Initial Environmental Examination

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NEP: Kathmandu Valley Wastewater Management Project − Dhobighat

Package No: KUKL/WW/TP-02

Prepared by the Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited, Ministry of Water Supply, Government of Nepal for the Asian Development Bank.

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CURRENCY EQUIVALENTS

(as of December 2017)

Currency unit	-	Nepalese rupee (NRs/NRe)
NRs1.00	=	$ 0.0097
$1.00	=	NRs 103.33

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

ABBREVIATIONS

ADB	Asian Development Bank
BAP	Bagmati Action Plan
CBP Team	Capacity Building and Public-Private Partnership Support Team
CBS	Central Bureau of Statistics
CASSC	Community Awareness and Safeguard Support Consultants
CEMP	Construction Environmental Management Plan
DBO	Design Build and Operate
DCC	District Coordination Committee
DWEC	District Wage Evaluation Committee
DNI	distribution network improvement
DSC	Design and Supervision Consultant
EA	Executing Agency
EARF	Environmental Assessment and Review Framework
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ENPHO	Environmental and Public Health Organisation
EPA	Environment Protection Act
EPR	Environment Protection Rules
ERP	Emergency Response Plan
HACCPP	Hazard Analysis and Critical Control Point Plan
HH	Household
HPCIDBC	High Powered Committee for Integrated Development of Bagmati Civilization
IEC	information, education and communication
IFC	International Finance Corporation
Lpcd	Liters per capita per day
LPG	liquefied petroleum gas
ICIMOD	International Centre for Integrated Mountain Development
IDA	International Development Assistance
IEE	Initial Environmental Examination
INGO	international nongovernment organization
ICSU	Income Consumer Support Unit
IUCN	International Union for Conservation of Nature
JICA	Japanese International Cooperation Agency
JBIC	Japanese Bank for International Cooperation
KUKL	Kathmandu Upatyaka Khanepani Limited Kathmandu
MoFE	Ministry of Forest and Environment
MoWS	Ministry of Water Supply
VWMPK	Valley Wastewater Management Project Kathmandu
VWSMB	Valley Water Supply Management Board
MSDS	Material Safety Data Sheets
MWSDB	Melamchi Water Supply Development Board
MWSP	Melamchi Water Supply Project
NEWAH	Nepal Water for Health
NGO	Nongovernment organization

NTFP	Non-timber forest product
NTNC	Nepal Trust for Nature Conservation
NWSC	Nepal Water Supply Corporation
OHS	occupational health and safety
PD	Project Director
PID	Project Implementation Directorate
PIU	Project Implementation Unit
PLC	Programmable Logic Controllers
PPE	personal protective equipment
PPP	public-private partnership
PPTA	Project Preparatory Technical Assistance
REA	Rapid Environmental Assessment
RoW	Right of Way
RP	Resettlement Plan
SAPI	Special assistance for project implementation
SPAF	Severely project affected family
SPS	Safeguards Policy Statement
SWC	Social Welfare Council
SWNCC	Social Welfare National Coordination Council
UDLE	Urban development through local efforts
UN	United Nations
UNEP	United Nations Environment Programme
VDC	Village Development Committee
WWTP	Wastewater treatment plant

WEIGHTS AND MEASURES

cm	- centimetre
db	- decibels
ha	- hectare
kg	- kilogram
km	- kilometre
km^2	- square kilometre
l	- litre
m	- meter
$_m2$	- square meter
m^3	- cubic meter
mg/l	- milligrams per litre
ml	- millilitre
MLD	- million litres per day, mega litres per day (1 mega litre = 1000m3)
mm	- millimetre
|jg/m^3	- micrograms per cubic meter

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Executive Summary

1. The proposed Kathmandu Valley Wastewater Management Project (KVWMP) will support the ongoing efforts of the Government of Nepal towards improving the wastewater services in Kathmandu Valley. The project will invest in rehabilitation and expansion of sewerage network, modernization and new construction of wastewater treatment plants, and improvement of wastewater management in Kathmandu Valley, which will complement the past and ongoing Asian Development Bank (ADB) projects.[1] The project is expected to increase operational efficiency, improve service delivery, and result in positive impact on health and quality of life for inhabitants of Kathmandu Valley. ADB requires the consideration of environmental issues in all aspects of its operations as per its Safeguard Policy Statement (SPS 2009). This initial environmental examination (IEE) has been prepared for the modernization and expansion of wastewater treatment plants. This IEE is updated for wastewater treatment plants that will be modernized and expanded under TP-02. The new wastewater treatment plants will be established at Sallaghari, Kodku and Dhobighat under this package.

2. **Categorization.** The project is considered Category B as per the SPS 2009 as no significant impacts are envisioned. This IEE assesses the environmental impacts and provides mitigation and monitoring measures to ensure no significant impacts as a result of the project.

3. **Scope.** The project's expected impact will be sustainable wastewater services for the residents of Kathmandu Valley. The expected outcome will be an improved wastewater collection and treatment system and increased access of wastewater services to the residents of Kathmandu Valley including poor women and men. The project will further consolidate the continuing efforts of the government and ADB in institutional development and improvement of governance in the wastewater sector.

4. **Implementation Arrangements.** The Ministry of Water Supply (MoWS) will be the executing agency responsible for overall strategic planning, guidance, and management of the project, and for ensuring compliance with loan covenants. Kathmandu Upatyaka Khanepani Limited (KUKL) will be the implementing agency, and the existing Project Implementation Directorate (PID) in KUKL will be responsible for (i) project planning, implementation, monitoring, and supervision; (ii) reporting to KUKL Board of Directors, MoWS, and ADB; and (iii) coordination of all activities in the project. PID has already established a safeguards unit staffed with environmental, social, and legal specialists. The PID, KUKL will recruit two consulting firms, design, supervision and management consultant (DSC) and Community Awareness and Safeguard Support Consultant (CASSC) firm. The DSC will have an environmental and social safeguard specialist to facilitate PID in implementation and supervision of safeguards-related works.

[1] Melamchi Water Supply Project (ADB 1820-NEP); Kathmandu Valley Water Supply Improvement Project (ADB 2776-NEP); Bagmati River Basin Improvement Project (ADB PPTA -43448).

5. **Description of the Environment.** The project is located in Kathmandu Valley which is densely populated. The project sites are located in government-owned land. Sallaghari WWTP located in Bhaktapur Municipality/ Ward 2, Kodku WWTP Located in Lalitpur Metropolitan City/ Ward 9 and Dhobighat WWTP located in Lalitpur Metropolitan City/ Ward 4. There are no protected areas, wetlands, or estuaries in or near the subproject location. Trees, vegetation, and animals are those which are commonly found in urban areas.

6. The site for Sallaghari WWTP is at 300-meter upstream form confluence point for Khasyang Khusung Khola and Hanumante river where Bhaktapur road and Nagarkot road intersect. The geographical coordinate is 27° 40’ 26.3” N, 85° 24’ 33” E.

7. The site for Kodku WWTP is located at left bank of Hanumante river in Balkumari area. The geographical coordinate is 27° 40’ 27” N, 85° 20’ 13” E near Balkumari temple and Balkmari Ghat.

8. The site of Dhobighat WWTP is located at left bank of Bagmati River in Lalitpur city in Kathmandu valley. Dhobighat temple and Sundarighat solar farm is near the site and geographic coordinates are 27° 40’ 36” N, 85° 17’ 55” E.

9. **Environmental Management.** An Environmental Management Plan (EMP) is included as part of this IEE. It will guide all stakeholders including PID, KUKL, DSC and contractors in the environmentally sound design, construction and operation of infrastructure under this project. In particular the EMP (i) recommends the measures and means of testing to be implemented to reduce the likelihood of potential environmental impacts during the design, construction and operation phase of the project; (ii) provides the necessary tools to carry out onsite environmental performance monitoring; (iii) ensures compliance with recommended standards and safety measures; (iv) recommends the public consultation and disclosure procedures; and (v) provides a grievance redress mechanism. The EMP will be included in the civil work bidding and contract documents.

10. Locations and siting of the proposed infrastructures were considered to further reduce impacts. These include (i) locating all facilities on government-owned land to avoid the need for land acquisition and relocation of people; (ii) beautification of remaining adjacent areas maintaining greenery; (iii) significant reduction of odour generated from the sewage disposed.

11. The construction and rehabilitation of WWTPs will be on existing treatment plant sites which are situated close to the residential areas within the Kathmandu valley. Mitigation measures during the design phase of the WWTPs have been included to ensure minimum nuisance to residents pertaining to odour and noise. This includes (i) air quality dispersion modelling for selection of appropriate odour management technologies; and (ii) establishment of tree screens to maintain an appropriate green zone buffer and fencing to restrict public access.

12. Operational and maintenance efficiency of the WWTPs were considered to ensure minimum impact to aquatic and public health. These include (i) WWTP processes designed to meet the prescribed BOD_5 reductions prior to discharge; (ii) operation of the WWTPs using a risk-based approach through the development and implementation of WWTP water safety plans; and (iii) incorporating a long-term

operational and maintenance component embedded in the design, build and operate (DBO) contract.

13. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. Mitigation will be assured by a program of environmental monitoring to be conducted during design, construction and operation phases. The environmental monitoring program will ensure that all measures are implemented and will determine whether the environment is protected as intended. It will include observations on- and off-site, document checks, photographs, monitoring of key parameters and interviews with workers and beneficiaries. Any requirements for corrective action will be reported to the ADB.

14. The stakeholders were involved in developing the IEE through discussions on-site and public consultation, after which views expressed were incorporated into the IEE and in the planning and development of the subproject. Several meetings, workshops, and focus group discussions were held with local residents, stakeholders and technical persons to keep them informed of the project and to get their feedback for the project design, as required. To provide for more transparency in planning, and for further active involvement of key stakeholders including the general public, the project information will be disseminated through disclosure of the translated versions of the IEE. The information will be made available at public places, including the offices of PID, KUKL main office and branch offices, and the Kathmandu Metropolitan City, Lalitpur Metropolitan City, Madhyapur Thimi Municipality, and Bhaktapur Municipality Offices. A copy of the updated IEE will be disclosed on the ADB and project-related websites and will also be available from PID upon request.

15. The most noticeable long-term benefit of the project will be the improved wastewater management system in Kathmandu Valley which will in turn improve the water quality of the rivers overtime and safeguard public health.

16. **Consultation, Disclosure and Grievance Redress.** Public consultations and disclosures will be continuous in the future during the design, construction and operation phases. The CASSC with the help of the Safeguard unit of PID will be responsible for the public consultations and information disclosures also during the time of project construction. Grievances will be addressed by the grievance redress mechanism, which incorporates a clear and grassroots process for addressing public complaints quickly.

17. **Monitoring and Reporting.** The safeguards staff within the PID will monitor the implementation of the EMP with support from the DSC and CASSC. The DSC Environmental Safeguards Officer will prepare quarterly progress reports and submit to PID and PID will prepare semi-annual monitoring reports and submit to ADB. ADB will post the environmental monitoring reports on its website. These reports will describe the progress of the implementation of the EMP, any compliance issues and corrective actions.

18. **Conclusion and Recommendations.** Overall the potential impacts of the project will be very positive, benefitting both the environment and the people. Some negative impacts are anticipated during implementation, but in specific areas and for a short duration (e.g., dust, noise, traffic problems, etc.). It is expected that these environmental impacts of the project will in general not be significant and can be reduced and/ or

prevented through adequate mitigation measures and regular monitoring during the design, construction, and operation phases of the project. Any potential odour nuisance will be assessed through air quality dispersion modelling during the design phase of the WWTPs and appropriate measures will be implemented to mitigate the nuisance. Based on the findings of the IEE, there are no significant environmental impacts, and the classification of the project as category B is confirmed, and no further special study or detailed environmental impact assessment (EIA) needs to be undertaken to comply with ADB SPS (2009).

