. Monitoring can easily be done. The project can be implemented in an environmentally acceptable manner. An expanded environmental impact assessment is therefore not warranted, and this IEE shall be the final environmental assessment document of the WWTP subproject. Its environmental classification as category B is deemed appropriate.

19. The PMU shall ensure that EMP requirements for the construction phase will be reflected in the tender documents and civil works contracts and implemented, including the contractor's submission of a contractor's EMP (CEMP). The PMU shall monitor the PIU's compliance to the EMP. In addition, creation of the ad hoc CCC and its operation, as part of the grievance redress mechanism, shall be included in appropriate sections of the subproject's civil works contracts. Institutional strengthening of TDM, including training, is recommended for effective EMP implementation. The PIU shall continue the process of public consultation and information disclosure during detailed design and construction.

I. INTRODUCTION

1. The Thimphu District Municipality (TDM) is a local government located in the Kingdom of Bhutan and one of the selected subprojects under the Urban Infrastructure Project (TA 7630-BHU) funded by the Asian Development Bank (ADB). The objective of the TA study is to assist the Government of Bhutan in preparing a project for sustainable urban development in its two largest cities and two large towns. It is intended to improve the livability and competitiveness in urban areas through the provision of better facilities such as roads, water supply, and sanitation infrastructure.

2. Preparation of this initial environmental examination (IEE) is part of the activities under the TA study. It provides ADB with an assessment of the environmental concerns to be considered regarding the subproject location, design, construction, and maintenance. This report is also intended to assist the TDM in the preparation of the required environmental document to meet the National Environment Commission (NEC) requirements for an application of the necessary environmental clearance before the start of the construction activities.

3. Preparation of the IEE involved field visits to the proposed subproject area; review of available information; and discussions with local government officials, NEC, other government agencies, and members of the community within the subproject area.

4. The IEE has been carried out in accordance with ADB's Safeguard Policy (2009) and the requirements describe in its Appendix 1 (Safeguards Requirement 1: Environment), and the laws of Bhutan and its requirements for environmental clearance as embodied by its Environmental Assessment Act of 2000.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

5. The policy, legal, and administrative frameworks relevant to the environmental assessment of infrastructure projects in Bhutan have been established by the following laws and regulations: (i) National Environmental Protection Act of 2007, (ii) Environmental Assessment Act of 2000, and (iii) Regulation for Environmental Clearance of 2002. At the national policy level, environmental protection and conservation is a constitutional mandate, and is required to (i) protect, conserve, and improve the pristine environment, (ii) safeguard biodiversity, and (iii) prevent pollution and ecological degradation.

6. The National Environmental Protection Act of 2007 is the overall law on environmental protection and specifies the powers, functions, and operational framework of the NEC, the government agency mandated to look after all issues related to the environment throughout the country. Their mandate includes the maintenance of environmental quality through the enforcement of environmental standards and promotion of best environmental management practices to address pollution and environmental hazards.

7. The Environmental Assessment Act of 2000 was enacted to establish procedures for the assessment of the potential effects of strategic plans, policies, programs, and projects on the environment, and for the determination of policies and measures to reduce potential adverse effects and to promote environmental benefits. Under this law, no development consent can be issued without first seeking an environmental clearance—under Chapter III of the act, issued in writing by the secretariat or the competent authority—to let a project proceed, and includes terms to ensure that the project shall be managed in an environmentally sound and sustainable way.

8. “Development consent” refers to the approval issued or renewed by a competent authority in the form of a license, lease, or permit for land use or construction. A competent authority is an agency of the government that has the power to issue development consent for a project. However, when an applicant is also a competent authority, the NEC shall be the competent authority, with jurisdiction to issue an environmental clearance. This law emphasizes the importance of public consultation, and requires the applicant to consult all concerned people and organizations prior to submission of the application or the environmental assessment documents to the competent authority.

9. Following the Environmental Assessment Act of 2000, the Regulation for Environmental Clearance of 2002 was adopted. The regulation defines responsibilities and procedures for the implementation of the Environmental Assessment Act of 2000 concerning the issuance and enforcement of environmental clearance for individual projects. Information on the process for obtaining an environmental clearance and timelines for processing are presented in Appendix 1.

10. In cases where a forest has to be cleared, the municipality has to apply for a forestry clearance from the Department of Forestry in compliance with the 2006 Forest and Nature Conservation Rules of Bhutan. Information on the process for obtaining a forestry clearance is presented in Appendix 2.

11. Aside from environmental laws and regulations, the 2004 Penal Code of Bhutan also includes a provision on environmental pollution, wherein Article 409 states that a defendant shall be guilty of the offense of environmental pollution if such defendant knowingly or recklessly pollutes or contaminates the environment, including air, water, and land, and makes it noxious to public health and safety.

12. International conventions are also part of the environmental framework, since Bhutan is a party to some international conventions, treaties, and agreements on the principles and actions necessary for sustainable development and environmental protection. It has ratified the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change (25 August 1995). These international conventions explicitly reference the application of environmental assessment to address the effects of human activities. The Convention on Biological Diversity, in particular, promotes the use of appropriate procedures requiring environmental impact assessment of proposed projects that are likely to have significant adverse effects on biological diversity

III. DESCRIPTION OF THE SUBPROJECT

A. Location

13. This subproject shall be located in the same location as the existing WWTP at Babesa, Thimphu City, on 5.2 ha of land.

B. Components and Cost Estimate

14. The proposed WWTP is designed for a treatment capacity of 14 mld to serve the 2020 wastewater flow. This is based on the proposed service area, population projections, and projected wastewater production. WWTP’s service area includes: the central core area, the UIDP-supported developments in Babesa, Simtokha, Lungtenphu, and Chang Bangdu, and other southern and central local areas such as Changzamtog, Changangkha, and upper and lower Motithang and Zilukha. A population projection for the WWTP service area was carried out using a growth rate of 2.5% per annum, as assumed in the city’s structural plan, and

considering the actual 2005 population census results. The population projections showed that the service area total populations for the years 2020 and 2027 will be 131,780 and 159,390, respectively. Based on the projected wastewater production of 120 liters per capita per day (lpcd), the required capacity of the Thimphu wastewater treatment plant will be 14 mld by 2020 and 19 mld by 2027. This assumes that: (i) all houses in the new development areas in south Thimphu will be connected by 2020, (ii) 75% of buildings in the core area will be connected by 2020, and (iii) there will be an infiltration rate of 5%.

15. Three treatment options were developed for the proposed WWTP, and shall be implemented through a design-build-operate (DBO) scheme. The final treatment technology of the WWTP shall be decided during implementation.¹ The possible treatment options are: (i) moving bed bioreactor (MBBR), (ii) intermittent decanted aerated lagoon (IDEAL), and (iii) biological aerated filter (BAF). All three systems can meet the NEC 2010 Environmental Discharge Standards for sewage treatment plant, provided adequate biomass separation is practiced. The standards are: BOD 30 mg/l, TSS 100 mg/l, and fecal coliforms 1000 MPN/100 ml. The capital and operating costs without contingencies based on 2011 prices are presented in Table 1.

Table 1: Capital and Operating Costs of Treatment Options

Option	Capital Cost (US\$)	Operating Cost (US\$)
MBBR	12,484,130	524,365
IDEAL	10,836,560	707,570
BAF	12,453,970	469,550

BAF = biological aerated filter, IDEAL = intermittent decanted aerated lagoon, MBBR = moving bed bioreactor.

16. The MBBR shall have the following components: (i) screen and grit removal system, (ii) two fluidized packing tanks, (iii) clarifier, (iv) anaerobic sludge digester, (v) solids dewatering system, and (vi) chlorination chamber. It uses fluidized packing, in which a fixed film of biomass forms. This system works well in temperate climates. There will be no primary sedimentation system in order to minimize odor. Solids dewatering shall take place inside a building with odor extraction by an activated carbon filter. Tanks will be small and unobtrusive, and can be placed inside a building. This system uses more air than an activated sludge system, due to a need to fluidize the packing. This translates to higher operational costs. Biomass yield is the smallest among the aerobic treatment systems. An anaerobic digester is necessary to stabilize sludge and reduce solids volume. The equipment is not exotic, but the packing may have to be sourced from outside India. Operating costs would be high with this system, but much less than the IDEAL system. It has the smallest requirement for land.

17. The IDEAL shall have the following components: (i) screen and grit removal system, (ii) two intermittent decanted aerated lagoons, (iii) flow balancing chamber, (iv) solids dewatering system, and (iv) chlorination chamber. The IDEAL is similar to a sequencing batch reactor. This system works well in temperate climates. Similar to the MBBR, there will be no primary sedimentation system in order to minimize odor. It will use large tanks, which will minimize untreated effluent to the river under severe wet weather events. Tanks are not unsightly and emit no objectionable odor. It will use more air than activated sludge system, as it is proposed to be run as an extended aeration plant. This eliminates the need for further sludge treatment. Biomass yield is reduced, and any solids produced will be considered stable. Equipment can be sourced from India. Capital cost is lower than the MBBR and BAF systems, but operating cost would be high with this system. This system is the easiest to operate and has a small footprint.

¹ An environmental assessment and review framework (EARF) was prepared to guide detailed planning and design of the WWTP during implementation. The IEE will be updated and reviewed by ADB at time of detailed design.

18. BAF shall have the following components: (i) screen and grit removal system, (ii) primary clarifier, (iii) one aerated filter tank, (iv) secondary clarifier, (iv) anaerobic sludge digester, (v) solids dewatering system, and (vi) chlorination chamber. BAF is a more modern version of the trickling filter and uses banks of rectangular filters. This system works well in temperate climates because air is forced. This system had a primary clarifier, and is proposed to be covered with air extraction. Solids dewatering will take place under the same conditions as the MBBR and IDEAL. An anaerobic digester is necessary to stabilize sludge and reduce solids volume. Operating cost would be low. Its land requirement is higher than IDEAL, but less than the MBBR.

19. Domestic wastewater shall enter the WWTP at the overflow weir and proceed to the screen and grit removal system. The wastewater shall exit the grit chamber and enter the aeration units. The treated effluent shall exit the aeration units and flow to a secondary clarifier or flow-balancing chamber before entering the chlorination chamber for disinfecting and discharge to the river. The removed screenings and grits shall be mixed with the daily sludge from the sludge dewatering system, and shall be sent to farmlands for land application.