I. INTRODUCTION

A. Purpose of the Report

19. The proposed Kathmandu Valley Wastewater Management Project (KVWMP) will support the ongoing efforts of the Government of Nepal towards improving the wastewater services in Kathmandu Valley. The project will invest in rehabilitation and expansion of sewerage network, modernization and new construction of wastewater treatment plants, and improvement of wastewater management in Kathmandu Valley, which will complement the past and ongoing Asian Development Bank (ADB) projects. The project is expected to increase operational efficiency, improve service delivery, and result in positive impact on health and quality of life for inhabitants of Kathmandu Valley.

20. The project has the ultimate objectives of:

(i) modernizing, expanding, and constructing wastewater treatment plants (WWTPs); and
(ii) supporting operational and financial improvements and capacity building.

21. The purpose of this initial environmental examination (IEE) is (i) to provide information on existing geographic, ecological, social and temporal context including associated facilities with the package (TP-01) area of influence, (ii) to find out the likely positive and negative direct and indirect impacts to physical, biological, socioeconomic and physical cultural resources in the package area of influence, (iii) identify mitigation measures and any negative impacts that should be mitigated during planning, implementation and operation, (iv) to establish Grievance Redress Mechanism for resolving environmental issues, (v) to describe the monitoring measures and reporting procedures to ensure early detection conditions that require particular mitigation measures, (vi) to describe the process undertaking during project design to engage stakeholders and affected persons and the planned information disclosure measures and the process of carrying out consultation with affected people and facilitating their participation during project implementation, (vii) to identify who is responsible for carrying out the mitigation and monitoring measures.

22. The mitigation measures are then carried forward into the Environmental Management Plan (EMP). The EMP assigns responsibilities, time frames, and performance indicators or standards for each mitigation measure to make sure that it is implemented. An environmental monitoring plan is also prepared. This monitoring plan identifies methods and responsibilities for checking the operation of the project against a range of relevant and agreed performance indicators.

B. Basis and Scope of the IEE

23. Both Nepal's law and the ADB policy require that the environmental impacts of development projects are identified and assessed as part of the planning and design processes, and that action is taken to reduce adverse impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of project development and implementation worldwide. This IEE is updated for wastewater treatment plant facilities that will be modernized, expanded and new construction under contract number TP-02. The new wastewater treatment plants will be established at Sallaghari, Kodku and Dhobighat under TP-02.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

24. The Safeguard Policy Statement (SPS, 2009) of ADB stipulates addressing environmental concerns, if any, of a proposed activity in the initial stages of project preparation. For this, ADB categorizes the proposed components into categories (A, B, or C) to determine the level of environmental assessment required to address the potential impacts. The project has been categorized as B. This IEE has been prepared to address the potential impacts, in line with the recommended IEE content and structure for category B projects. Stakeholder consultation was an integral part of the IEE. An EMP outlining the environmental measures to be adhered to during implementation of the project has also been prepared. The EMP will form part of the bidding and contract documents for civil work.

25. ADB's environmental safeguards policy principles are defined in SPS, 2009, Safeguard Requirements 1 and the IEE is intended to meet these requirements **Error! Reference source not found.**

Table II-1: ADB SPS 2009 Safeguard requirements

SPS 2009 - Safeguard Requirements	Remarks
Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment (EA) so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.	REA has been undertaken (Appendix 1), indicating that subproject is NOT: (i) environmentally critical; and (ii) adjacent to or within environmentally sensitive/critical area.
SPS 2009 - Safeguard Requirements	Secondary influence areas. Significant adverse impacts during construction will be temporary and short-term, can be mitigated without difficulty. There is no adverse impact during operation. Hence, IEE is sufficient. The IEE including specific description of the environment and corridor of impact will be updated as necessary based on the final design and alignments.
Conduct EA to identify potential direct, indirect, cumulative, & induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential trans boundary global impacts, including climate change.	IEE has been undertaken to meet this requirement. (Section V). No transboundary & global impacts, including climate change.
Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.	Analysis of "with-subproject "or "without subproject" is not considered because the proposed project is modernization and improvement of existing facility.

Avoid, and where avoidance is not possible, minimize, mitigate, &/or offset adverse impacts and enhance positive impacts by means of environmental planning & management. Prepare an EMP that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.	An EMP has been prepared to address this requirement. Section VIII
Carry out meaningful consultation with affected people & facilitate their informed participation. Ensure women's participation. Involve stakeholders, including affected people & concerned NGOs, early in the project preparation process & ensure that their views & concerns are made known to & understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to EA. Establish a GRM to receive & facilitate resolution of affected people's concerns & grievances on project's environmental performance.	Key informant and random interviews have been conducted (Appendix 7). A grievance redress mechanism for the resolution of valid project-related social and environmental issues/concerns is presented in Section VII.
Disclose a draft IEE (including the EMP) in a timely manner, before project appraisal, in an accessible place & in a form & language(s) understandable to affected people & other stakeholders. Disclose the final EA, & its updates if any, to affected people & other stakeholders.	The draft IEE will be disclosed on ADB's website prior to project appraisal. Copies of both SPS-compliant IEE and Government of Nepal-approved IEE will be made available at the offices of the PMO, Project Implementation Support Unit (PISU) and Water Users' and Sanitation Committee (WUSC)for public consultation. For the benefit of the community, the summary of the IEE will be translated in the local language and made available at (i) offices of executing and implementing agencies, (ii) area offices, (iii) consultant teams' offices; and (iv) contractor's campsites. It will be ensured that the hard copies of IEE are kept at places which are conveniently accessible to people, as a means to disclose the document and at the same time creating wider public awareness. An electronic version of the IEE will be placed in the official website of executing and implementing agencies and the ADB website after approval of the IEE by ADB.
Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.	EMP implementation, reporting and disclosure of monitoring reports are in this IEE.

Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.	The subproject does not encroach into areas of critical habitats.
Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.	This requirement is only minimally applicable to the subproject in the aspect of waste generation, e.g., effluent from septic tanks and generated sludge and sludge disposal from water supply and sanitation structures. The subproject will not involve hazardous materials subject to international bans/phase outs.
Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.	EMP provides measures to mitigate health and safety hazards during construction and operation.
Conserve physical cultural resources and avoid destroying or damaging them by using field- based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.	The subproject will not affect any physical cultural resource. The EMP recommends the measure/s to mitigate adverse impact on physical cultural resources (PCRs) in case of chance find.

B. National Law and Rules

26. The requirement for environmental assessment in Nepal is established by the National Environment Protection Act (1997). The procedures are defined in the Environment Protection Rules, as amended. These rules require IEE for sewerage projects costing more than NRs. 50 lakhs. The Government's Urban Environmental Management Directive (2011) sets the standards for wastewater effluents (Appendix 3).

27. The legal provisions for environmental protection in Nepal are found in different laws and regulations. Nepal is also a signatory to many international agreements and conventions related to environmental conservation such as

(i) Plant Protection Agreement for Asia and the Pacific Region, 1956
(ii) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973
(iii) Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), 1972
(iv) International Tropical Timber Agreement, 1983
(v) Convention on Biological Diversity, 1992

C. Policies and Legal Framework of KUKL

28. The Government of Nepal remains fully committed to providing safe drinking water and sanitation services--considered as a fundamental human need and a basic human right--for all of its citizens. The Government is committed to providing improved water supply and sanitation services of medium and higher levels commensurate to the capacity to pay of the served populations. In the 1990s, political liberalization and a focus on decentralization saw important new actors in the sector emerge, namely the community groups, local governments, and the private sector, including nongovernment organizations (NGOs). However, the ever-growing urban population and increasing water demand has been placing a strain on the existing urban water supply and sanitation services. There have been a number of efforts to streamline planning and investment in the sector. Some of the major efforts are examined below.

29. The National Urban Policy (2007) highlights the historical imbalances and haphazard nature of urban development in Nepal. It views urban centres as catalysts of economic development linked to north-south and east-west access corridors. The policy also flags poor sanitation, environmental degradation, and lack of services by the urban poor as requiring urgent attention. It proposes the building of capacity of municipalities to plan and manage integrated local development activities, including the preparation of urban master plans to be moderated by central and regional authorities. Private sector involvement and investment in infrastructure development is specifically sought.

30. The National Urban Water Supply and Sanitation Sector Policy (2009) was formulated to provide the overall policy support and guidance toward achieving equity in service delivery by ensuring that the financially marginalized households within the service areas are mainstreamed as valid customers through the design and implementation of financial incentives, where required.

31. The Local Governance Operationalization Act, 2074 (2017) provides the legal basis for the devolution of responsibilities and authorities for social, economic, institutional, and physical infrastructure development, including water and sanitation systems, to the local government. While periodic district plans have been formulated in

52 districts, a decade-long political conflict, including the absence of locally elected officials for most of this period, have frustrated implementation plans.

32. The Nepal Water Supply Corporation Act (2007), as amended, Water Supply Management Board Act (2006), and Water Supply Tariff Fixation Commission Act (2006) have facilitated the improved management of Kathmandu Valley's water and sanitation services. They established the legal basis for private sector management of water supply and independent tariff setting and regulations that are applicable to all urban areas.

33. Nepal's procedures for environmental assessment of development projects are described in the Environment Protection Act (1997) and the Environment Protection Rules (1997), as amended). Projects that need EIA and IEE are identified in the rules. Accordingly, the responsibility for undertaking an IEE for this proposed project lies with the Kathmandu Upatyaka Khanepani Limited (KUKL/Project Implementation Directorate (PID) as the project proponent, on behalf of the Kathmandu Valley Water Supply Management Board (KVWSMB). Public involvement, including notification of stakeholders, dissemination of information, and consultation, is a requirement, particularly during the review and approval of the IEE report.

III. DESCRIPTION OF THE PROJECT

A. Existing Situation

34. The wastewater service area is smaller than the KUKL water service area as it only includes the municipalities of Kathmandu, Lalitpur, Bhaktapur, and Madhyapur-Thimi. The water service area covers a number of municipalities within the valley. Wastewater services will logically be required in all urban areas of municipalities. There is strong correlation between this study area and the zones adopted in the Bagmati Action Plan. Based on the population census in 2011, the adopted population for the urban wastewater area was 2,510,788 million, inclusive of the permanent and other population categories.

35. There are only five major wastewater treatment plants (WWTP) in Kathmandu Valley. Table III-1 presents a snapshot of these plants.

Table III-1: Snapshot of existing centralized WWTPs

Parameter	WWTP		
	Sallaghari	Kodku	Dhobighat
Year established	1983	1982	1982
Reported nominal	2	1.1	15.4
Original supporting agency	GTZ/ Germany	IDA, Engineering Science/ USA	IDA, Engineering Science/ USA
Operator	KUKL	KUKL	KUKL
Type of plant originally installed	Aerated lagoon	Waste stabilization pond	Waste stabilization pond
Catchment served	North & south Bhaktapur	East Lalitpur	Kathmandu and Lalitpur
Existing operation status	treatment significantly below design intentions	treatment significantly below design intentions	Not operational since 1982

HPCIDBC = High Powered Committee for Integrated Development of Bagmati Civilization, IDA = international development assistance, KUKL = Kathmandu Upatyaka Khanepani Limited, MLD = million liters per day, USA = United States of America, WWTP = wastewater treatment plant.

36. The proposed project package TP-02 however comprises modernization and expansion of Sallaghari WWTP, Kodku WWTP and Dhobighat WWTP.

Sallaghari WWTP

37. The total area of Sallaghari WWTP is 3.4 ha situated in ward-2 of Bhaktapur Municipality. It consists of five stabilization ponds. Currently there is a very low influent flow and load because of nil-operation of the south collector and only a small flow

coming from the north collector.

38. Sallaghari WWTP was originally designed as an aerated lagoon, but the aerators were removed many years ago and the water level has been decreased from the original 3.0 m to 0.5 m. Currently, Sallaghari WWTP acts as through-flow reactor having a low detention time with short circuiting and producing vegetation and sludge. During dry weather there is no effluent flow. The site for Sallaghari WWTP is at 300-meter upstream form confluence point for Khasyang Khusung Khola and Hanumante river where Bhaktapur road and Nagarkot road intersect. The geographical coordinate is 27° 40' 26.3" N, 85° 24' 33" E.

Kodku WWTP

39. The total area of Kodku WWTP is 6.5 ha situated in ward-9 of LMC which consisting of four ponds, currently with a relatively low influent flow (1,500 m^3/d) and load (1,000 kgBOD/d). The first two basins were originally anaerobic ponds with 4 meters of water depth. This is no longer the situation and the depth now are only about 0.5 m. The next pond is facultative and the last one is smaller. Disinfection equipment has not been in operation for many years.

40. Kodku WWTP was also originally a stabilization pond having a small sludge drying bed. Kodku WWTP acts as through-flow reactor having a low detention time with short circuiting and producing vegetation and sludge. During dry weather there is no effluent flow. The site for Kodku WWTP is located at left bank of Hanumante river in Balkumari area. The geographical coordinate is 27° 40' 27" N, 85° 20' 13" E near Balkumari temple and Balkmari Ghat.

Dhobighat WWTP

41. The total area of Dhobighat WWTP is 30.4 ha situated in ward-4 of LMC and consisting originally of four stabilization ponds (area totally 19.4 ha). However, the plant has had no influent flow and load since the 1980s because of total non- operation of the Sundarighat pumping station. The treatment plant area is now used for different farming, and recreation and informal purposes as well as being used by KUKL as a storage area for sewer pipes. The site of Dhobighat WWTP is located at left bank of Bagmati River in Lalitpur city in Kathmandu valley. Dhobighat temple and Sundarighat solar farm is near the site and geographic coordinates are 27° 40' 36" N, 85° 17' 55" E.

B. Project Rationale

42. Improvement of wastewater systems are urgently needed in Kathmandu Valley because it is currently suffering from the lack of properly functioning sewerage systems. This project has been designed to raise the quality of the infrastructure and services of selected areas of Kathmandu Valley, thereby increasing the quality of life of the people.

43. Kathmandu Valley has gone through a phase of rapid and unplanned urbanization and industrialization without adequate infrastructure development. To improve the present conditions of the wastewater services in Kathmandu Valley, the Government, with the assistance of ADB, has embarked on a two-pronged improvement strategy that includes capital investments for infrastructure development, i.e. supply augmentation and system improvement, and institutional reforms.

44. Kathmandu Valley is the most densely populated region in Nepal whose population has been increasing rapidly, especially in Kathmandu, the centre of administration, commercial, social, and economic activities. During the last 3 decades, growth in population has been significantly driven by in-migration. The in-migration is largely due to better employment and business opportunities and better educational and medical facilities, but also countrywide insurgency and security concerns in the recent years.

45. The rapid urbanization of Kathmandu Valley has brought negative impacts to its overall development. Water has become scarce as demand exceeds supply. Lack of operational wastewater system facilities has converted the holy Bagmati River into a highly polluted watercourse. Congested and crowded roads have brought hardship to travellers and road junctions have become garbage dumping sites. Despite these negative impacts, the urbanization of the valley has continued at a similar rate over the past 10 years. According to urban planners, from urban basic service management and disaster relief management aspects, Kathmandu Valley has a carrying capacity of only 5 million people.

46. WWTPs will be constructed and rehabilitated within the existing site and the sewerage network improved and expanded. Septage from individual septic tanks for 30% of the households not having access to the sewerage system will be pumped out, transported, and treated together with the sludge from the WWTP for the production of energy.

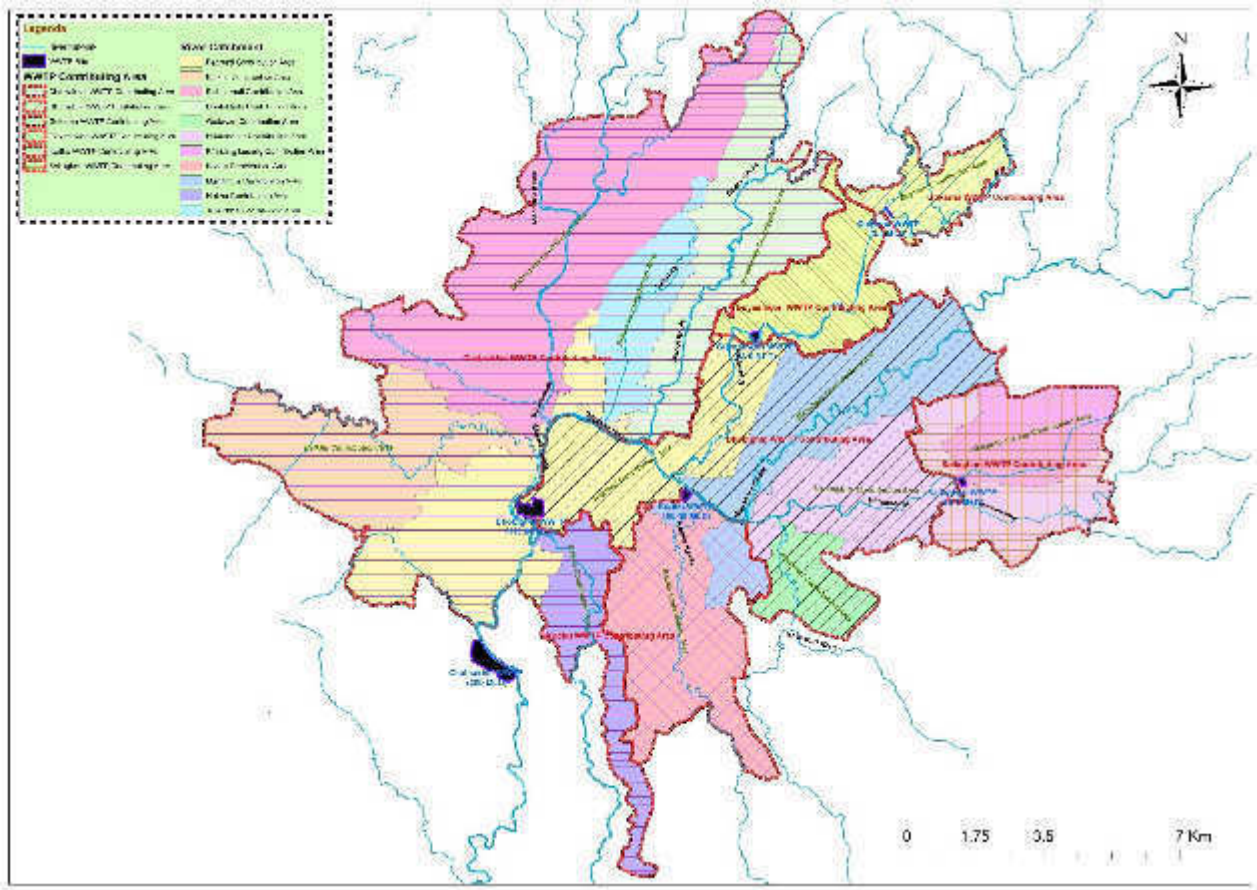


Figure III-1: Proposed WWTP locations and existing natural drainages within the valley.

47. KUKL, which legally commenced operation in February 2008, established a Project Management Unit. The Government and ADB in April 2009 have restructured the unit into a Project Implementation Directorate (PID) to manage and implement ADB-assisted projects. The PID includes a Safeguards Unit to monitor and evaluate all social and environmental aspects of ADB projects.

C. Description of Proposed Project

48. The proposed project includes rehabilitation and construction of wastewater treatment plants of Sallaghari, Kodku and Dhobighat. Further the project will have energy generation of approximately 910 KW through sludge digestion and gasification, etc.

49. The new WWTPs will employ the activated sludge process (ASP). This mechanical process has been selected to ensure operational efficiency and reduce the likelihood of odors. Appropriate ASP technologies (SBR, MBBR, oxidation ditch etc) will be established. Environmental buffer zones (i.e. tree screenings etc) will be established at the new WWTP sites to minimise nuisance to neighbouring residents.

Table III-2: Wastewater Treatment Scenario in Kathmandu Valley in 2020 and 2030.

Wastewater Treatment Plants	**Wastewater to be Treated** (MLD)		**WWTP Area Available** (hectare)	**Effluent Standards** (BOD mg/l)	
	Year 2020	**Year 2030**		**Year 2020**	**Year 2030**
Sallaghari	13.1	13.1	3.4	50.0	30.0
Kodku	7.0	11.2	6.5	50.0	30.0
Dhobighat	39.2	81.6	30.0	50.0	50.0

MLD = million litres per day, WWTP = wastewater treatment plant. *Land still to be acquired.

D. Catchment Area

50. The interceptor sewer collects the wastewater from the sewer networks and conveys the dry weather flow into the treatment plant. The wastewater treatment plants (WWTPs) proposed in the PPTA for this Kathmandu Valley Wastewater Management Project is 4 facilities (Guheswori, Sallaghari, Kodku, Dhobighat, Gokarna WWTP). The capacity of the proposed WWTPs will not be sufficient to treat the quantity of wastewater generated of the service area for the year 2030; WWTP is also planned at Khokana. The flow generated from the respective catchment area will be conveyed in the proposed WWTP location and the flow in excess of WWTP capacity will be diverted to the Khokana WWTP.

51. After consideration of location, topographical condition, route of planned interceptor, the service area has been divided into numbers of macro catchment areas. Boundaries of Sub Catchment Area are same as Master plan except small modification.

52. These catchments have been selected to show the major areas draining to the sewer system, assuming it was functional. The catchment area of in this master plan is as follow.

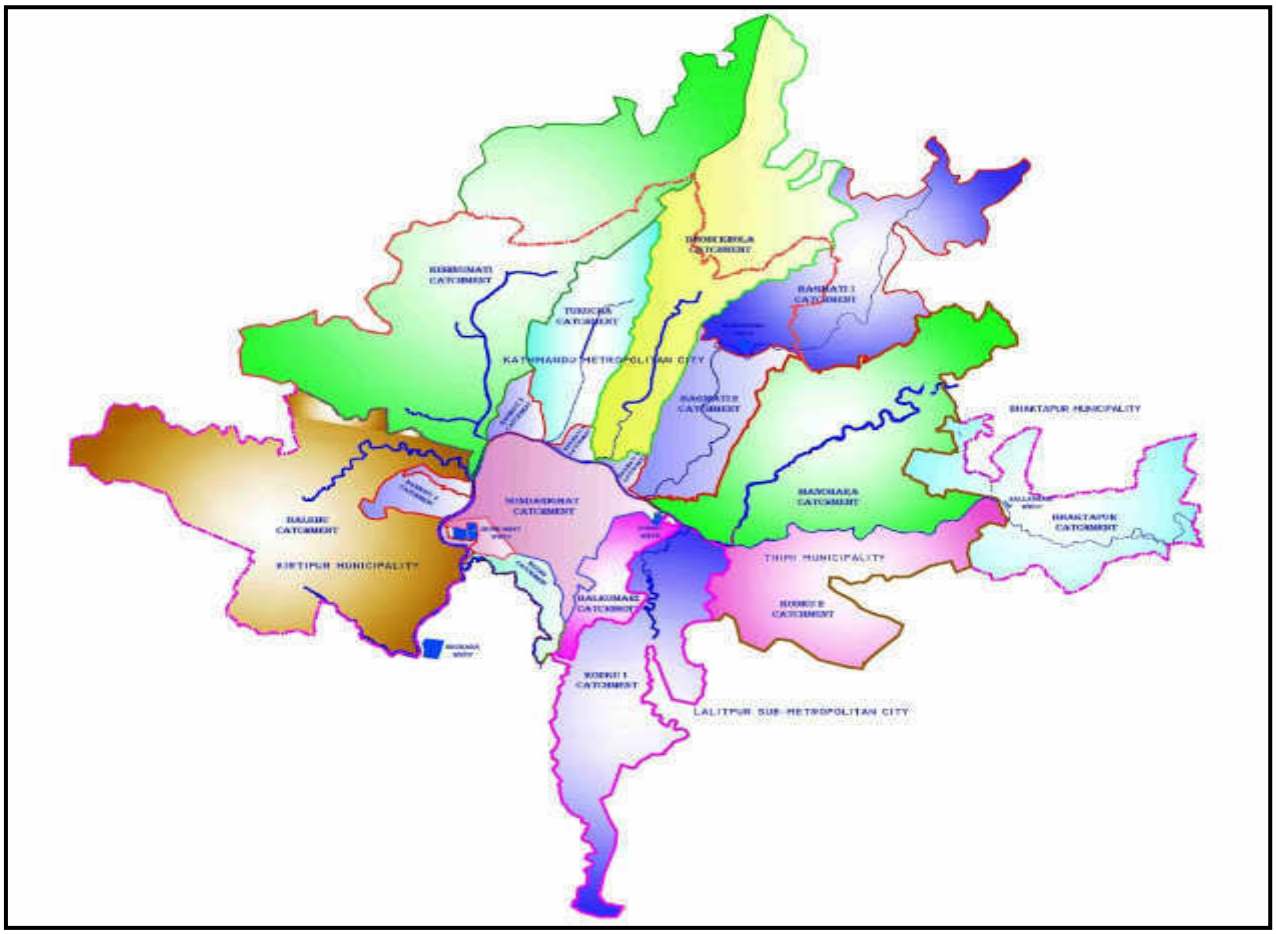


Figure III-3 Catchment Area of Kathmandu Valley

Estimation of wastewater generation by Treatment Area

53. Expected amount of generated wastewater has been calculated using population and indexes and shown as below table.

Table III-3 Estimation of wastewater generation

Treatment Area		Sallaghari	Kodku	Dhobighat
Projected Population	2015	108.4	141.1	573.1
	2020	120.2	194.6	724.3
	2030	152.1	379.8	1,193.6
Generation Rate (lpcd)	2015	66.7		
	2020	98.6		
	2030	116.2		
Connection rate (%)	2015	70		
	2020	80		
	2030	80		