C. Preconstruction

20. As the technology option for the WWTP in Thimpu will be selected after ADB Board approval, the following are required activities to be conducted by the PMC in coordination with the DMSC and overseen by the PMU and PIU during the planning and detailed design stage in preparation of construction:

- (i) Conduct a flood and hydrology study (using statistical methods if necessary) to confirm 50- to 100-year flood levels, and to confirm that the height of the existing gabion walls at the lagoon site and the proposed wall design of the new WWTP are adequate to ensure a 1-m freeboard during the maximum design flood height.;
- (ii) Work with the government to ensure that there is no narrowing of the channel downstream through fill and reclamation activities which is less than the narrowest section of river within 2 km downstream from the new WWTP site, or other distance as recommended by the hydrological studies.;
- (iii) Ensure that the selected WWTP technology complies with Bhutan's effluent discharge standards;
- (iv) Ensure that for any option requiring partial decommissioning of the existing WWTP, the government will obtain and submit to ADB prior to construction a written permission from the NEC granting temporary waiver of government effluent discharge standards during the time of construction, while ensuring existing effluent discharge levels, in particular biological oxygen demand, are not exceeded;
- (v) Ensure that for any option requiring partial decommissioning of the existing WWTP, a water quality study on river water downstream of the lagoon site is conducted to project temporary impacts on water quality during construction, if any²;
- (vi) Ensure that an EMP for decommissioning shall be prepared addressing the following: proper disposal of sludge, proper disposal or reuse of the plastic liner, and proper disposal of any saturated/contaminated soils that may be unsuitable for use as fill.

² It is noted that the assimilative capacity of the river is high, even during dry season, and no sensitive downstream impacts exist.

21. The draft IEE prepared by the PPTA during the feasibility stage will be updated and reviewed by ADB at time of detailed design.

D. Construction

22. Construction shall require: (i) site clearing and marking of alignments; (ii) stockpiling of construction materials; (iii) excavation by backhoe and bulldozers for the new structures; (iv) construction of buildings; (v) concreting for required tanks; (vi) installation of piping systems; (vii) installation of electromechanical equipment; and (viii) cleaning and closure of construction sites.

E. Implementation and Operation

23. Thimphu District Municipality shall continue to operate the proposed WWTP. Construction of the subproject is scheduled to start in the fourth quarter (Q4) of 2013, and is expected to be completed Q1 2016.

F. Existing WWTP

24. The existing Thimphu WWTP has a capacity of 1,750 m³/day and is currently operating close to its capacity. It is a waste stabilization lagoon system using two process trains of anaerobic pond, followed by a facultative pond, and then by a maturation pond before discharging the effluents to the river (Photo No.1, Appendix 3). This process requires a large land take, but is operationally very simple and does not require highly skilled operators. Simple laboratory analyses of influent and effluent are all that are required to ensure the plant is operating efficiently.

25. The WWTP is well maintained. Influent and effluent analyses have been undertaken at various stages of the treatment process. Its laboratory is in good condition and equipped for monitoring the performance of the facility. It has capabilities to test BOD, COD, suspended solids, phosphates, sulfide, pH, ammonia, and fecal coliform. A senior technician overseeing the daily operation of the WWTP is also the person performing the laboratory tests. Laboratory tests done in July 2011 showed that the effluents from the WWTP have BOD 47 mg/l and TSS 135 mg/l, which is beyond the NEC 2010 Environmental Discharge Standards for sewage treatment plant.

26. During summer, odor from the lagoons is minimal. However, in winter, the WWTP has a foul odor that migrates offsite and is the cause of complaints from residents in the nearby northern area, since the general airflow of the valley moves towards that direction. Generation of odor during winter is due to the slowing down of the lagoons' biological processes affected by lower temperatures and less sunlight. Temperatures in Thimphu can drop to very low levels during winter, conditions that are not suitable for a lagoon technology. Consequently, there is a need to replace the lagoon system with a better technology, aside from increasing its capacity to handle future wastewater loadings. Several studies have been undertaken for upgrading the existing WWTP with the use of surface aerators, but have been found to be not feasible in providing sufficient capacity for handling the projected wastewater loadings.

IV. DESCRIPTION OF THE ENVIRONMENT

27. A brief description of the existing environmental and socioeconomic conditions of the Thimphu WWTP Subproject influence area is presented in the following subsections:

A. Physical Resources

28. Thimphu city, the capital of Bhutan, is located in western Bhutan at 27°30' N latitude and 89°30' E. Its approximate altitude ranges from 2,240 to 2,648 mean sea level (msl) with the surrounding hills rising over 3,800 msl. It is accessible by road, from India, through the southern town of Phuentsholing, about 175 km away. It is also accessible by air from Paro, which is about 55 km away. Dechencholing in the north and Sebitang in the south mark the administrative extremities of the city. Geographically, the city is spread along the Wang Chhu (river) valley in a linear fashion. The city is divided into: (i) southern parts—Babesa and Semotokha, the settlements of Lungtenphu and Changjiji near the river, the elevated area of Motithang, the flat areas of Hejo and Jongshina; (ii) northern parts—Taba and Dechencholing; and (iii) the city core along the river on flat land. The proposed WWTP subproject is located in Babesa. The city part of the valley enjoys a warm, temperate climate with an average annual rainfall varying between 500 mm and 1,000 mm. The average daily winter temperature varies between 5°C and 15°C, and the average daily temperature during summer varies between 15°C and 30°C. The southwest monsoon brings rainfall to the valley during the months of mid-June to September. The average annual rainfall is typically 13 mm with a maximum average of 167.5 mm during June, and often no precipitation at all in November.

29. Geologically, Bhutan is divided into two broad geological zones, the Lesser Himalayan belt along the southern and southeastern border, and the Tethyan belt in remaining parts. The Lesser Himalayan formation includes a wide range of sedimentary and low-grade metamorphic rocks, including argillites and metargillites, sandstones, quartzites, limestone, dolomite, and gypsum. The Tethyan formation mainly includes stronger gneisses that account for more than 70% of the country's bedrock, schists, and marble, affording a relatively high degree of stability, compared to other locations in the Himalayas. Thimphu district falls in the Tethyan belt, and the bedrock comprises mainly gneiss and Tethyan metasediments, schists, quartzite, and limestone. The city's valley has high content of alluvium deposited over time by the Wang Chhu River.

30. The Wang Chhu basin is one of the four principal river basins in Bhutan, and its main river, the Wang Chhu, flows through Thimphu. It is a fast flowing river. River flows vary from a low of 3–5 m³/s in January and February to around 135 m³/s in August and September. The existing WWTP discharges to this river. Water quality testing in 2005 revealed that upstream of the WWTP site, the water has a nitrate concentration of 1.4 mg/l and a phosphate concentration of 0.07 mg/l. Turbidity was 2.0 mg/l.

B. Ecological Resources

31. The site of the proposed WWTP is the existing WWTP site, and is presently classified as an institutional area based on the Thimphu Structure Plan. It is a relatively flat land bounded in the west by the Wang Chhu and by open spaces in the east dominated by grasses, with ongoing construction of buildings. Further to the east is a relatively developed area right across the highway to Paro. These areas are unlikely habitats for large wild animals, rare or endangered species. Farm and domesticated animals are therefore the predominant faunal species, such as cows, goats, house cats, and dogs. An important fact to consider is that the proposed WWTP site is not within an undisturbed landscape. (See Photographs 1 to 4 in Annexes.) It is in a general zone with residential areas and a highway that has been functional for a very long time. Hence, over the years, ecological changes due to human activities resulted in the present residential, agricultural, and institutional landscapes.

32. **Protected areas.** There are nine protected areas in Bhutan, four of which are designated as national parks, four are wildlife sanctuaries, and one is a strict nature reserve. Information from the Nature Conservation Division of the Department of Forestry indicated that there are no protected areas in and around Thimphu.

C. Economic Development

33. Thimphu started to be developed in 1961, when the King declared it the new capital of Bhutan. Today, the city is undergoing massive development. New tree-lined streets are being laid, and the clock tower area in the center of the city has been transformed into a park-cum-open air theater where live cultural performances take place. In 2008, the national stadium was completed, together with a new riverside park. The area around the *dzong* and government buildings is a particularly green and attractive district. Norzin Lam is the city's main thoroughfare, and is lined with hotels and shopping complexes. The city is a major tourist destination in Bhutan with its various religious structures, festivals, handicrafts, small zoo, traditional buildings, and designated scenic walks. Around 80% of all tourists to Bhutan spend most of their time in Thimphu. Tourist groups flying into Bhutan use the city as an arrival point before departing to remote regions for trekking.

34. Bhutan's economy is dependent on agriculture. Most of the land currently under cultivation lies in small and often isolated pockets along the main river valleys, and is concentrated in the southern foothills. There is a shortage of flat land for farming, and some farming land on the Wang Chhu valley floor near Thimphu is subject to conversion to residential or industrial use.

D. Socio and Cultural Resources

35. Thimphu Dzongzags population was 98,676 in 2005, according to the National Housing and Population Report. Thimphu City contributes 40% of the nation's urban population and 12.5% of the national population. City limits cover a total area of about 27 km² with a population density of 3,046 persons per km². The city's structure plan projected a population of 162,327 for the year 2025 due to a high population growth rate and carrying capacity of the city. Southern Thimphu (Chang Bangdu, Lungtenphu, Simtokha, Babesa, and Serbithang) is now experiencing rapid development with the provision of basic infrastructures supported by ADB's Urban Infrastructure Development Project (2258-BHU).

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

36. A comprehensive screening for environmental impacts is made through a review of the parameters associated with sewage treatment projects against the components of the proposed WWTP subproject and the environment where the facilities will be located. A screening checklist was developed from various sources such as ADB's Rapid Environmental Assessment (REA) Checklist, and the World Bank's Environmental Source Book. Some items on the checklist may not be applicable to this particular subproject. However, they are included in the discussions to indicate that their applicability was reviewed in the environmental impact screening process. This will help identify which topics do not require further attention.

37. The assessment is made on the following phases of the subproject: (i) preconstruction, (ii) construction, and (iii) operation and maintenance. Results of the environmental impacts screening are summarized in Table 2, while the discussions of each issue are presented in the succeeding sections. In Table 2, impact types and magnitudes are indicated for both impacts without mitigating measures and situations when mitigating measures will be implemented. The

screening table uses the symbols “+” for positive impacts and “-” for negative impacts. Symbols for impact magnitudes are “Δ” for insignificant and “●” for significant. The symbol for an insignificant negative impact is “Δ -”, while a significant negative impact is “● -”. The second column of the table indicates the type and magnitudes of the impacts without any mitigating measures being applied. Some impacts already have insignificant magnitudes even without mitigations, and mitigating measures are therefore no longer required. The last column of the table indicates the expected impact magnitude after applying the mitigating measures. Hence, a significant negative impact (● -) will become insignificant (Δ) after applying the mitigating measures. A summary of the environmental impacts that should be carried to the section for the environmental management plan (EMP) is presented in Table 3.