Treatment Area		Sallaghari	Kodku	Dhobighat
Total Generation (mld)	2015	5.1	6.6	26.8
	2020	9.5	15.4	57.1
	2030	14.2	35	110

Water quality

54. If the pollutant concentration of wastewater is estimated by pollution loading rate and water consumption rate, return rate and connection rate should not be reflected in estimation because pollutant will be mixed with water during water use. So, the water quality has been estimated by water consumption and pollution loading rate. BOD5 47 gpcd used in PPTA has been adopted as a pollution loading rate, other water quality parameter was estimated using the pollutant concentration ratios presented in site investigation.

Table III-4 Wastewater Characteristics

Parameters	Unit	BOD_5	COD_{cr}	SS	T-N	T-P
Pollution Loading Rate*	gpcd	47	125	63	12	2.0
Domestic water	lpcd	120				
Commercial & Industrial water	lpcd	12				
Infiltration	lpcd	13 ~ 26				
Discharge sum	lpcd	145 ~ 158				
Concentration (Max)	mg/L	320	860	430	83	13.8
Concentration (Min)	mg/L	300	790	400	76	12.6
Concentration (Design) (2030)	mg/L	300	800	400	79**	12
Guheshwori WWTP (2015)	mg/L	498				

*Population load has been assumed by 47 gpcd in PPTA 7936 and proportionality of all other quality parameters based on the analyzed quality data of sampled wastewater
** Ammonia Nitrogen

55. Effluent of wastewater quality for design is based on the fact that the water consumption per capita per day will increase up to 120 lpcd by year 2030 after current water supply system development and discussion with the Client.

56. The life time of wastewater treatment plant is more than 40 years and if the highly concentrated raw wastewater quality during low water consumption is the design base for the plant, it is not economic development since the concentration will reduced by increase of water supply capacity of Kathmandu Valley. Design of the plant based on estimated raw wastewater quality after completion of water supply system development can prevent the unnecessary cost for the construction but the reliability of data for influence quality is low and highly concentrated influence shall be received during initial stage of operation. When construction of required capacity of wastewater treatment plant is difficult due to insufficient funding, consideration of wastewater quality after project target year would be more appropriate and temporary controlling plan during

highly concentrated influent should be established for initial operational period.

57. The Septage from individual households will be accepted and managed in the Kodku, Sallaghari, and Dhobighat WWTPs along with the sludge produced from the wastewater treatment process, for energy production. Approximately a combined capacity of 910 kW will be generated through sludge digestion and/ or gasification.

Table III-5: WWTP Components and features of the project TP-02

Sn.	Particulars	Description
1.	Project location	1. Sallaghari, Bhaktapur-2; 2. Balkumari Kodku, LMC-9 and 3. Sundarighat, Dhobighat LMC-4
2.	Project Works	Modernization & Expansion of 3 Wastewater Treatment Plant at Sallaghari, Kodku and Dhobighat
3.	Employer	Project Implementation Directorate (PID)/KUKL
4.	Executing Agency	KUKL
5.	Funding Agency	Asian Development Bank and Government of Nepal
6.	Estimated capacity after rehabilitation and expansion	1. 14.2 MLD, 2. 17.5 MLD and 3. 37.0 MLD
7.	Design Life	Structures-minimum 60 years Mechanical and equipment- minimum 15 years
8.	WWTP Components	Screening and Grit chambers, Primary Sedimentation Tanks, Activated Sludge Tanks, Secondary Sedimentation Tanks, Tertiary Treatment Facility, Disinfection Facility, Sludge Thickening Facility, Anaerobic Sludge Digester, Bio-Gas Generation Facilities, Sludge Dewatering machine etc.
9.	Access to site	Can be accessed easily in all sites with existing road networks
10.	Contract agreement date	26 January 2017 (7 May 17- Commencement)
11.	Contract Duration	913 days
12.	Intended Completion Date	5 November 2019
13.	Contract amount	NRs. **3,920,622,374.18**

E. Treatment Process

58. The process design concepts are based on providing a treated effluent to specified quality standards that will be suitable for irrigational reuse or river discharge. The WWTPs concept design includes sufficient redundancy and robustness to treat peak hour flow of 1.8 times of average daily flows for up to the effluent quality required.

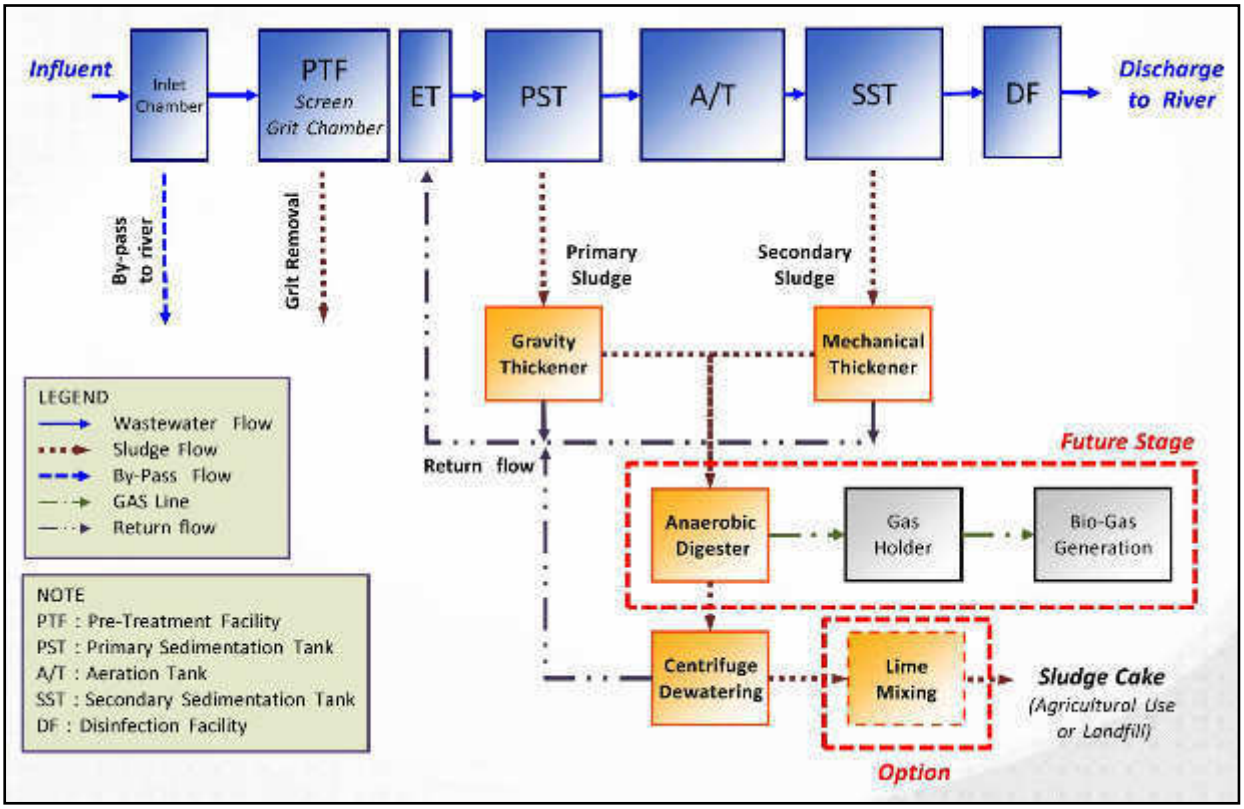


Figure III-2 Process Flow Diagram of Kodku and Sallaghari WWTPs

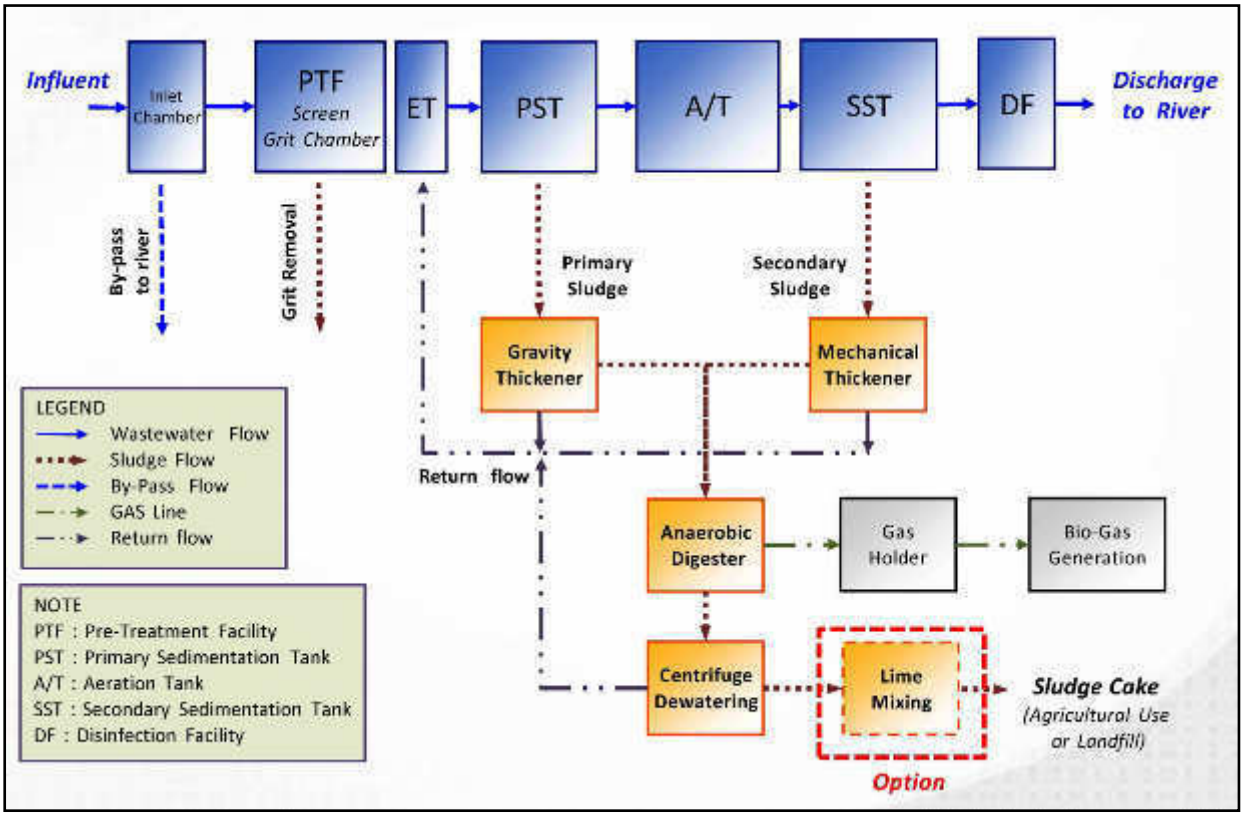


Figure III-3 Process Flow Diagram of Dhobighat WWTP

59. The conceptual design for solids handling in this design concept includes waste sludge thickening, digestion, dewatering, and disposal of the sludge as landfill.

F. Design of Wastewater Treatment Plants

Inlet facility at Dhobighat WWTP

60. The pipeline to collect wastewater for Dhobighat WWTP should be planned and installed before completion of interceptor construction by HPCIDBC since inflow facility need to be constructed at the location shown in Figure 7.1 Invert level of interceptor by HPCIDBC is 1270.0 m in elevation and diameter is 1,600mm. As shown in Figure 7.1, the bridge crossing Bagmati river and road for heavy vehicle will be constructed at the entrance of the Dhobighat WWTP.

Figure III-4 Area of inflow pipe for Dhobighat WWTP

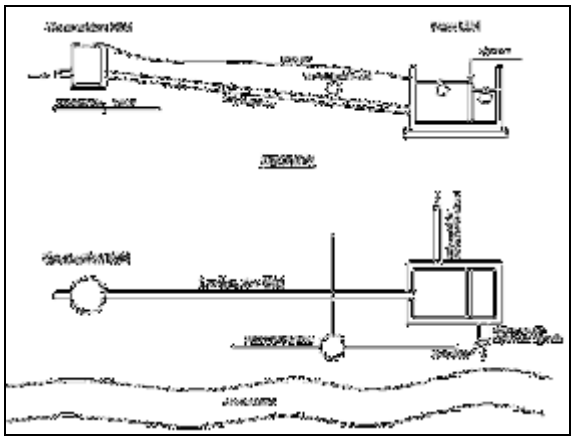


Figure III-5 Connection Manhole at inlet of Dhobighat

61. The water supply pipe under KUKL management is completed. The wastewater influence pipeline with diameter of 1,600 mm, should cross under the mentioned water supply pipe. To control the influent amount and emergency bypass discharge, the manhole near the Bagmati river should be constructed and level of discharge weir should be higher than 1272.5 m. The emergency bypass manhole should have flap gate to prevent back flow and material and type should not effluence the flow direction of the discharge. Minimum size of the gate should be larger than D1800mm with circular shape or 2.5 meter rectangular gate. The connection point should be installed water stop material

Inlet facility at Kodku WWTP

62. Kodku WWTP receives raw wastewater from interceptor on Hanumante which will be implemented under WW/IN/03 package. Addition to Hanumante Interceptor, wastewater from south of wastewater treatment plant is collected through D600mm interceptor which pass Balkumari area as shown in Figure III-6.

63. Main inflow facility is installed on interceptor on Hanumante and wastewater from South will be connected to inflow facility by construction of new pipeline with D600mm. Removal of grit chamber and construction D600m pipeline should be included. When exceeding wastewater is received into WWTP, emergency by-pass should be

constructed. Discharge invert level of by-pass line should be 1289.7 m.

Inlet facility at Sallaghari WWTP

64. D600mm existing interceptor located at east corner of WWTP will be closed but the interceptor shall be also connected to inflow facility of the WWTP since it requires some time for changing connection from existing interceptor to new interceptor. During raining when influent of raw wastewater exceed, emergency by-pass manhole should be installed and the elevation of weir is 1300.65 m. discharge facility should be circular pipe or box culvert with size of 700mm. The location of discharge is Kaasen Khola and level of emergency discharge point is 1300.25m.

Figure III-6 Area of inflow pipe for Kodku WWTP

Figure III-7 Area of inflow pipe for Sallaghari WWTP

G. Pretreatment building

65. Equalization pump station, screen, and grit chamber is unified into equalization tank and the pretreatment facility should be covered with single building for operation and maintenance purpose and collection of bad odors. As Table III-6, inlet facilities should be capable to handle capacity with future expansion plan and mechanical and electrical shall be in capacity of 1st phase development. For civil structure without M&E facilities should be maintained and stop the influence of the water using stop log so that it can be used for future expansion.

Table III-6 Capacity of inlet facility of pretreatment Process under 1st Phase

WWTP	Final Capacity (MLD)	Capacity of inlet facility and pretreatment* (MLD)	
		Civil and Architecture	Mechanical and Electrical
Dhobighat	110	110	37
Kodku	35	35	17.5
Sallaghari	14.2	14.2	14.2

* Inlet facility and Pre-treatment process includes inlet pipe, screen, grit chamber, equalization pump station, discharge pipe

Coarse screen

66. Influent to the pretreatment building will discharge into an open, common channel. This common channel will lead to two to four parallel screen channels. All common screen channels will be sized for the design peak flow. Individual screen channels will be sized for the flow capacity of the screen and the space requirements of the screen. According to the plan for target year 2030, two screens will be installed on Dhobighat, Kodku, and Sallaghari WWTP. The spacing and type for the Screen will be

20mm and auto-bar screen, respectively (Table III-7).

Fine screen

67. De-gritted sewage will flow by gravity to fine screens, which are critical components in the operation of primary sedimentation tank. The spacing of the fine screen will be 6mm to minimize the impact from debris at the primary sedimentation tank.

Table III-7 Preliminary design specification of screens

Parameter		Dhobighat	Kodku	Sallaghari
Design flow*, MLD		66.6	31.5	25.6
Coarse Screen Dimension	Materials	Stainless Steel	Stainless Steel	Stainless Steel
	No. of screen	2	2	2
	Mesh size	20mm	20mm	20mm
	Width, m	1.8m	1.2m	1.0m
	Length, m	6.5m	6.2m	5.25m
	Depth, m	4.0m	4.0m	3.0m
Fine Screen Dimension	Materials	Stainless Steel	Stainless Steel	Stainless Steel
	No. of screen	2	2	2
	Mesh size	6mm	6mm	6mm
	Width, m	1.8m	1.2m	1.0m
	Length, m	6.5m	6.2m	5.25m
	Depth, m	4.0m	4.0m	3.0m

*peak flow

Grit chamber

68. The number of grit chamber at Dhobighat, Kodku, and Sallaghari WWTP will be 2ea of each WWTP. Also, the peak flow rate at Dhobighat, Kodku, and Sallaghari WWTP is designed to 66.7, 31.5, and 25.6 MLD, respectively.

69. The retention time and size of the designed grit chamber is shown in Table 7-3 by phase and capacity.

Table III-8 Design criteria and preliminary design specification of grit chamber

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria	Removed sand	gravity over 2.65		
	Removed minimum particle size	0.2mm		
	Average velocity	0.3 m/sec		
	HRT	30~60 sec		
	SLR	3,600 $m^3/m^2 \cdot d$		
Design flow, MLD		66.7	31.5	25.6
Type		gravity	gravity	gravity
No. of tank		2	2	2
Average velocity, m/s		0.3	0.3	0.3
HRT, sec		38	36	34

Parameter		Dhobighat	Kodku	Sallaghari
SLR, $m^3/m^2 \cdot d$		2,523	1,432	1,280
Dimension	Width, m	1.8	1.2	1.0
	Length, m	11.0	11.0	11.0
	Depth, m	1.1	1.0	0.5

H. Equalization tank and Influent pumping

70. The site drainage pumping station, to handle plant side streams (return flow) and tank drains, will be constructed.

71. During rainy season, control of volume for sluice gate located prior to grit chamber is required to prevent inflow of equalization tank more than peak flow. To prevent from submersion of the tank from the case, control overflow and O&M with sluice gate before the grit chamber should be established.

72. Equalization tank of control of the daily variation of wastewater at dry season was planned. Flow rate of all of unit process after equalization tank was designed average flow rate. And also, excess flow has to consider overflow line from equalization tank to inverted siphon at catchment interceptor of crossed river. Influent flow will distribute to individual pump wet wells from a common inlet channel, and each wet well will be provided with an isolation gate to facilitate wet well maintenance. Each pump will draw from its own wet well and pump up above grade to the pretreatment building described below.

73. The influent pump will be non-clog submersible pumps and will be able to pass at least 100mm solids. Because the pumps will have the capability to pass such large diameter solids, it will be possible to locate the first set of plant influent screens downstream of the pumps in an above-grade facility. This design will avoid the need to locate these screens upstream of the pumps where the screens would have to be below grade.

74. Table III-9 shows number and type of pumps to be installed on the influent pumping facility. The pumps shall be installed by target year and the number of back up pumps must be complying with the design. The motors will be close-coupled and extended shafting will not be needed.

75. The two pump discharge headers will discharge into an open, common channel in the adjacent pretreatment building. All individual pump suction and discharge piping will be sized for the design peak flow. When high concentrated wastewater is received, secondary sludge can be put into equalization tank so that nutrients can be removed before 1st sedimentation tank. The sludge will be settled at the primary sedimentation tank and transfer to sludge treatment facility. The pipeline transferring secondary sludge into equalization tank should be installed and capacity of sludge suction pump of primary sedimentation tank should be designed accordingly

Table III-9 Preliminary design specification of pumping station and equalization tank

Parameter	Dhobighat	Kodku	Sallaghari
Equalization tank			
Design flow, MLD	66.6	31.5	25.6

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria		HRT : 3.5 hr		
Type		On line	On line	On line
No. of sump		2	2	2
Dimension	Width(W), m	30.0	16.0	16.0
	Length(L), m	36.0	35.0	34.0
	Height(He), m	4.5	4.1	3.4
Volume, m^3		9,720	4,592	3,699
HRT, hr		3.5	3.5	3.5
Pump of equalization tank				
Design flow, MLD		48.1	22.8	18.5
Type		Submersible	Submersible	Submersible
No. of pump(W+S)		6(5+1)	6(5+1)	6(5+1)

76. An odor control system will be provided for the influent pumping station wet wells.

Plant side streams and tank drains will flow by gravity to the site drainage pumping station, where they will also be separately pumped to the pretreatment building. This flow will also be metered and automatically sampled.

I. Primary treatment facility

77. Design criteria and preliminary design specification for primary sedimentation tank (PST) is shown on Table III-10. Retention time of the PST is 2.3 to 2.6 hr and the number of tanks in Dhobighat, Kodku, and Sallaghari WWTP will be 4, 2 and 2, respectively.

78. The shape of the primary sedimentation tank is rectangular type for easy installation of cover to prevent odor. The sludge is collected by chain flight and additional scum removal equipment is applied on the design. The average removal ratio of SS and BOD for the primary sedimentation tank is planned 55% and 33%, respectively.

79. The sludge drawn from the sedimentation tank will be average of 25,000mg/L, and the pump capacity for sludge has been designed by the average value. (Refer to appendix 3)

Table III-10 Design criteria and preliminary design specification of PST

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria	SLR	35~70 $m^3/m^2 \cdot d$		
	HRT	2~4 hr		
	Water depth	2.5~4 m		
	Loading rate of weir	Below 250 $m^3/m \cdot d$		
	SS removal rate	55%		
	BOD removal rate	33 %		
	Type	Rectangle		

Parameter		Dhobighat	Kodku	Sallaghari
Design flow, MLD		37	17.5	14.2
No. of tank (train)		4(8)	2(4)	2(4)
Surface area, m^2		836	440	400
Volume, m^3		3,520	1,760	1,520
Weir length of train, m		20	20	16
Dimension	Width, m	10.0	10.0	10.0
	Length, m	22.0	22.0	20.0
	Depth, m	4.0	4.0	3.8
SLR, $m^3/m^2 \cdot d$		42	39.8	35.5
HRT, hr		2.3	2.4	2.6
Rate of weir, $m^3/m \cdot d$		231	219	222
No. of sludge collector		4	2	2
No. of pump for sludge(W+S)		2(1+1)	2(1+1)	2(1+1)
No. of valve		4	2	2

J. Biological treatment system

1.1.1. Aeration tank

80. The effluent from the primary sedimentation tank is designed to flow into the Biological Treatment System. The biological treatment system is designed for conventional activated sludge (completely mixed) type. The reactor is designed in rectangular shape considering top covering, O &M, and expandability, and etc. The Bio-reactor is designed for 9.0hr of retention time, MLSS of 2,500mg/L for stable production of microorganism, and sludge return rate of 50% from the secondary sedimentation tank. (Refer to Table III-11) The capacity of the blower which supplies air into the bio-reactor is shown in Table III-11 and each blower building layout has been arranged by considering efficiency and expandability of bio-reactor.