38. Environmental impacts arising from decommissioning of the WWTP were also reviewed but are no longer further discussed due to the following: (i) decommissioning of the WWTP is a remote possibility since it will serve the growing urban areas, and such facility is critical for sustaining those areas; (ii) residual waste cleanup is not a major concern, since the facilities are not industrial manufacturing plants with potential problems for toxic and hazardous wastes; and (iii) sludge from decommissioning is also not a major concern, since the WWTP is provided with sludge management units.

Table 2: Summary of Environmental Impacts Screening for WWTP Subproject

Environmental Impacts and Risks	Without Mitigation	With Mitigation
PRECONSTRUCTION PHASE		
Encroachment on environmentally sensitive areas	NA	NA
Impacts and risks to biodiversity conservation	NA	NA
Potential damage to historical areas and cultural areas	Δ -	Δ
Potential nuisance and problems to the public	● -	Δ
Loss of assets (IR concerns)	NA	NA
CONSTRUCTION PHASE		
Modification of construction site topography	Δ -	Δ
Removal of trees	NA	NA
Displacement of rare or endangered species	NA	NA
Soil erosion and sediments of construction sites	● -	Δ
Noise from construction equipment	● -	Δ
Local air pollution due to construction activities	● -	Δ
Oil and other hazardous materials released	● -	Δ
Vehicular traffic congestion and public access	Δ -	Δ
Hazards to public due to construction activities	Δ -	Δ
Temporary decrease of effluent quality	● -	Δ
Disposal of existing sludge from ponds	● -	Δ
Pollution and health risk due to workers' camp	● -	Δ
Occupational health and safety at work sites	● -	Δ
Increase employment opportunity in work sites	● +	● +
Improper closure of construction sites	● -	Δ
OPERATION AND MAINTENANCE PHASE		
Discharge of poor quality effluents	● -	Δ
Noise and dust pollution from WWTP	Δ -	Δ
Disposal of sludge from WWTP	● -	Δ
WWTP foul odor offsite migration	● -	Δ
Drowning risk in WWTP ponds	● -	Δ
Health risk in WWTP operation	● -	Δ
Increase employment opportunities	Δ +	Δ
Hazard from unused septic tanks	● -	Δ

WWTP = Wastewater Treatment Plant

Legend: n.a. = not applicable; Δ = insignificant; ● = significant;

+ = positive; - = negative

A. Design/Preconstruction Phase Considerations

39. **Design considerations.** The proposed Thimphu WWTP should have a robust plant siting study to protect the facility from risks. The following design considerations are necessary: (i) conducting a flood and hydrology study to confirm the 50- and 100-year flood levels, and to confirm that the height of the existing gabion walls at the lagoon site are adequate to ensure a 1-m freeboard during the maximum design flood height; (ii) government to ensure no narrowing of the channel downstream through fill and reclamation activities within 2 km downstream from the WWTP site; (iii) WWTP technology shall comply with Bhutan's effluent discharge standards.

40. A flooding study will reasonably provide information if the site is a secure place for the proposed WWTP. In general, the design shall address reliability of maintaining good effluent quality that complies with government standards, appropriate sludge handling system, reliable odor control, and minimizing hazards to workers and community.

41. The WWTP will not be located in areas that are environmentally sensitive and areas with historical and cultural importance. As described in the environmental baseline, the proposed site is the area occupied by the existing WWTP, with its immediate eastern surroundings dominated by open spaces and a highway. However, there are ongoing construction activities for buildings near the existing WWTP, and one has already been occupied near the anaerobic pond. Most areas immediately adjacent to the highway near the site are already occupied by residential and other structures, while the western side of the site is bounded by the Wang Chhu River. There are no known archaeological and cultural assets in these sites. Nevertheless, precautions will be taken to avoid potential damage to any archaeological and cultural assets by inclusion of provisions in tender and construction documents requiring the contractors to immediately stop excavation activities and promptly inform the authorities if archaeological and cultural assets are discovered.

42. **Impacts and risks to biodiversity conservation.** The issue on impacts and risks to biodiversity conservation is not applicable to the WWTP subproject, since its components will not be located in an area that is environmentally sensitive. The areas surrounding the WWTP site are not undisturbed, and over the years, ecological changes due to human activities in the area have resulted in the present residential, agricultural, and institutional landscapes.

43. **Nuisance and problems to the public.** Potential nuisances and problems to the public during construction of the WWTP subproject can best be avoided if proactively addressed during detailed design and preconstruction phase. Odor, a complaint of the existing WWTP, shall be addressed in the design by enclosing the odor generating units of the proposed WWTP and extracting the air with activated carbon units for odor removal. Consultation and information dissemination to potentially affected people shall be done during detailed design. Tender documents shall include provisions addressing potential nuisances and problems to the public during construction. These include environmental management provisions on the following issues: (i) erosion and sediment runoff, (ii) noise and dust, (iii) vehicular traffic, (iv) construction wastes, (v) oil and fuel spillages, (vi) construction camps, and (v) public safety and convenience. These shall also be reflected in the construction contracts.

44. The EMP will be incorporated into bidding and contract documents.

B. Construction Phase Environmental Impacts

45. **Site preparation.** Construction of the WWTP's components will not involve significant modification of the construction site topography. This issue is therefore considered not significant. Removal of trees will not be an issue, since the site is already used by the existing WWTP. The issue on displacement of rare or endangered species is not applicable to the WWTP subproject, since there are no known rare or endangered species within the proposed site.

46. **Soil erosion and sediment of construction sites.** During rainy periods, exposed soil at the construction site can easily be washed away by runoff and carried to the natural drainage system. Hence, soil erosion of the construction sites could occur if preventive measures are not instituted.

47. The proposed reclamation area on the banks of the Wang Chhu is a potential source of sediment and can easily release soil materials to the river if not provided with a containment/retaining wall during the filling process. During rainy periods, soil materials from the fill can easily be carried by runoff to the river.

48. **Mitigation.** Control of the surface runoff is necessary in preventing erosion. The contractor shall be required to use structural erosion prevention and sediment control practices which will divert the storm water flows away from the exposed areas, prevent sediments from moving offsite, and reduce the erosive forces of runoff waters. These may include the following: (i) interceptor dikes, (ii) pipe slope drains, (iii) straw bale barriers, (iv) sediment traps, (v) silt fencing, and (v) temporary sediment basins. Whenever possible, total exposed area shall be minimized.

49. The reclamation area should be provided with a containment/retaining wall during the filling process, and the level of the wall should progressively rise with the filling process to prevent the release of soil materials.

50. **Construction noise.** Potential sources of noise are the construction equipment, such as trucks and other equipment, which can generate noise of 80 dB from a distance of 30 m. However, loud noise sources such as blasting are not expected in the construction activities of the WWTP subproject.

51. **Mitigation.** Nuisance from equipment noise can be mitigated with the use of sound suppression devices for the equipment. Noisy equipment shall not be operated during nighttime to early morning (9 p.m.–6 a.m.). According to NEC standards, noise levels in rural/residential areas should not exceed 55 dB during daytime and 45 dB during nighttime. Workers using noisy equipment shall be provided with earplugs.

52. **Local air pollution due to construction activities.** Dust generation from earthworks and soil preparation activities during dry periods will be an air pollution problem. Intermittent episodes of air pollution from smoke belching equipment may also occur. This issue is considered significant during dry periods. Another potential source of air pollution are large stockpiles of construction materials such as soil and aggregates. Without any mitigating measures, dust generation could be significant during dry periods. This issue is important for the proposed WWTP, since some areas of the site will be excavated for the construction of the WWTP tanks.

53. **Mitigation.** The contractor should be required to perform regular water spraying of the sites during dusty periods in order to reduce the generation of dusts. He will also be required to use equipment that are properly maintained and are not smoke belchers. Covers shall be required for stockpiles that will be left idle for a long time. Covers will prevent dust generation due to wind action. Trucks transporting loose construction materials such as sand, gravel, spoils, and the like shall be provided with tarpaulin cover.

54. **Temporary decrease in effluent quality of existing WWTP.** There are two options in executing the WWTP construction: (i) decommission one polishing pond to be used for the new WWTP layout, and (ii) using 0.8–1.2 ha of reclaimed land adjacent to the existing WWTP to avoid decommissioning. .

55. **Mitigation.** For any option requiring partial decommissioning of the existing WWTP, the government will obtain and submit to ADB prior to construction a written permission from the NEC granting temporary waiver of government effluent discharge standards during the time of construction, while ensuring existing effluent discharge levels, in particular biological oxygen demand, are not exceeded. Water quality monitoring will continue during construction. There is a laboratory at the existing WWTP that can handle these tests.

56. **Disposal of existing sludge from ponds.** Sludge from existing ponds to be decommissioned will be removed. Without proper management, this may cause pollution. Unsuitable soil also needs to be removed from the site.

57. **Mitigation.** Sludge from decommissioned ponds shall be hauled and applied to farmlands and/or landfill sites based on government oversight. The plastic liner shall be recovered and sold to interested buyers. Any unsuitable soil of the ponds shall be hauled and applied to farmlands and/or landfill sites.

58. **Oil and other hazardous materials spills.** Heavy equipment and vehicles will be used in the various construction activities for the WWTP subproject. Aside from fuel, oil, and grease, these activities may also involve the use of paints and solvents. There is potential for accidental release of these materials.

59. **Mitigation.** As part of good construction practice, the contractors will be required to implement an awareness program for all workers regarding the prevention and management of spills and proper disposal of used containers. Fuel and oil shall be stored in a designated secured area provided with an impermeable liner to prevent accidental spills from seeping into the ground.

60. **Vehicular traffic congestion and public access.** Construction activities, such as hauling of construction materials, may cause traffic congestion on a highway and may hinder public access. This issue is not considered significant, since the proposed construction of the WWTP is not a large construction activity and the hauling of materials may be scheduled to avoid traffic congestion.

61. **Hazards to public due to construction activities.** Construction activities will be confined to the existing compound of the WWTP. The fence, warnings signs, and construction guards will help keep people away from the site. Hence, this issue is considered insignificant.