81. A fine bubble membrane diffused aeration system most likely with membrane diffusers will be provided in each aeration tank with individual air flow meters and control valves to monitor the air flow to each aeration grid. The current concept provides single stage centrifugal turbo blowers with inlet guide vane and variable discharge diffuser vanes to control the rate of air discharged from the blowers. The blowers will draw air from a common suction header which will be furnished with an inlet air filtration system including inlet and outlet and an inlet pressure drop monitoring system suitable for the site conditions.

82. Individual blower accessories will include inlet and discharge silencers, inlet and discharge expansion joints, air check valve on the blower discharge and the blow-off piping, inlet and discharge isolation valves, bypass valve for startup unloading, a main discharge header blow-off valve, a shaft vibration monitoring system, inlet and discharge vacuum and pressure gauges, inlet thermometer, high discharge pressure switch and a high discharge temperature and pressure transmitter. Consideration will be given to acoustical enclosures for the blowers during preliminary design development. A complete blower control panel will be provided with each blower.

Table III-11 Design criteria and preliminary design specification of biological reactor

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria	F/M ratio	0.1~0.3 kgBOD/kgMLSS·d		
	MLSS	1,500~4,000 mg/L		
	Flow of RAS	30~80%		
	RAS concentration	8,000~11,000 mg/L		
Design flow, MLD		37	35	14.2
HRT, hr		9.0	9.0	9.0
No. of reactor		4	2	2
Dimension	Width, m	10	10	10
	Length, m	70	66	54
	Depth, m	5.0	5.0	5.0
Volume, m^3		14,000	6,600	5,400
MLSS, mg/L		2,500	2,500	2,500
SRT, day		5.1	5.1	5.1
AOR, kgO_2/d		9,040	4,280	3,473
Diffuser type		Fine bubble membrane	Fine bubble membrane	Fine bubble membrane
No. of blowers(W+S)		4(3+1)	3(2+1)	3(2+1)
Sludge production, kg/d		4,961	2,347	1,904
RAS ratio, %		50(max, 100%)		
RAS conc., mg/L		10,000		
F/M ratio		0.20		

1.1.2. Secondary sedimentation tank (SST)

83. The mixed liquor overflowed from the bio-reactor flows into the Secondary Sedimentation Tank. In SST, microorganism generated from the bio-reactor maintains optimal solid retention time by sedimentation and returning of sludge to the bio-reactor. In addition, excess sludge of certain amount will be transported to mechanical thickener and pass through the thickening process.

84. The excess sludge concentration has been designed approximately 1%. The HRT of the secondary sedimentation tank has been designed 3.5 to 3.7hr and dimension for SST of each treatment plant has shown in Table III-12.

85. The structure of SST has been designed in rectangular shape with one-body building, as same as the other structures including pretreatment facility, primary sedimentation tank, and bio-reactor.

Table III-12 Design criteria and preliminary design specification of SST

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria	Surface loading rate	20~30 $m^3/m^2 \cdot d$		
	HRT	3~5 hr		
	Loading rate of weir	Below 190 $m^3/m^2 \cdot d$		
	Solid loading rate	40~125 $kg/m^2 \cdot d$		

Parameter		Dhobighat	Kodku	Sallaghari
Type		Rectangle		
Design flow, MLD		37.0	17.5	14.2
No. of tank (train)		4(8)	2(4)	2(4)
Surface area, m^2		1360	680	560
Volume, m^3		5,440	2,720	2,128
Weir length of train, m		28	24	20
Dimension	Width, m	10.0	10.0	10.0
	Length, m	34.0	34.0	28.0
	Depth, m	4.0	4.0	3.8
SLR, $m^3/m^2 \cdot d$		28.6	27.1	26.7
HRT, hr		3.4	3.5	3.4
Rate of weir, $m^3/m \cdot d$		165	182	178
SOR, kg/ $m^2 \cdot d$		107	102	100
No. of sludge collector		4	2	2
No. of return sludge pump(W+S)		8(4+4)	4(2+2)	4(2+2)
No. of excess sludge pump(W+S)		2(1+1)	2(1+1)	2(1+1)

K. Disinfection facility

86. The disinfection facility is a unit facility installed to comply with E.coli standard for discharge or reuse purpose from the final effluent. It is known that using liquid chlorine is hard to handle and requires explosion-proof facility. Hence, sodium hypochlorite contact (SHC) is designed for this time due to its simple facilitation and in-situ production compare to liquid chlorine. The SHC chamber is designed for easy handling and operation using hypochlorite generated by electrolysis from salt, which has equal disinfection ability to liquid chlorine. The specification and details of the SHC are shown in Table III-13 below.

Table III-13 Design criteria and preliminary design specification of Disinfection Chamber

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria	Type	Hypo chlorite contact (in situ generated from NaCl)		
	HRT	Over 20 min		
Design flow, MLD		37	17.5	14.2
No. of tank		2	2	2
HRT, min.		20	20	20
Volume, m^3		520	240	195
Dimension	Width, m	2.0	1.5	1.5
	Length, m	52.0	32.0	26.0
	Depth, m	2.5	2.5	2.5

L. Deodorization facility

87. There are a number of sources for odors within wastewater treatment and sludge management facilities. Significant potential sources at treatment facilities include pre-treatment (screen, grit chamber, and pumping station), equalization tanks, thickening system, dewatering systems.

88. It will be designed in the planning of odor control systems include on ventilation rates, negative pressure, material construction and odor treatment technologies methods. Table III-14 provides recommended ventilation rates for various covered process and criteria for establishing ventilation rates for covered processes.

Table III-14 Recommended ventilation rates

Process	Ventilation rate
Screen	7 times /hr x volume x 50%
Grit chamber	10 m^3/m^2.hr x area
Pumping station	3 m^3/m^2.hr x area
Equalization tanks	
Primary sedimentation tanks	
Gravity thickener	10 m^3/m^2.hr x area
Waste sludge chamber	
Mechanical thickener	7 times /hr x volume x 50%
Mixed sludge chamber	10 m^3/m^2.hr x area
Digested sludge chamber	
Dewatering facility	7 times /hr x volume x 50%
Screw conveyor	
Cake discharge room	
Criteria for establishing ventilation rates of covered processes	
●Maintenance of a minimum negative pressure : 3cm water column for prevent release of odors	
●Maintenance a safe working environment: H_2S conc. must remain below 10 ppm	
●Minimize the potential for buildup of combustible gases such as methane	
●Control H_2S levels to reduce corrosion	

89. Enclosing an odorous process, ventilation of the enclosed space, and treatment of the air are very effective means of controlling odor and emissions.

90. Odor control technology will be designed with bio-filtration which is known to relative low capital and O&M cost and effective with a range of odors. Bio-filter uses a porous media to absorb and absorb component from an airstream similar to dry media scrubbers. It is typically constructed with an in-ground air distribution system that discharges through media bed, which can be open to the environment, covered, or totally enclosed for a stack discharge. Packaged, proprietary bio-filter systems are also available. Bio-filters are effective in removing both odor and volatile organic compound (VOC) and are considered most appropriate for airstream with hydrocarbon levels up to, 1000 ppm such as methane. Refer to Table III-15 for design criteria.

Table III-15 Design criteria of bio-filter

Item	Range	Typical
Detention time, sec	30~60	60
Bed depth, cm	0.6~1.0	1.0
Surface loading rate, m^3/m^2• min.	Up to 2.5	1.0
Moisture content, %	45~65	50
Media pH	6~9	7

Media temperature, ℃	5~45	15~37
Influent gas humidity, %	>95	>98

Table III-16 Preliminary design specification of deodorization facility

Parameter	Dhobighat	Kodku	Sallaghari
Volume per minute of collected odor in wastewater treatment, m^3/min.	243.3	153.2	135.5
Safe factor	1.1	1.1	1.1
Design, m^3/min.	270	170	150

M. Sludge treatment facility

1.1.3. Thickening Facility including Sludge tank

91. The sludge drawn from the sedimentation tank passes through thickening process, which primary sludge goes to gravity thickener whereas secondary sludge goes to mechanical thickener.

92. The concentration and return rate of the concentrated sludge for gravity thickener treating primary sludge is designed to 5% and 85%, whereas mechanical thickener treating secondary sludge is 5% and 90%, respectively. Table III-17 and Table III-18 present design criteria and preliminary design specification for sludge thickening process. In case of gravity thickener, FRP type of cover installation has been applied to the design for prevention of odor.

Table III-17 Design criteria of the thickener

Parameter	Value	Remark
Gravity thickener for 1st sludge		
No of Tank	2	
HRT, hr	Below 24	
SLR, kg/m^2·d	25~70	
Effective depth, m	4.0	
Thickened Sludge Concentration, %	5.0	
Sludge capture rate, %	85.0	
Cover material	FRP	For odor control
Mechanical Thickener for 2nd sludge		
Thickened Sludge Concentration, %	5.0	
Sludge capture rate, %	90.0	

Table III-18 Preliminary design specification of thickener

Parameter	Dhobighat	Kodku	Sallaghari
Gravity thickener			
SLR, kg/m^2·d	70	70	70
HRT, hr	25.7	21.4	21.4
No. of thickener	2	2	2

Diameter, m	8.7	5.9	5.3
SWD, m	3.0	2.5	2.5
Thickened sludge			
Mass, kg/d	8,410	3,273	2,655
Flow rate, m^3/d	138	65	53.0
Supernatant			
Mass, kg/d	1,221	578	469
Flow, m^3/d	187	89	72
Mechanical thickener			
No. of thickener	2	2	2
Thickened sludge	5%	5%	5%
Thickener type	Centrifuge	Centrifuge	Centrifuge
Flow rate, m^3/d	89	42	34
Supernatant			
Mass, kg/d	496	235	190
Flow rate, m^3/d	407	192	156

1.1.4. Digestion

93. The sludge digestion is applied to decompose of concentrated sludge by anaerobic microbes. Anaerobic digestion has been adopted to stabilize sludge for this project. As by-product, mainly methane and carbon dioxide gas will be generated. The methane gas is utilized to power of generation. It will be adopted at Dhobighat WWTP. The Digestion facility for Sallaghari and Kodku WWTP shall be adopted in future stage.

94. As shown in Table III-19, the anaerobic digestion tank is completely mixed type with 20 days of retention time, single reaction tank, and operation temperature shall be maintained 35℃ by external heating (waste heat recovery from the generator).

Table III-19 Design criteria of anaerobic digestion

Parameter		Value	Remark
Type		Single-stage	
Mixing		Mixer	
Operating Temperature		35℃	
HRT, day		>20	
VS Removal rate, %	For 1st Sludge	55	FS
	2nd Sludge	35	
VS Contact, %	For 1st Sludge	60	FS
	2nd Sludge	67	

Table III-20 Preliminary design specification of anaerobic digestion

Parameter	Dhobighat	Kodku(Future)	Sallaghari(Future)
Input sludge			
Solid, kg/d	11,383	5,385	4,369

Volume, m^3/d	228	108	87
No. of digester	2	2	2
Diameter, m	14.3	9.8	9.8
Depth, m	14.2	14.2	11.5
Tank volume(m^3)	4,553	2,154	1,748
HRT, day	20	20	20
Digested sludge			
Solid, kg/d	8,057	3,811	3,092
Volume, m^3/d	161	76	62

95. The organic matter in the sludge breaks down into gas, which is mostly methane and carbon dioxide, from the anaerobic digestion tank and methane can be used as energy. Table III-20 shows preliminary design of storage tank for gas generated from anaerobic digestion tank.