62. **Pollution and health risk due to workers' camp.** The contractor is expected to erect temporary workers' camps during construction of the subproject. Improperly managed silt runoff and sanitary wastes from these camps may reach nearby areas. Poor sanitation and lack of

proper solid waste management at the workers' camp will provide the conditions for vermin and other disease vectors to easily multiply and infect the workers. This may lead to the transmission of diseases from the workers' camp to other areas. These conditions will increase public health risk.

63. **Mitigation.** The construction contractor shall be required to: (i) install proper sanitary facilities to prevent the indiscriminate discharge of sanitary wastes at the camps surroundings; (ii) implement proper solid waste management; and (iii) prevent surface runoffs from flowing into the workers' camps to avoid carrying away any contaminants. The contractor shall be required to use temporary diversion drains, catch drains, and silt traps at these camps.

64. **Increase employment opportunities at work sites.** Various construction activities for the WWTP will definitely require a number of workers skilled and non-skilled workers. The impact would be beneficial and significant, since employment opportunities in the area will increase.

65. **Enhancement.** Whenever possible, the contractor shall be encouraged to use available local labor for these construction activities. The recruitment of workers shall be coordinated with the local officials.

66. **Improper closure of construction sites.** Construction activities will generate construction solid wastes after completion of work. This may include used wood materials, steel works cuttings, paint and solvents containers, used oil from equipment, unused aggregates, etc. If not removed from the sites after completion of construction activities, these solid wastes will cause aesthetic problems, and some will be potential sources of contaminants for surface runoffs.

67. **Mitigation.** After completion of work activities, the contractor shall be required to remove the construction wastes from the sites before finally leaving. The entire site must be free of any construction solid wastes. The contractor shall also be required to implement surface restoration.

68. **Occupational health and safety.** Hazards exist in all construction sites in many different forms, such as sharp edges, falling objects, flying sparks, chemicals, noise, and various potentially dangerous situations. Good practice in occupational health and safety requires that employers protect their employees from workplace hazards that can cause injury.

69. **Mitigation.** Contractors shall be required to address the issue on occupational health and safety at the construction sites by: (i) implementing a health and safety plan; (ii) ensuring that an equipped first aid station is available at all times; (iii) providing the workers with potable water and adequate sanitation facilities; (iv) providing the workers with clean eating areas; and (v) providing the workers with personal protective equipment (PPE) to minimize exposure to a variety of hazards.

70. However, establishing and maintaining a safe and healthful work environment requires responsibilities from both the contractors and their workers. In general, contractors are responsible for: (i) performing a "hazard assessment" of the workplace to identify and control physical and health hazards; (ii) identifying and providing appropriate PPE for employees; (iii) training employees in the use and care of the PPE; (iv) maintaining PPE, including replacing worn or damaged PPE; and (v) periodically reviewing, updating, and evaluating the effectiveness of the PPE program. Workers should: (i) properly wear PPE; (ii) attend training

sessions on PPE; (iii) care for, clean, and maintain PPE; and (iv) inform a supervisor of the need to repair or replace a PPE.

C. Operation Phase Environmental Impacts

71. **Discharge of poor quality effluents.** Wastewater treatment plants have the potential to produce low quality effluents that will not comply with effluent regulations. This situation can happen if the proposed WWTP is not operated to its design parameters, and in operational situations that may lead to poor operational performance.

72. **Mitigation.** The WWTP shall be operated according to its design in order to deliver effluent quality satisfying NEC's 2010 Environmental Discharge Standards for sewage treatment. The DBO contractor shall ensure that its plant operators are properly trained in operating the facility and in handling situations that may lead to poor quality effluents. Operating manuals shall be provided to ensure the plant is operated as designed. A pollution prevention program shall also help in ensuring that the proposed WWTP will comply with effluent regulations.

73. Pollution prevention is not producing waste in the first place. It means implementing activities that can reduce the amount and toxicity of waste generated. A pollution prevention program shall be implemented for the proposed WWTP that includes: (i) adopting a preventative maintenance program to predict problems before they occur, rather than reacting to them after an occurrence; (ii) tracking and posting statistical control tools so all employees know at what level the plant is operating, and what optimal operation levels are; (iii) establishing a screening mechanism for purchase of chemicals to evaluate less toxic alternatives; (iv) an emergency plan for handling accidental spills or releases of harmful chemicals; and (iv) evaluating opportunities for energy savings.

74. **Noise and dust pollution of WWTP.** Noise of the WWTP is not an issue during operation, since there will be no significant sources of mechanical noise within the site. Potential sources of noise, such as pumps, blowers, and mounted aerators will be provided with enclosures that provide noise attenuation. There will be no operational activities that will cause dust generation. Mitigating measures are therefore not necessary for noise and dust pollution.

75. **Disposal of sludge from WWTP.** Operation of the WWTP will generate sludge from the aerated and primary treatment units. The sludge has to be removed from the aerated units in order to maintain its design performance. The sludge cannot simply be disposed of without proper treatment, since it may cause land pollution.

76. **Mitigation.** Sludge from the aerated units of the proposed WWTP (MBBR and BAF) shall be directed to an anaerobic sludge digester before being sent to a mechanical sludge dewatering system, while sludge of an IDEAL system will sent directly to the sludge dewatering system. Dewatered sludge shall be hauled and applied to farm lands, landfill sites, or composting areas of TDM.

77. **WWTP's foul odor offsite migration.** Operation of WWTP has the potential for generating foul odor that may be carried offsite. Hence, there is a need to prevent the foul odor from migrating.

78. **Mitigation.** Mitigations shall include the following: (i) provide enclosed building for primary treatment units; (ii) landscaping with trees and shrubs around the facility shall be done

to position them as wind breaks; (iii) close monitoring of the aeration units to ensure the conditions are not anaerobic (without enough oxygen); and (iv) provision of odor control units.

79. **Drowning risk in WWTP tanks and ponds.** The potential for drowning always exists when liquids are stored in large tanks and ponds. Persons and animals falling in the tanks and ponds of the WWTP can drown easily, since these are deep facilities.

80. **Mitigation.** To reduce the risk of drowning in the tanks and ponds, the WWTP shall be: (i) provided with a safety station with a pole, rope, and flotation device in a visible, well-marked location along the berms; (ii) posted with warning signs indicating that the tanks and ponds are deep and that dangers exist; (iii) provided with at least a 5-foot-high fence to keep people and animals away; and (iv) provide security personnel to guard the facility.

81. **Health risk in WWTP operation.** Operation of the WWTP has an associated health risk for the workers and the public, since sewage is an infectious material. It can cause disease if ingested or if it comes in contact with broken skin. Accidents involving sewage spills at the facility can seriously threaten the health and safety of the personnel.

82. **Mitigation.** The public should be kept away from the facility. A 5-foot-high fence shall be provided to keep people away. Utmost care should be taken to avoid sewage spills. Workers shall be trained on health and safety aspects of handling sewage spills at the WWTP. A written health and safety plan for workers shall be prepared for the WWTP operation. The plan shall, among others: (i) clearly identify conditions that may cause acute workers' health and safety problems; (ii) specific requirements that all workers should comply with; (iii) include procedure on management of spills; and (iv) specify training requirements for health and safety. All workers should have the authority to stop any work if they observe any unsafe conditions that present imminent danger, particularly injury.

83. **Hazard from unused septic tanks.** Houses in four southern Thimphu local areas of Lungtenphu, Semtokha, Babesa, and Changbangdu, where sewer pipeline networks are already laid under the ongoing ADB supported UIDP 2258-BHU, are not allowed to connect to the sewer pipelines unless the proposed WWTP is commissioned. These houses have their own septic tanks. Upon commissioning of the new WWTP, the houses will then be allowed to connect to the sewer pipeline networks, and there will be no need for their septic tanks. These idle tanks have to be decommissioned in order not to become hazards to the public.

84. **Mitigation.** Decommissioning shall be done by first removing the contents of the tanks. The septage shall be sent to the new WWTP for proper treatment. As soon as the septic tanks are empty, they shall be filled with sand to avoid leaving an empty chamber in the ground.

85. **Increase employment opportunities.** WWTP operation and maintenance will definitely require a number of workers. The impact would be beneficial, since employment opportunities in the area will increase. However, the expected number of workers will be small, since WWTP operation and maintenance is not labor intensive. This impact is therefore considered less significant.

86. **Cumulative effects.** Cumulative effects generally refer to impacts that are additive or interactive in nature, and result from multiple activities over time. In the case of this WWTP subproject, the cumulative effect would be its additional organic and nutrient load to Wang Chhu. The WWTP discharge point is downstream of this river, which originates upstream of Thimphu and flows down through the city. The river receives organic and nutrient load from the built-up areas of Thimphu, since the city drains to this river. However, the additional loadings

from the WWTP would be of acceptable levels and can easily be handled by the river's assimilative capacity. The WWTP is design to consistently produce effluent of good quality. The WWTP's cumulative effect on the river's water quality is therefore not an issue.

87. After screening, Table 3 lists the environmental impacts and risks that requires mitigation and shall be carried to the EMP section.

Table 3: Environmental Impacts and Risks for Inclusion in EMP of WWTP Subproject

Environmental Impacts and Risks	Without Mitigation	With Mitigation
PRECONSTRUCTION PHASE		
Potential damage to historical areas and cultural areas	Δ -	Δ
Potential nuisance and problems to the public	● -	Δ
CONSTRUCTION PHASE		
Soil erosion and sediments of construction sites	● -	Δ
Noise from construction equipment	● -	Δ
Local air pollution due to construction activities	● -	Δ
Temporary decrease of effluent quality	● -	Δ
Disposal of existing sludge from ponds	● -	Δ
Oil and other hazardous materials releases	● -	Δ
Pollution and health risk due to workers' camp	● -	Δ
Occupational health and safety at work sites	● -	Δ
Increase employment opportunity in work sites	● +	● +
Improper closure of construction sites	● -	Δ
OPERATION AND MAINTENANCE PHASE		
Discharge of poor quality effluents	● -	Δ
Disposal of sludge from WWTP	● -	Δ
WWTP foul odor offsite migration	● -	Δ
Drowning risk in WWTP tanks and ponds	● -	Δ
Health risk in WWTP operation	● -	Δ
Hazard from unused septic tanks	● -	Δ

WWTP = wastewater treatment plant

Legend: n.a. = not applicable; Δ = insignificant; ● = significant;

+ = positive; - = negative

VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

88. During the planning phase, TDM has undertaken various activities concerning information disclosure, public consultation, and public participation for its proposed WWTP subproject under UIP. The intent was to achieve a meaningful stakeholders' consultation and ensure subproject success.