Table III-21 Preliminary design specification of gas holding tank

Parameter	Dhobighat	Kodku(Future)	Sallaghari(Future)
HRT, hr	12	12	12
Total gas flow rate, m^3/d	2,688	1,272	1,032
Methane gas flow rate, m^3/d	1,761	833	676
Volume, m^3	1,344	636	516
No. of holder	2	2	2
Diameter, m	10.0	6.4	6.2
Height, m	8.6	8.6	8.6

1.1.5. Dewatering and disposal

96. Dewatering is a unit process which produces sludge cake from digested sludge by reducing percentage of water content. Centrifugal type of mechanical dewatering is applied to achieve less than 78% of water content and 95% of recovery rate for the Project. Table III-22shows result of preliminary design for the dewatering.

Table III-22 Design criteria and preliminary design specification of dewatering

Parameter	Dhobighat	Kodku	Sallaghari
Design sludge			
Solid, kg/d	9,056	3,811	3,092
Volume, m^3/d	181	76	62
Sludge capture rate, %	95	95	95
Sludge Cake			
W/C, %	78	78	78
Solid, kg/d	7,655	3,621	2,938
Volume, m^3/d	35	16.5	13
Return flow			

Return Sold, kg/d	403	191	155
Flow rate, m^3/d	126	60	48
No. of dewatering facility	2	2	2
Dewatering facility type	Centrifuge	Centrifuge	Centrifuge

1.1.6. Final disposal of cake

97. The method for disposal of dewatered sludge cake shall be landfill after dewatering. In order to reduce the cost on disposal, the contractor can sell or distribute the sludge for agricultural use if the water ration of the sludge is decreased down to 50%

98. If the contractor wants to use the sludge for agricultural use as sales, mixing the sludge with lime (Cao) can be one of option for additional treatment for agricultural use. The lime will be mixed at 10% of dry weight of total sludge amount and the mixture will pass through ripening process for 0.5 day. Odor collecting and removal facility will be needed in storage area for ammonia gas and other odor substance generated by temperature rise from mixing with lime.

Table III-23 Preliminary design specification of quick lime treatment (Optional for the Contractor)

Parameter		Dhobighat	Kodku	Sallaghari
Design criteria	Add. fraction of CaO	20 % of sludge dry mass		
	Day for CaO storage	10 days		
	Ripping HRT	0.5 day		
	Safe factor	1.1		
	Bulk density (Powder)	890 kg/m^3		
	Assay	85%		
	W/C for Final product, %	50%		
Cake(Design sludge)				
Volume, m^3/d		34.8	16.5	13.4
Mass, kg/d		7,655	3,621	2,938
W/C, %		78	78	78
Required CaO, kg/d		1,801	890	691
Flow rate for CaO, m3/d		2	1	1
CaO storage volume		20.2	9.6	7.8
No. of CaO facility		2	1	1
CaO facility type		Screw feeder	Screw feeder	Screw feeder
Ripe bed volume		20	10	8
Dimension	Width, m	10	10	10
	Length, m	7	3	3
	Depth, m	0.3	0.3	0.3
Final product				
Flow rate m^3/d		18.9	8.9	7.3

Mass, kg/d	9,456	4,473	3,629

N. Bio-gas generation facility

99. The gas generated by anaerobic digestion process contains 65 % of methane, which enough to produce useful energy. The design is planned to use gas collected from the gas holding tank for generation of electricity. The gas to be used in generator will be filled in after pretreatment including moisture removal and desulfurization process. The bio-gas generation facility of Sallaghari and Kodku WWTP shall be adopted in future stage.

Table III-24 Design criteria and preliminary design specification of bio-gas generation facility

Parameter		Dhobighat	Kodku(Future)	Sallaghari(Future)
Design criteria	Calorific value of biogas	8,560 kcal/Nm^3		
	Operating hour	24 hr (330days per year)		
	Calorific value of electricity	860 kcal/kWh		
	Gas engine efficiency	35 %		
Design gas flow rate, Nm^3/d		1,761	833	676
Capacity of gas engine, kW		296	140	114
No. of gas engine		1	1	1
Gas engine, kW		330	160	130

O. Buildings

1.1.7. General design criteria of buildings

- Comply with national regulation for building, firefighting, planning, and other stated international standard.
- Ventilation system for the service building should be able to maintain suitable environment (temperature and humidity) for electrical equipment and electric control device.
- Insulation of the building should be equal or better to the national standard.
- HVAC should be installed in every room.
- Buildings should be equipped with electricity and lightings, wastewater drainage system, and able to collect and treat storm water.
- Cooling system should be installed to maintain 25℃, the maximum temperature.
- Emergency shower and eyewash station should be installed at the delivery point and outside of storage facility for the chemicals.

100. The buildings to operate WWTP can be categorized by its purpose. (a) Gate house located at the main entrance for security and safety, (b) administration building which includes control room, administration room, working area, and conference room, (c) building shaped screen, grit chamber, pumping station and equalization tank, (d) sludge thickening and dewatering building, (e) air blower building and electrical room, (f) sludge treatment building for final disposal of the sludge, and other buildings necessary for treatment process should be designed and constructed.

Table III-25 Preliminary design specification of buildings

No	Building or Structure	Rooms	Dimension (W * L * H * floors)		
			Dhobighat	Kodku	Sallaghari
1	Administration Building 2 floors	Control room Laboratory Director room, Office Conference room Toilet & shower room Locker & dress room Store & Rest room Kitchen & Dining room	17m x 28m x 4 m (2 floors)	12m x 26m x 4 m (2 floors)	12m x 20m x 4 m (2 floors)
2	Pre-treatment Building	Screen Grit chamber Equalization tank	Area of Pre-treatment	Area of Pre-treatment	Area of Pre-treatment
3	Sludge Treatment Building	Thickening & dewatering room Sludge cake room	18.5m x 12m x 5m	10m x 14m x 5 m	10m x 14m x 5 m
4	Blower &Electrical Building	Blower room Electrical room Generator room Workshop (mechanical) Workshop (electrical) Toilet & shower room	15m x 30m x 5 m	12m x 26m x 5 m	12m x 26m x 5 m
5	Biogas Generation Building	Engine room Compressor room Scrubber room	12m x 20m x 5 m	Future	Future
6	Storage House	Chemical storage (CaO, NaCl, polymer) Storage hall Waste material storage	10m x 14m x 4 m	9m x 10m x 4m	9m x 10m x 4m
7	Gate House	Security room, Toilet	3m x 4m x 3m	3m x 4 x 3m	3m x 4 x 3m

P. Return flow

101. The supernatant generated from thickening and dewatering process will be return to the grit chamber or at the end of the primary sedimentation tank by pump after collecting at the reactor for about 1.0 hr.

Table III-26 Preliminary design specification of return flow facility

Parameter		Dhobighat	Kodku	Sallaghari
Design flow rate, m^3/d		720	341	276
Type		Rectangle	Rectangle	Rectangle
Dimension	W, m	3.6	2.5	3.0
	L, m	3.0	2.5	2.0
	He, m	3.0	2.5	2.1
Volume, m^3		32.0	16.0	13.0
No. of tank		1	1	1
HRT, min.		65.0	66.0	65.6
No. of pump for supernatant(W+S)		3(2+1)	2(1+1)	2(1+1)

Q. Electrical, Instrumentation and Supervisory Control System

Electrical overview

102. Electrical device will be selected focusing on safety, reliability, economic,

efficiency, applicable functions and convenience of O&M. An accidental electric shock by operation failure of electrical equipment will be prevented. And, convenient operation and maintenance will be kept by preparing simplified circuit and equipment, selecting cubicle type incoming and distribution switch gear.

103. Compact sized equipment will be selected as far as possible to reduce space in equipment installation room, to provide easiness of installation and dismantling, and to keep compatibility with surrounding environment. Lead-in point for dedicated 11kV incoming line should be received approval from NEA(Nepal Electricity Authority) for design, the main lead-in shall be received. The construction expense shall be arranged by discussion.

104. The newly-installed earthing of electric equipment shall be an integrated grounding system, and earth resistance shall be lower than 5 ohms.

105. Lightning protection system of protected area is designed by following IEC or IS (India Standard), and the design adopted a well-used method for maintainability. Firefighting facility is also complying with IS (Indian Standard) and electric and mechanical equipment shall be segregated for convenience of construction.

Electrical system of WWTP

106. Electrical Items shall be provided as shown in and Process & Instrumentation Diagram(P&ID). The 11kV incoming line will be supplied from Nepal Electricity Authority (NEA) substation. It is proposed to provide new dedicated 11 KV power line up to HT metering under provisional sum.

107. According to below table, each WWTP will be supplied with 11kV power line from local substation.

Table III-27 11kV Power supply plan to WWTPS

WWTP	Substation	Distance	Voltage
Kodku	Baneshwor	2km	11kV
Sallaghari	Bhaktapur	2km	11kV
Dhobighat	Lagankhel / Teku	3~5km	11kV

108. The electrical system is installed from new HT metering via indoor VCB. Dry cast resin (mold type) transformer and VCB shall be provided. Therefore, the facility should be installed inside building for easily accessible repair and maintenance.

109. The power transformer shall be applied on basis of international codes and standard for high quality performance and low power loss. NEA test certificate must be required for installation.

110. The capacity of power transformer is applied and designed to cover electrical load in the WWTP. However, connected load will be calculated using detailed electrical load exactly in the detail design stage. Therefore, capacity of transformer and emergency generator is subjected to be variable. Approximately, capacities of transformer are as follow;

Table III-28 Transformer Capacity

WWTP	Transformer Capacity
Kodku	11kV/0.4~0.23kV 3Phase DYn-11 1,500kVA x 1EA
Sallaghari	11kV/0.4~0.23kV 3Phase DYn-11 1,000kVA x 1EA
Dhobighat	11kV/0.4~0.23kV 3Phase DYn-11 1,500kVAx1EA

111. The standby diesel generator shall be applied on basis of international codes and standard for high quality performance. The capacity of standby generator is designed to cover essential loads in WWTP, and to prepare reliable operation of the plant; in case the incoming power supply from grid fails. And, the capacity of each standby generator is selected considering about 60~80% of transformer. Approximately, capacities of generator are as follow;

Table III-29 Standby generator Capacity

WWTP	Standby generator Capacity
Kodku	0.4~0.23kV 3P 4W 50Hz 650kVA/520kW x 1EA
Sallaghari	0.4~0.23kV 3P 4W 50Hz 650kVA/520kW x 1EA
Dhobighat	0.4~0.23kV 3P 4W 50Hz 825kVA/660kW x 1EA

112. The power system shall be installed to supply electricity in tandem with Photovoltaic system that will be installed in future. And, the system shall be arranged to apply PV system to the power system immediately.

R. Estimated population to be served

113. The estimated population to be served by the new and rehabilitated WWTPs are provided below:

(i) **Sallaghari WWTP (TP-02) -** It is estimated that the new WWTP will treat wastewater for an equivalent population of 100,000 and 125,000 by years 2020 and 2030 respectively.
(ii) **Kodku WWTP (TP-02)** - The new WWTP will accept and treat wastewater for an equivalent population of 80,000 and 110,000 by year 2020 and 2030 respectively.
(iii) **Dhobighat WWTP (TP-02) -** The new WWTP will serve about 200,000 and 1,600,000 population of Kathmandu valley by the year 2020 and 2030 respectively.

114. The schematic layout plans of the WWTPs are presented in Figure III-3, Figure III-4, and Figure III-5. Whereas Figure III-2 shows the proposed wastewater treatment plant locations.