89. In the course of conducting the PPTA study, information regarding the proposed WWTP subproject was disclosed to the public during a socioeconomic survey (SES) in July 2011. It was an occasion not only for project disclosure, but also for stakeholder identification and to scope issues and concerns. During the SES, respondent households in Thimphu were informed about the proposed subproject and interviewed for socioeconomic data..

90. **Public consultation.** Last 20 August 2011, TDM conducted an initial public consultation and formally discussed the proposed WWTP subproject with the stakeholders and requested their views. Stakeholders were encouraged to raise their social and environmental issues. Participants included a people's representative, business representative, concerned individuals, TDM PIU, and consultants. Stakeholders expressed support for the proposed

WWTP subproject. A summary of the consultation outcomes is presented in Table 4, while the documentation is presented in the appendixes.

91. **Future disclosure and consultations.** A continuing process of public consultation and information disclosure shall be advocated. During detailed design, TDM's PIU shall again conduct public consultations and information disclosure. Views of the stakeholders will be considered in the overall design process. Stakeholders' consultations shall be continued throughout the duration of the construction. The PIU shall keep records of environmental and social complaints received during consultations, field visits, informal discussions, and/or formal letters, together with the subsequent follow-up and resolutions of issues. A consultation and participation plan is also part of the project, and will be implemented by the PMU.

Table 4: Summary of Consultation Outcomes

Group Represented	Issues/ Concerns Raised	Project's Response
Business group	What about those houses that will not be connected to the new sewerage system?	Some areas will have their own sewerage system in the future, since as of now there are not enough funds to cover all areas.
Business group	How will the new WWTP address the odor problem, since the previous consultants of the existing WWTP gave assurance to the government that the WWTP would not emit a foul odor, but it did?	The various WWTP options have odor control units.
Lungtenphu area	The future the capacity of the proposed WWTP might not be adequate, due to more migration into the area.	Space of the existing WWTP, to be decommissioned, shall be used in the future for additional capacity of another WWTP.
Concerned citizens	What might be built in the future might be the same as the existing WWTP, and will surely create the same problem about odor.	Option for treatment has not been decided since the proposed WWTP will be implemented through a design-build-operate scheme. Nevertheless, all the proposed options have been tried in several cities of developed countries.

WWTP = Wastewater treatment plant.

VII. GRIEVANCE REDRESS MECHANISM

92. Local grievance redress mechanism (GRM) is important in the implementation of the proposed Thimphu WWTP subproject, since any complaints and concerns of the affected people must be addressed promptly, at no costs to the complainant, and without retribution. This mechanism shall be disclosed in public consultations during detailed design and in meetings during construction. Complaints about the environmental performance of the subproject during the construction phase can best be handled at various levels, including by an ad hoc construction complaints committee (CCC) formed for the expeditious resolution of the complaints.

93. **First level GRM.** An expeditious resolution to most grievances during construction can easily be handled by the contractors' representatives at the construction site, and whenever necessary, together with the construction supervision consultants. At this first level, the grievance should be resolved within 2 days maximum. If the complaint is not resolved at this level, the complainant may elevate his grievances to the second level GRM, which is the ad hoc CCC.

94. **Second level GRM.** Thimphu shall form the ad hoc CCC to be chaired by its PIU head. Members shall include the following: (i) contractor's highest official at the site such as construction manager or construction superintendent; (ii) the elected people's representative of

the WWTP area, the Thuemi; and (iii) the PIU head. Creation of the ad hoc CCC and its operation shall be included in appropriate sections of the civil works contract. Expedient resolution of complaints during construction is important, since activities are sometimes continuous and can easily change the landscapes within a week. For the quick filing of complaints, the CCC shall prepare a form to be used for the filing of grievances and complaints. The use of the form will also facilitate the filing of complaints by illiterate persons through the assistance of another person.

95. The steps to be followed in filing complaints and the procedures for redress are the following: (i) complainant shall provide the background and file the complaint verbally or in writing to the CCC, and the CCC secretary shall assist the complainant in filling up the complaint form; (ii) within 2 working days, the Thimphu PIU head, contractor's representative, and complainant shall discuss if the complaint can be resolved without calling for a CCC meeting; (iii) if the complaint cannot be resolved by the PIU head and contractor's representative, a CCC meeting shall be called with the complainant to resolve the complaint within 5 working days.

96. **Third and fourth level GRMs.** If the complaint cannot be resolved at the CCC, the complainant has the option to first raise the issue to the Mayor of Thimphu (third level GRM), and if the complaint cannot be resolved at the Mayor's level, the complainant shall seek recourse with the courts.

97. **Complaints to NEC.** Complaints about environmental performance of the WWTP during operation may be brought to the attention of the NEC.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

98. This section addresses the need for mitigation and management measures for the WWTP subproject. Information includes: (i) mitigating measures to be implemented, (ii) required monitoring associated with the mitigating measures, and (iii) implementation arrangement. Institutional set-up is presented in the implementation arrangement, and discusses the roles during implementation and the required monitoring. It also outlines the requirements and responsibilities during preconstruction, construction, and operation.

A. Environmental Mitigation

99. Table 5 presents the information on: (i) required measures for each environmental impact that requires mitigation; (ii) locations where the measures apply; (iii) associated cost; and (iv) responsibility for implementing the measures. Details of mitigating measures are already discussed in Section V, where the need for mitigation of each impact was determined in the screening process. Costs for mitigations during the preconstruction, construction, and operation phases are part of the detailed design cost, construction contracts, TDM operation, and maintenance costs, respectively.

Table 5: Environmental Mitigation Plan of WWTP Subproject

Project Activity	Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Location	Mitigation Cost	Responsibility Implementation/ Supervision
PRECONSTRUCTION PHASE					
Conduct a flood and hydrology study (using	Upstream flooding	Confirm that the height of the existing gabion walls at the lagoon site and the proposed wall design of the	WWTP site	Part of PMC and DMSC	PMU/PIU

Project Activity	Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Location	Mitigation Cost	Responsibility Implementation/ Supervision
statistical methods if necessary) to confirm 50- and 100-year flood levels.		new WWTP are adequate to ensure a 1-m freeboard during the maximum design flood height.			
Narrowing of the channel downstream	Upstream flooding	No narrowing of the channel downstream through fill and reclamation activities within 2 km downstream from the new WWTP site, or other distance as recommended by the hydrological studies	WWTP site	Part of PMC and DMSC	PMU/PIU
Ensure that the selected WWTP technology complies with Bhutan's effluent discharge standards.	Poor discharge not compliant with standards	Technology to meet effluent discharge standard. Ensure that for any option requiring partial decommissioning of the existing WWTP, the government will obtain and submit to ADB prior to construction a written permission from the National Environmental Commission (NEC) granting temporary waiver of government effluent discharge standards during the time of construction, while ensuring existing effluent discharge levels, in particular biological oxygen demand, are not exceeded.	WWTP site	Part of PMC and DMSC	PMU/PIU
Final IEE	IEE not adequate	The draft IEE prepared by the PPTA during the feasibility stage will be updated and reviewed by ADB at time of detailed design.	NA	Part of PMC and DMSC	PMU/PIU
Excavation requirements	Potential damage to archaeological and cultural assets	Tender documents shall include a provision that will require construction activities to be stopped immediately upon discovery of any archaeological and cultural relics, and authorities will be informed promptly.	WWTP site	Part of detailed design cost	PIU, design consultants/PMU
Social and community concerns	Potential nuisance and problems to the public	Consultation with the affected communities regarding the expected impacts and proposed mitigation measures of the project; Tender documents shall include provisions addressing the potential nuisances and problems to the public during construction phase	Access route to WWTP	Part of detailed design cost	PIU, design consultants/PMU
CONSTRUCTION PHASE					

Project Activity	Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Location	Mitigation Cost	Responsibility Implementation/ Supervision
Civil works	Soil erosion and sediments of construction sites during rainy periods	Total area exposed shall be minimized; use of temporary diversion drains, silt fence, and catch drains at work sites; containment/retaining wall during the filling process for the reclamation area	WWTP site	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Nuisance from noise of construction equipment	Consultation with affected areas; not to operate noisy equipment during nighttime (9 p.m.–6 a.m.); sound suppression for equipment; ear plugs for workers	WWTP site	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Air pollution due to construction activities	Water spraying for dust control; construction materials with potential for significant dust generation shall be covered; no smoke belching equipment	WWTP site	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Temporary decrease in effluent quality of existing WWTP	For any option requiring partial decommissioning of the existing WWTP, the government will obtain and submit to ADB prior to construction a written permission from NEC granting temporary waiver of government effluent discharge standards during the time of construction, while ensuring existing effluent discharge levels, in particular biological oxygen demand, are not exceeded	WWTP site	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Disposal of sludge from existing ponds	Hauling and burying of sludge and unsuitable soil in farm lands/landfill; recovery of plastic liner and selling to interested buyer	WWTP site	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Oil and other hazardous materials spills	Awareness program of contractor's workers for preventing release of materials; fuel/oil in secured area provided with impermeable liner to contain spills	WWTP site	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Pollution and health risks due to workers' camp	Proper camp sanitation; installation of sanitary facilities; solid waste management; surface runoff control	Workers' camp	Incorporated in construction contract	Contractor/ TDM's PIU, supervision consultants
Civil works	Increase employment opportunities	Contractor required to give preference to local labor; workers recruitment to be coordinated with local officials	WWTP site	No cost	Contractor/ TDM's PIU, supervision consultants
Rehabilitation and closure of	Improper closure of	Removal of all construction wastes and implement	WWTP site	Incorporated in	Contractor/ TDM's PIU,

Project Activity	Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Location	Mitigation Cost	Responsibility Implementation/ Supervision
construction sites	construction sites	surface restoration		construction contract	supervision consultants
OPERATION PHASE					
Wastewater treatment	Discharge of poor quality effluent	Operate WWTP according to design parameters; DBO contractor shall ensure that its operators are properly trained, including in handling of operational situations that may produce poor effluent quality; provision of plant operating manuals; implementation of a pollution prevention program	WWTP	Part of capital, operation and maintenance costs	TDM/ NEC
Wastewater treatment	WWTP sludge disposal	WWTP is provided with a sludge digester system and mechanical sludge dewatering system; dewatered sludge to be applied to farm lands, landfill, or composting area of TDM	WWTP	Part of capital, operation and maintenance costs	TDM/ NEC
Wastewater treatment	WWTP foul odor offsite migration	Provide building enclosure for the primary treatment units; trees and shrubs as windbreaks; close monitoring of aeration units to ensure conditions are not anaerobic (without enough oxygen); provision of odor control units	Perimeter of WWTP	Part of capital, operation and maintenance costs	TDM/NEC
Wastewater treatment	Drowning risk in WWTP tanks and ponds	WWTP to be provided with safety station, warning signs, and 5-foot-high fence	WWTP	Part of capital, operation and maintenance costs	TDM/ NEC
Wastewater treatment	Health risk in WWTP operation	Health safety plan; workers trained in health and safety; 5-foot-high fence	WWTP	Part of capital, operation and maintenance costs	TDM/ NEC
Unused septic tanks upon connection of houses to new sewerage system	Hazard of unused septic tanks	Decommissioning of septic tanks by hauling the septage to the new WWTP for proper treatment. Empty tanks shall be filled with sand to avoid leaving an empty chamber in the ground.	Houses to be connected to the new sewerage system	Hauling the septage and sand filling part of TDM's operational cost	TDM

ADB = Asian Development Bank, DSMC = Design Supervision and Management Consultant, IEE = Initial Environmental Examination, NEC = National Environment Commission, PIU = Project Implementation Unit, PMU = Project Management Unit, PPTA = project preparation technical assistance, TDM = Thimphu District Municipality, WWTP = Wastewater Treatment Plant.

100. Although details of the required mitigating measures are already discussed in the screening for impacts, the following items are discussed further to highlight their importance: (i)

tender documents and construction contracts, (ii) contractor's environmental management plan, (iii) WWTP's operating plan, and (iv) unanticipated environmental impacts.

101. Tender documents and construction contracts. Environmentally responsible procurement advocates the inclusion in construction contract documents of provisions addressing the management of environmental impacts and risk during construction. This includes the contractor's submittal of a CEMP and site management plan. Tender documents and construction contracts shall therefore include environmental management provisions on the following issues: (i) erosion and sediment runoff, (ii) noise and dust, (iii) vehicular traffic, (iv) construction wastes, (v) oil and fuel spillages, (vi) construction camps, and (vii) public safety and convenience.

102. Contractor's EMP. During construction, each contractor will be guided by its detailed contractor's EMP (CEMP). This shall be based on the WWTP subproject's EMP, with details on staff, resources, implementation schedules, and monitoring procedures. The agreed CEMP will be the basis for monitoring by the PMU, PIU, and other monitoring parties. The inclusion of provisions requiring the contractor to submit a CEMP in construction contract documents is important, since the contractor will be legally required to allocate a budget for mitigation measures implementation. The CEMP will allow the PIU's construction supervision engineer to focus on specific items expected from the contractor regarding environmental safeguards on a day-to-day basis. With the CEMP, TDM can easily verify the associated environmental requirements each time the contractor will request approval for work schedules.

103. The CEMP shall be prepared by all contractors before the start of the construction, and shall be approved by TDM's PIU. This requirement shall be included in the construction contracts. It shall provide details on specific items related to the environmental aspects during construction. It shall include specifications on requirements for dust control, erosion and sediment control, avoidance of casual standing water, management of solid wastes, workers' camp sanitation, pollution from oil, grease, fuel spills, and other materials due to the operation of construction machineries, safety and traffic management, avoidance of inconveniences to the public, and air and noise pollution control. It shall also include guidance on the proper design of the construction zone, careful management of stockpiles, vegetation, topsoil, and vehicles and machinery.

104. WWTP operating plan. TDM shall ensure that an operating plan has been prepared prior to the start of the WWTP's operation. This plan shall include, among others, guidelines on how to address the issues on environmental safety, and health and safety of workers.

105. Unanticipated environmental impacts. Where unanticipated environmental impacts become apparent during project implementation, TDM shall prepare a supplementary environmental assessment and EMP to assess the potential impacts, and outline mitigation measures and resources to address those impacts.

B. Environmental Monitoring

106. Table 6 presents information on: (i) aspects or parameters to be monitored; (ii) location where monitoring is applicable; (iii) means of monitoring; (iv) frequency of monitoring; (v) responsibility of compliance monitoring; and (vi) cost of monitoring. The PMU shall prepare quarterly environmental monitoring reports to be submitted to ADB detailing the status of mitigating measures implementation. A sample template for the environmental monitoring report is presented in the appendices

107. **Environmental monitoring cost.** Monitoring cost for preconstruction is minimal cost to the PMU, since this is simply verification by the PMU on whether the EMP is included in tender and contract documents. Construction monitoring cost is minimal cost to the PIU, since it will be their personnel who will do the checking of the construction activities, which is part of their operational costs. Monitoring costs of construction supervision consultants are minimal, since this is also part of their contracts. The cost for GRM is also minimal, since these are only for meetings for resolving complaints and is included in the contractor's contract. During the operation phase, effluent monitoring costs are part of TDM's operational cost, using the existing laboratory of the WWTP. Costs for monitoring of other activities such as sludge disposal, generation of odor, and safety and health issues are minimal costs to TDM, since these are only inspection activities.

Table 6: Environmental Monitoring Plan of WWTP Subproject

Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Implementation Responsibility	Compliance Monitoring Responsibility	Monitoring Cost
PRECONSTRUCTION PHASE						
Conduct a flood and hydrology study (using statistical methods if necessary) to confirm 50–100-year flood levels	WWTP site	Study conducted and designs modified accordingly	Once	Part of PMC and DMSC	PMU/PIU	Part of PMC and DMSC
Narrowing of the channel downstream	WWTP site	Visual inspection Confirmation by TMD	Once	Part of PMC and DMSC	PMU/PIU	Part of PMC and DMSC
Ensure that the selected WWTP technology complies with Bhutan's effluent discharge standards	Poor discharge not compliant with standards	Design specifications	Once	Part of PMC and DMSC	PMU/PIU	Part of PMC and DMSC
Final IEE	PMU office	ADB endorsement of IEE	Once	Part of PMC and DMSC	PMU/PIU	Part of DMSC
Specific provision in tender documents on archeological/cultural relics	Civil works excavations	Verify draft and final documents	Twice – draft and final documents	Design consultants	PMU	Part of project management in detailed design (minimal cost)
Consultation meetings; specific provisions in tender documents on nuisance and problems to public	Access route to WWTP	Verify meetings documentation; verify draft and final documents	After completion of meetings; twice – draft and final documents	PIU, design consultants	PMU	Part of project management in detailed design (minimal cost)
CONSTRUCTION PHASE						
Total area to be exposed; runoff flowing into disturbed sites	WWTP site	Visual inspection of sites; plans verification	Daily during rainy periods	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU
Noise levels not to exceed	WWTP site	Use of sound level	Daily	Contractor	Construction	Part of

Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Implementation Responsibility	Compliance Monitoring Responsibility	Monitoring Cost
55 dB during daytime and 45 dB during nighttime		meter			supervision consultants, PIU	consultant's construction supervision contract; minimal cost to PIU
Dust, covering of stockpiles, smoke belching	WWTP site	Visual inspection of sites	Daily	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU
BOD and suspended solids of existing WWTP discharge	Existing WWTP discharge outfall and 1 km downstream	Laboratory testing of parameters	Weekly for suspended solids; monthly for BOD	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU
Volume of sludge from ponds	Decommissioned ponds of existing WWTP	Visual inspection of ponds	During period of sludge removal	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU
Oil and other hazardous materials spills	WWTP site	Visual inspection of sites	Daily	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU
Sanitary toilets, garbage bins, runoff controls	Workers' camps	Visual inspection of camps	Once before start of construction and once monthly	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU

Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Implementation Responsibility	Compliance Monitoring Responsibility	Monitoring Cost
Construction wastes	WWTP site	Visual inspection of sites	Once before final stage of demobilization	Contractor	Construction supervision consultants, PIU	Part of consultant's construction supervision contract; minimal cost to PIU
Number of local labor employed	WWTP site	Verification of contractor's records	Once a month	Contractor	PIU	No cost
OPERATION PHASE						
NEC 2010 Environmental Discharge Standards: BOD 30 mg/l, TSS 100 mg/l, fecal coliform 1000 MPN/100 ml	WWTP discharge point	Effluent sampling and laboratory tests using the existing laboratory of the WWTP	Twice monthly	TDM	NEC	Part of TDM's operation cost
Trees and shrubs	Perimeter of WWTP	Visual inspection of sites	Once a year	TDM	NEC	Minimal cost to NEC since this is visual inspection only
Safety station, warning signs, and fence	WWTP	Visual inspection of sites	Once a year	TDM	NEC	Minimal cost to NEC since this is visual inspection only
Health safety plan; workers training	WWTP	Verification of plan and operation records	Once a year	TDM	NEC	Minimal cost to NEC since this is visual inspection only
Empty septic tanks	Houses to be connected to the new sewerage system	Visual inspection of sites	Upon connecting of houses to new sewerage system	TDM	NEC	Minimal cost to NEC since this is visual inspection only

DSMC = Design Supervision and Management Consultant, IEE = Initial Environmental Examination, NEC = National Environment Commission, PIU = Project Implementation Unit, PMU = Project Management Unit, TDM = Thimphu District Municipality, WWTP = Wastewater Treatment Plant.

108. **Project performance monitoring.** Project performance monitoring presents the desired outcomes as measurable events by providing parameters or aspects that can be monitored and verified (Table 7). A tendering process advocating environmentally responsible procurement is a desired outcome during the preconstruction phase. This can easily be verified by checking if EMP requirements are incorporated in construction contracts. Desired outcomes of construction phase include effective management of environmental impacts and reduced risk to public. For the operation phase, the WWTP discharges shall meet NEC standards for BOD, COD, suspended solids, pH, oil and grease, and coliform.

Table 7: Project Performance Monitoring of WWTP Subproject

Desired Outcomes	Aspects/Parameters to be Monitored	Means of Monitoring	Frequency	Implementation	Compliance Monitoring	Monitoring Cost
PRECONSTRUCTION						
Detailed design is environmentally responsive	Environmental management plan EMP requirements incorporated in detailed design	Verify detailed design documents; EMP requirements reflected in tender documents	Two reviews: (i) draft detailed design documents and (ii) prior to approval of final documents	PIU, design consultants	PMU	Minimal cost
Tendering process advocates environmentally responsible procurement	EMP requirements incorporated in construction contracts	Verify construction contract documents	Prior to finalization of construction contract documents	PIU	PMU	Minimal cost
CONSTRUCTION PHASE						
Effective management of environmental impacts during construction	Number of public complaints on construction activities	Verification of contractor's records; PIU's coordination with local officials	Once a month	Contractor	Construction supervision consultants, TDM's PIU	Part of consultant's construction supervision contract; minimal cost to TDM's PIU
Reduce risk to public during construction	Number of accidents involving construction activities	Verification of contractor's records; TDM's PIU coordination with local officials	Once a month	Contractor	Construction supervision consultants, PIU, PMU	Part of consultant's construction supervision contract; minimal cost to TDM's PIU
OPERATION PHASE						
WWTP effluents meets NEC standards	NEC 2010 Environmental Discharge Standards: BOD 30 mg/l, TSS 100 mg/l, fecal coliform 1000 MPN/100 ml	Effluent sampling and laboratory test	Quarterly	TDM	NEC	Part of TDM's operation cost (\$15,000 /year)
WWTP operation	Public complaints on WWTP	Verification of operation	Once a year	TDM	NEC	Minimal cost

Desired Outcomes	Aspects/ Parameters to be Monitored	Means of Monitoring	Frequency	Implementation	Compliance Monitoring	Monitoring Cost
acceptable to the public	operation	records				

EMP = environmental management plan, mg/L = milligrams per liter, ml = milliliter, NEC = National Environment Commission, PIU = Project Implementation Unit, PMU = Project Management Unit, TDM = Thimphu District Municipality.

C. Implementation Arrangement

109. This subsection presents the (i) institutional set-up, (ii) implementation schedule, (iii) required clearances and permits, and (iv) capability building

110. **Project management unit (PMU).** The PMU will appoint one staff to oversee the monitoring of environmental safeguards implementation. In general, this staff will oversee contractor's compliance with the environmental management plans, public complaints, PIU environmental monitoring, and reporting to ADB. Specifically the PMU is responsible for the following activities related to environmental safeguards: (i) confirming that IEEs with EMPs are updated, where necessary, by design monitoring supervision consultants (DSMC) in accordance with ADB's Safeguard Policy Statement (SPS, 2009) based on detailed designs, and submitted to ADB for review and approval prior to contract award; (ii) confirming that additional environmental assessment requirements for the WWTP option are conducted as per the EARF, including flood and water quality studies, etc.; (iii) confirming that EMPs are included in the bidding documents and civil works contracts; (iv) ensuring that contractor's EMPs (CEMPs) are prepared by contractors prior to construction and endorsed by PIUs; (v) establishing a system to monitor environmental safeguards of the project, including monitoring the indicators set out in the monitoring plan of the EMP; (vi) facilitating and confirming overall compliance with all government rules and obtaining all required environmental clearances and any other environmental permits prior to contract award; (vii) supervising and providing guidance to the PIUs to properly carry out environmental monitoring and reporting; (viii) reviewing, monitoring, and evaluating the effectiveness with which the CEMPs are implemented, and recommending necessary corrective actions to be taken as necessary; (ix) consolidating quarterly environmental monitoring reports from PIUs and submitting semiannual environmental monitoring reports to ADB; (x) ensuring timely disclosure of final IEE/EMPs in locations and form accessible to the public, and (xi) addressing, recording, and reporting on any grievances brought about through the grievance redress mechanism in a timely manner, as per the IEEs.

111. **Project implementation units (PIU).** The four PIUs will appoint one staff to oversee the monitoring of environmental safeguards implementation. The PIU, with the assistance of DSMC environmental specialists (consultant support), will do the following: (i) ensure the draft IEE/EMP prepared during the feasibility study is updated during detailed design stage, where necessary; (ii) ensure EMPs are included in bidding documents and civil works contracts; (iii) ensure overall compliance with all government rules and obtain all required environmental clearances, as well as any other environmental permits prior to contract award; (iv) oversee implementation of EMP and CEMPs, including environmental monitoring; (v) take corrective actions when necessary to ensure no environmental impacts; (vi) submit quarterly environmental monitoring reports to the PMU, and; (vii) address any grievances brought about through the grievance redress mechanism in a timely manner, as per the IEEs.

112. **Implementation schedule.** As presented in the project description, construction of the WWTP subproject is scheduled to start on Q1 2014 and to be completed on Q1 2017. TDM

shall ensure that construction contract provisions related to the EMP shall be included in the tendering stage in 2013.

113. **Clearances and permits.** Under present environmental regulations in Bhutan, TDM shall apply for an environmental clearance from NEC for the WWTP. TDM shall ensure that it has applied for an environmental clearance by Q1 2012, since the maximum time for EC processing is 1 year.

114. **Capability building.** UIP implementation will be supported by consulting services that include: (i) project management advisory services, including detailed engineering designs, preparation of contract documents, support to construction supervision and quality control; and (ii) institutional development and capacity building for MWHS, the PMU, and the municipalities with subprojects. Cost of the capacity building is included in the overall UIP consulting services.

115. The use of a more advanced mechanical system in a WWTP will be a new experience for TDM. An associated capacity-building program will be necessary for achieving good environmental performance during operation. It shall be implemented to address the proper operation and maintenance of the WWTP.

IX. CONCLUSION AND RECOMMENDATIONS

116. Presently, almost all the wastewater from central and southern Thimphu is conveyed to its sole WWTP in Babesa, southern Thimphu. Its design capacity is already exceeded by the capacity of the available sewerage network in the city. Although the WWTP is well maintained, laboratory tests done in July 2011 showed that the effluents from the WWTP have BOD 47 mg/l and TSS 135 mg/l, values that exceeded the NEC 2010 Environmental Discharge Standards of BOD 30 mg/l and TSS 100 mg/l for sewage treatment plants. Odor generated by this existing WWTP has become a source of frequent complaints. Consequently, the government has made the construction of a new WWTP that will address the issues on adequate treatment capacity, space constraints, and odor nuisance in the surrounding areas its topmost priority. The proposed 14 mld WWTP will address all these issues.

117. The environmental screening process has highlighted the environmental issues and concerns of the proposed WWTP subproject. The screening has considered the fact that the proposed construction activities will be confined in the existing land allocated for sewage treatment, which is presently occupied by the existing WWTP. The proposed WWTP subproject is therefore not a new incursion into an ecologically untouched area.

118. Based on the screening for potential environmental impacts and risks of the proposed WWTP subproject, there are no significant negative environmental impacts and risks that cannot be mitigated. Hence, the proposed WWTP subproject can easily be implemented in an environmentally acceptable manner. There is no need for further environmental assessment study. A full EIA is not warranted and the subproject's environmental classification as category B is deemed appropriate. The IEE shall therefore be finalized as the final environmental assessment document of the proposed WWTP subproject.

119. Implementation of the proposed WWTP subproject is hereby recommended with emphasis on the following: (i) EMP of WWTP subproject shall be included in the design process; (ii) contracts of design consultants shall have provisions requiring the consultants to consider EMP recommendations in the design process; (iii) the tendering process shall advocate environmentally responsible procurement by ensuring the inclusion of EMP provisions

in the bidding and construction contract documents; (iv) contractor's submission of a CEMP shall be included in the construction contract; (v) contract provisions on creation and operation of the grievance redress mechanism shall be included in construction contracts; (vi) DBO contractor shall ensure that his personnel are properly trained in operation and maintenance of the WWTP; (vii) monitoring of health and safety requirements shall be given more importance during implementation to reduce risks to the public and to workers; and (viii) TDM shall continue the process of public consultation and information disclosure during detailed design and construction.

APPENDIX 1: APPLICATION OF ENVIRONMENTAL CLEARANCE UNDER THE REGULATIONS FOR ENVIRONMENTAL CLEARANCE OF PROJECTS (2002)

The following procedures shall apply to the screening of all environmental information by the secretariat or competent authority.

1. Environmental information: During the planning and design of a project, and prior to any irrevocable commitment of resources or funds, the applicant shall submit complete environmental information to either the secretariat or competent authority.
2. Minimum contents of environmental information: The environmental information shall contain a short and concise description of the following elements:
 - (i) the potential adverse effects of the project on the environment, including the direct, indirect, and cumulative effects;
 - (ii) how the project complies with relevant sectoral guidelines or code of best practices, if any, issued by the secretariat or competent authorities;
 - (iii) how the impacts of the project will be avoided, minimized, or reduced; and
 - (iv) the environmental benefits of the project, including how the project will benefit concerned people and use clean and sustainable technologies.
3. Modification of proposal/application: If an applicant intends to make a material change to a project, including an increase in production capacity or the manner of implementing the project after submission of an environmental application, the application shall be treated as a new application.
4. Determination of adequacy of the environmental information: When the secretariat or competent authority receives an application/proposal for the issuance of environmental clearance, it shall communicate its decision to the applicant in writing within the time limit specified in Annex 1. When the competent authority determines that an application is duly completed, it shall accept the application and either proceed with review, if it is a listed project, or forward it to the secretariat for environmental clearance if it is a non-listed project, or falls under Section 17 of this regulation.
5. Public notice of proposal: After receipt of notice that the application is adequate, the applicant must comply with the minimum requirements for public consultation set forth in Sections 31 of this regulation concerning the environmental application only in case of significant projects.
6. Screening decision: The secretariat or competent authority shall screen the application for environmental clearance as per sectoral guidelines and within time limit as per Annex 1. The secretariat or competent authority may issue an environmental clearance for the project on the basis of the environmental application only if the project meets the requirements set forth in Section 25 of this regulation. The environment application may contain terms and conditions consistent with Section 30 of this regulation; otherwise the secretariat or competent authority may ask the applicant to carry out environmental assessment or issue a blanket denial to the project.
7. If the secretariat or competent authority requires an environmental assessment or denies the project, a notice of the decision shall be promptly sent to the applicant.
8. When a decision on the environmental clearance has been taken, the secretariat or the competent authority shall make a public announcement of the decision and make the information available to the public under Article 28 of the EA Act, 2000.

Applicable Time Limits of Processing for Environmental Clearance

Action	Time Limit
Response by secretariat/competent authority on the receipt of application. This is simply an acknowledgement of the receipt of the application.	Within 15 days
Review by the secretariat/competent authorities to assess the adequacy of the application as per government rules and guidelines	1–3 months
Competent authority forwards application to secretariat for non-listed projects and listed projects if it falls under Section 17 of this regulation	Within 15 days
Screening of a project will be undertaken to determine the level of environmental assessment required.	1–3 months
If screening determines that an environmental assessment is required, the level and time frame for the assessment will be determined through negotiations between relevant parties and approved by the secretariat/competent authority.	Time frame to be negotiated
Decision/response on the environmental clearance based on the findings of the environmental assessment report	1–3 months
Public notification on decision by the secretariat/competent authority	Within 15 days
Appeal on the decision	Within 30 days from the date of publication of public notification
On approval of the clearance, a legal undertaking with the proponent of new projects to comply with the EA Act, 2000	10 days–1 month

Note: Applicable time limits are subject to submission of correct and complete information based on applicable government regulations and guidelines.

**APPENDIX 2: PROCEDURES FOR OBTAINING FORESTRY CLEARANCE FROM THE
DEPARTMENT OF FORESTS FOR CLEARING FOREST LAND**

1. Land ownership has to be determined, whether it is government land or private land.
2. If it is government land, the applicant has to make a written application to the Dzongkhag Land Allotment Committee.
3. Once the application is with the committee, the Chairman then writes to all concerned authorities, including NEC, for their consent
4. The committee will then work with the National Land Commission for the registration of the said land in the name of the applicant.
5. After registration, the Forestry Department is supposed to clear the area within 60 days.
6. If the Forestry Department fails to clear the area within 60 days, the applicant has the right to cut down the trees after the forest officials have marked the trees for felling
7. The logs belong to the government, and are to be auctioned.
8. If the land is a private land and has to be acquired, then the procedures for resettlement, land substitution, and compensation shall be followed.

APPENDIX 3: SITE OF PROPOSED WASTEWATER TREATMENT PLANT

Photo No.1 – Existing WWTP area showing maturation pond.
Further north are the anaerobic and facultative ponds.

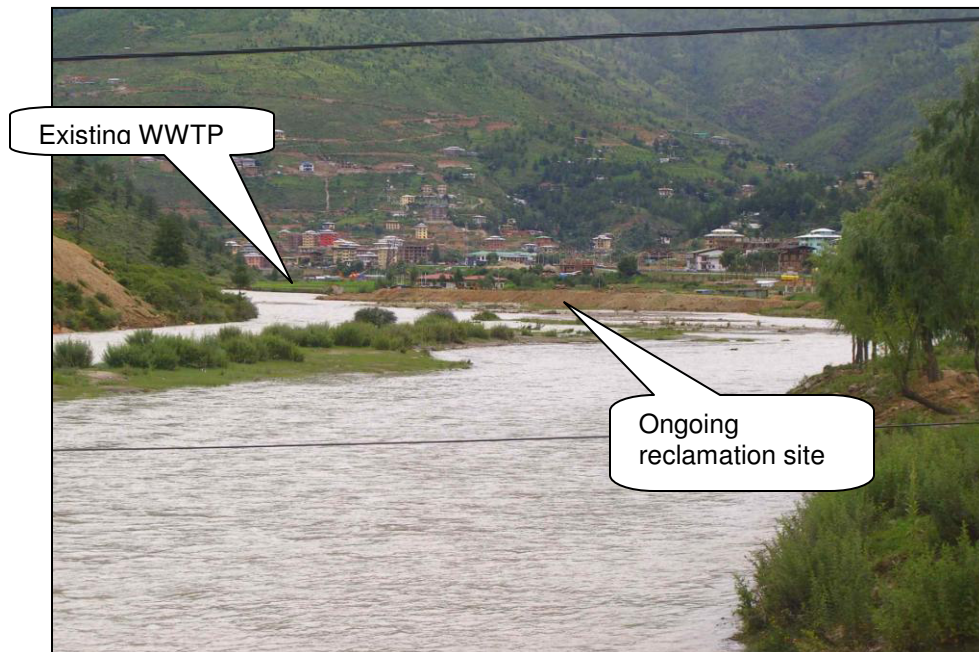


Photo No. 2 – Existing and proposed WWTP site showing the ongoing reclamation area as seen from downstream of Wang Chhu



Photo No. 3 – Area between the ongoing reclamation site and highway, a private property with ongoing construction of buildings



Photo No. 4 – Thimphu-Paro highway cited in Photo No. 3; further on the right side is the existing and proposed WWTP.

APPENDIX 4: MINUTES OF THE PUBLIC CONSULTATION/MEETING HELD AT PIU OFFICE, THIMPHU THROMDE, 20 AUGUST 2011

Opening/ Presentations:

1. PIU project manager of Thimphu District Municipality (TDM) opened the public consultation/meeting at around 10:45 AM a.m. by welcoming everybody and explaining that the purpose of the meeting is was to present the proposed new wastewater treatment plant (WWTP), and to elicit views from the stakeholders regarding the proposal, particularly issues that they may wish to raise.

2. The consultant's wastewater treatment specialist made a presentation of the planning and preliminary design of the proposed WWTP. Three options of the treatment systems were presented, including the land area requirement, difficulty of operation, capital costs, and operating costs. The wastewater treatment specialist explained that the land requirement for this new WWTP will be much less than the existing system. All three options shall have the same primary treatment units with a system for receiving septage from septage trucks. In between presentations, the PIU project manager translated the presentation into the Bhutanese language.

Comments, Views, Issues, and Concerns Raised by Stakeholders

3. Lhendub Dorji, Managing Director of the East-West Construction, asked if the proposed WWTP is designed based on population projection. The wastewater treatment specialist said yes, and proceeded to present the population projection figures.

4. Lhendub Dorji asked about those houses that will not be connected to the new sewerage system. The PIU project manager answered that some areas will have their own sewerage system in the future, since as of now, there are not enough funds to cover all areas.

5. Mr. Kinley, Lungtenphu people's representative, expressed his fear that in the future the capacity of the proposed WWTP might not be adequate due to more migration into the area. The PIU project manager explained that the space of the existing WWTP (to be decommissioned) shall be used in the future for additional capacity of another WWTP.

6. Dasho Chang Ugyen expressed his apprehension that what might be built in the future will be the same as the existing WWTP, and will create the same problem about odor. The PIU project manager answered that it will be a new technology for Bhutan, and has been tried in several cities of developed countries. The PIU project manager explained that at this stage, the option for treatment has not been decided, since the proposed WWTP will be implemented through a design-build-operate scheme.

7. The participants suggested that TDM should also present the proposed project to a larger audience. The PIU project manager answered that this consultation is only an initial one, and TDM will have a consultation with a large group in the future before actual project implementation.

8. Lhendub Dorji asked about how the new WWTP will address the odor problem, since the previous consultants of the existing WWTP gave assurance to the government that the WWTP

would not emit a foul odor, but it did. The wastewater treatment specialist explained that the various WWTP options have odor control units.

9. The stakeholders said that the proposed WWTP's operating expenses are quite high. However, they believed that the people are willing to pay the increase in water tariff if the services for sewerage are provided. The wastewater treatment specialist explained that since the options are intensive systems, the operating expenses will surely be high.

10. The PIU project manager closed the meeting by thanking everyone for their participation in the public consultation.

11. Meeting closed at 12:25 p.m.

APPENDIX 5: LIST OF PARTICIPANTS OF THIMPHU PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

Stakeholders/participants:

- Kinley – Lungtenphu people’s representative
- Dasho Chang Ugyen – public representative
- Lhendub Dorji – Managing Director, East-West Construction




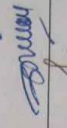
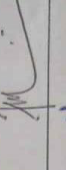
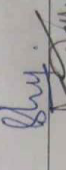



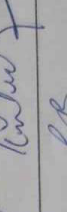
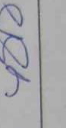
Thimphu Thromde

- Kinley Penjure – Project Manager, PIU Thimphu
- Thuleton Tshering – engineer, PIU
- Peldon – engineer, PIU
- Budha Mani Homagai – engineer, PIU
- Tashi Dorji – engineer, PIU

Consultants

- Ruel Janolino – Environment Specialist, Poyry
- Brace Boyden – Wastewater Treatment Specialist, Poyry
- Angelito Corpuz – Involuntary Resettlement Specialist, Poyry

APPENDIX 6: ATTENDANCE SHEET OF THIMPHU THROMDE PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

ADB TA 7630-BHU: URBAN INFRASTRUCTURE PROJECT LIST OF PUBLIC CONSULTATION PARTICIPANTS PROPOSED WASTEWATER TREATMENT PLANT SUBPROJECT OF THIMPHU CITY				
Consultation Date: 20 AUGUST 2011				
No.	Name	Designation	Organization	Signature
1.	Kinley	City Councillor of Luytenphu (Thromde)	Thimphu Municipality	
2.	Dasho Chang Ugyen	Public Representative	-	
3.	Lhundub Dorji	M.D.	Pvt. Sec.	
4.	Thukten Fshering	Engineer, PIU	Thimphu Municipality	
5.	Peldon	Engineers, PIU	Thimphu Thromde	
6.	Budha Mani Homogai	Engineer, PIU	"	
7.	TASHI DORJI	Engineer, PIU	"	
8.	RUEL JANUOLINO	CONSULTANT	POYRA	
9.	ANGELITO N. CORPUZ	CONSULTANT	"	
10.	Kinley Penjore	Project Manager	Thimphu Thromde	
11.	BH BOYDEN	CONSULTANT	ADB-POYRA	

APPENDIX 7: PHOTOGRAPHS OF THIMPHU PUBLIC CONSULTATION MEETING



Photo No. 5 – PIU Project Manager explaining the purpose of the public consultation meeting, 20 August 2011



Photo No. 6 – A people's representative (Thuemi) raising a point at the public consultation meeting, 20 August 2011



Photo No. 7 – PIU Project Manager explaining some points at public consultation meeting, 20 August 2011



Photo No. 8 – WWTP Treatment Specialist explaining a point at the public consultation meeting, 20 August 2011

APPENDIX 8: SAMPLE CONTENTS FOR ENVIRONMENTAL MONITORING REPORT

A. Summary of EMP Implementation

1. Overall status of EMP implementation
2. Key issues, corrective actions, and any grievances

B. Details of EMP Implementation Status

1. Permissions/consents (list of relevant permits, clearances, etc. and status of obtaining these)
2. Field visits and consultations (sites visited, dates, persons met)
3. Training (nature of training, number of participants, date, location, etc.)
4. Progress of work (percentage physical completion)
5. Design/location/preconstruction stage monitoring
6. Construction stage monitoring
7. Operation stage monitoring
8. Occupational health risks and safety plan for workers
9. Redress of grievances (type of grievance, date, persons, etc.)
10. Corrective actions taken

APPENDIX

Consents

Permissions

Monitoring data (water quality, air quality, etc.)

Photographs

Maps