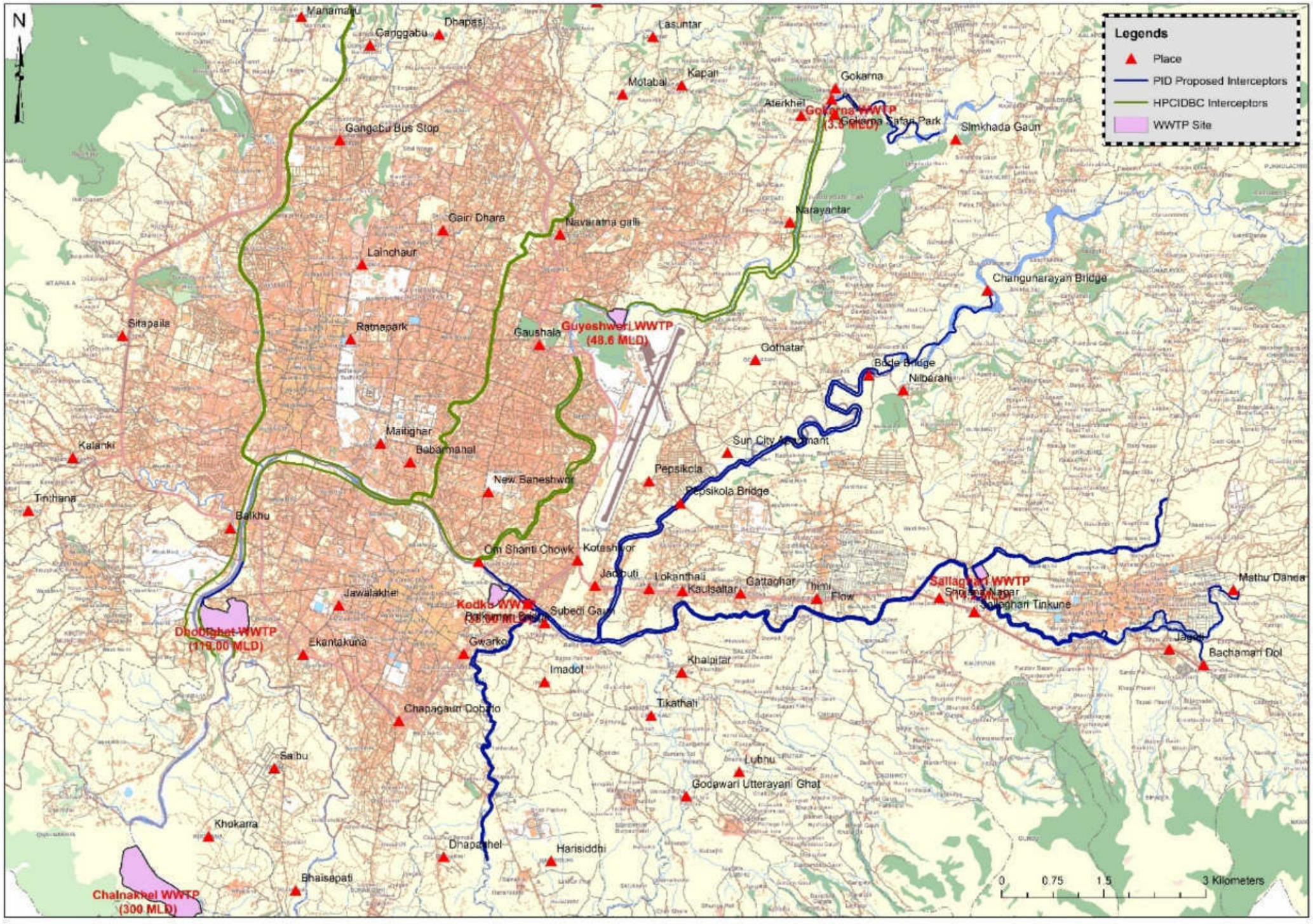
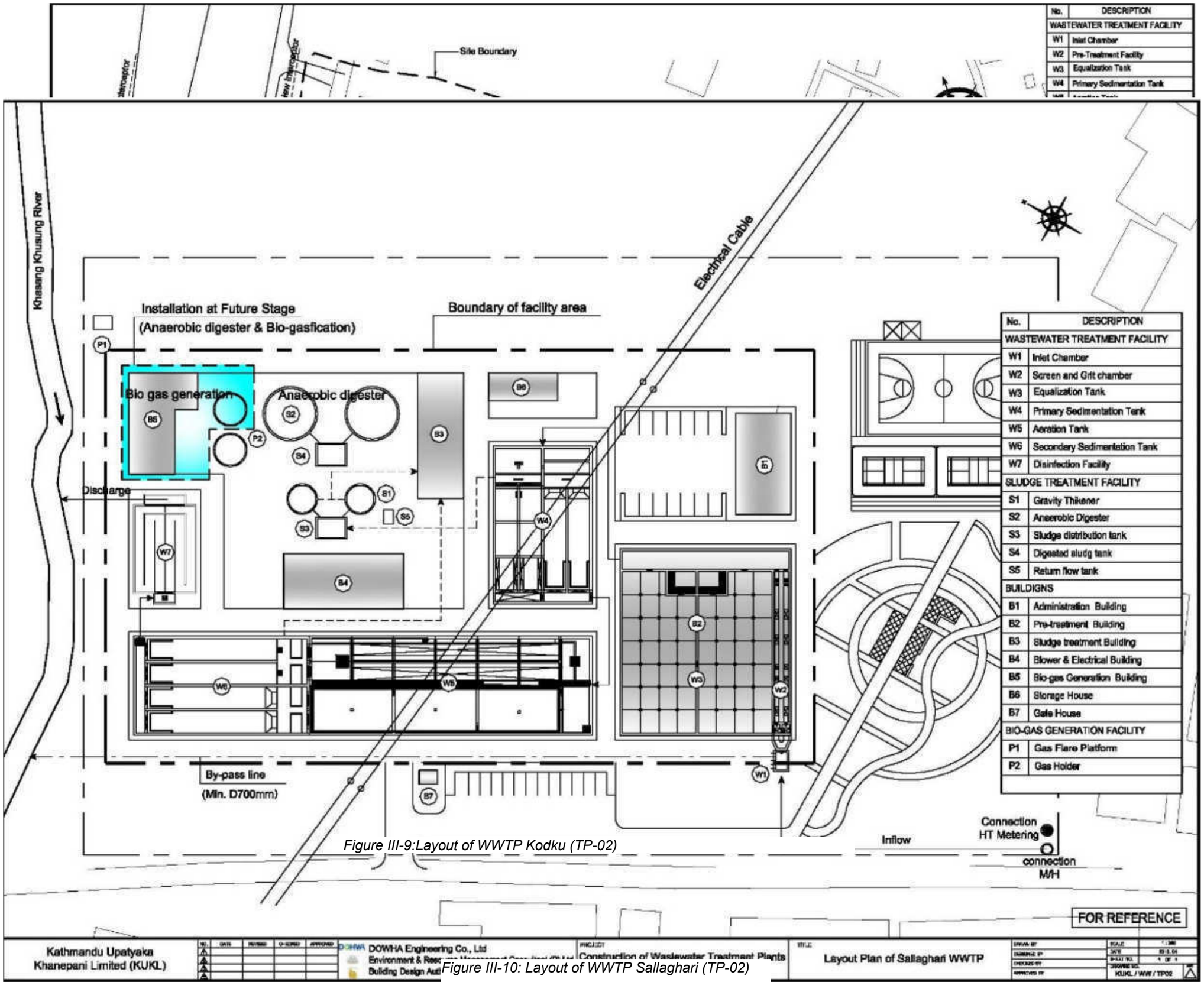


Figure III-8: Project components and schematic layout of Kathmandu Valley with proposed Treatment plants and interceptor alignments



No.	DESCRIPTION
WASTEWATER TREATMENT FACILITY	
W1	Inlet Chamber
W2	Screen and Grit chamber
W3	Equalization Tank
W4	Primary Sedimentation Tank
W5	Aeration Tank
W6	Secondary Sedimentation Tank
W7	Disinfection Facility
SLUDGE TREATMENT FACILITY	
S1	Gravity Thikener
S2	Aneerobic Digester
S3	Sludge distribution tank
S4	Digested sludg tank
S5	Return flow tank
BUILDIGNS	
B1	Administration Building
B2	Pre-treatment Building
B3	Sludge treatment Building
B4	Blower & Electrical Building
B5	Bio-gas Generation Building
B6	Storage House
B7	Gate House
BIO-GAS GENERATION FACILITY	
P1	Gas Flare Platform
P2	Gas Holder

Figure III-9:Layout of WWTP Kodku (TP-02)

Figure III-10: Layout of WWTP Sallaghari (TP-02)

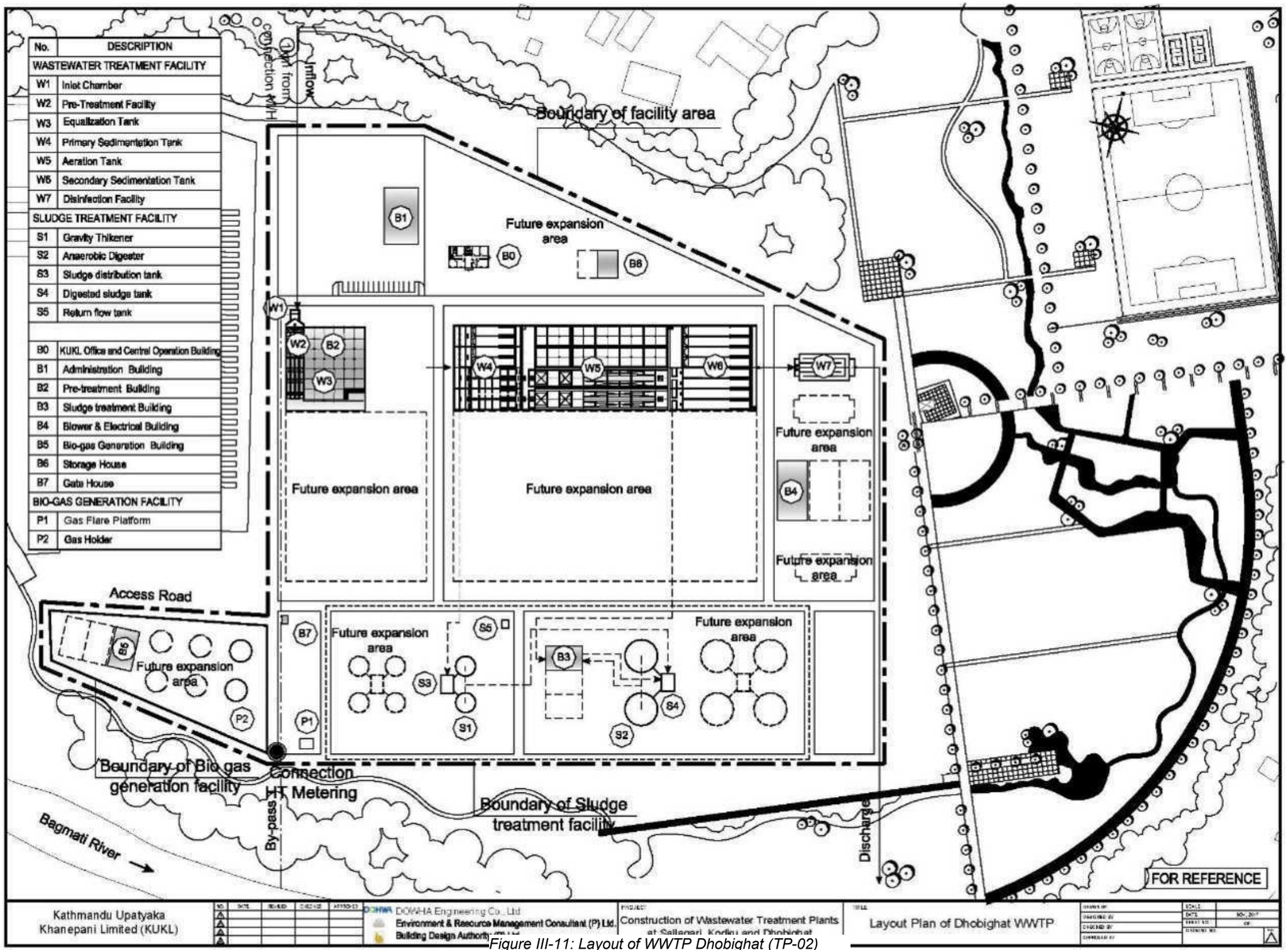


Figure III-11: Layout of WWTP Dhobighat (TP-02)

S. Implementation Schedule

200. Detailed design of WWTP packages was started in the mid of 2013. Construction is scheduled to commence in the mid of 2014 to be completed by the end of 2019.

201. The project implementation schedule for proposed TP-02 including other sub-projects under loan-3000 is given in Table III-30 for an overall project period. Most of the activities have been scheduled on a continuous basis.

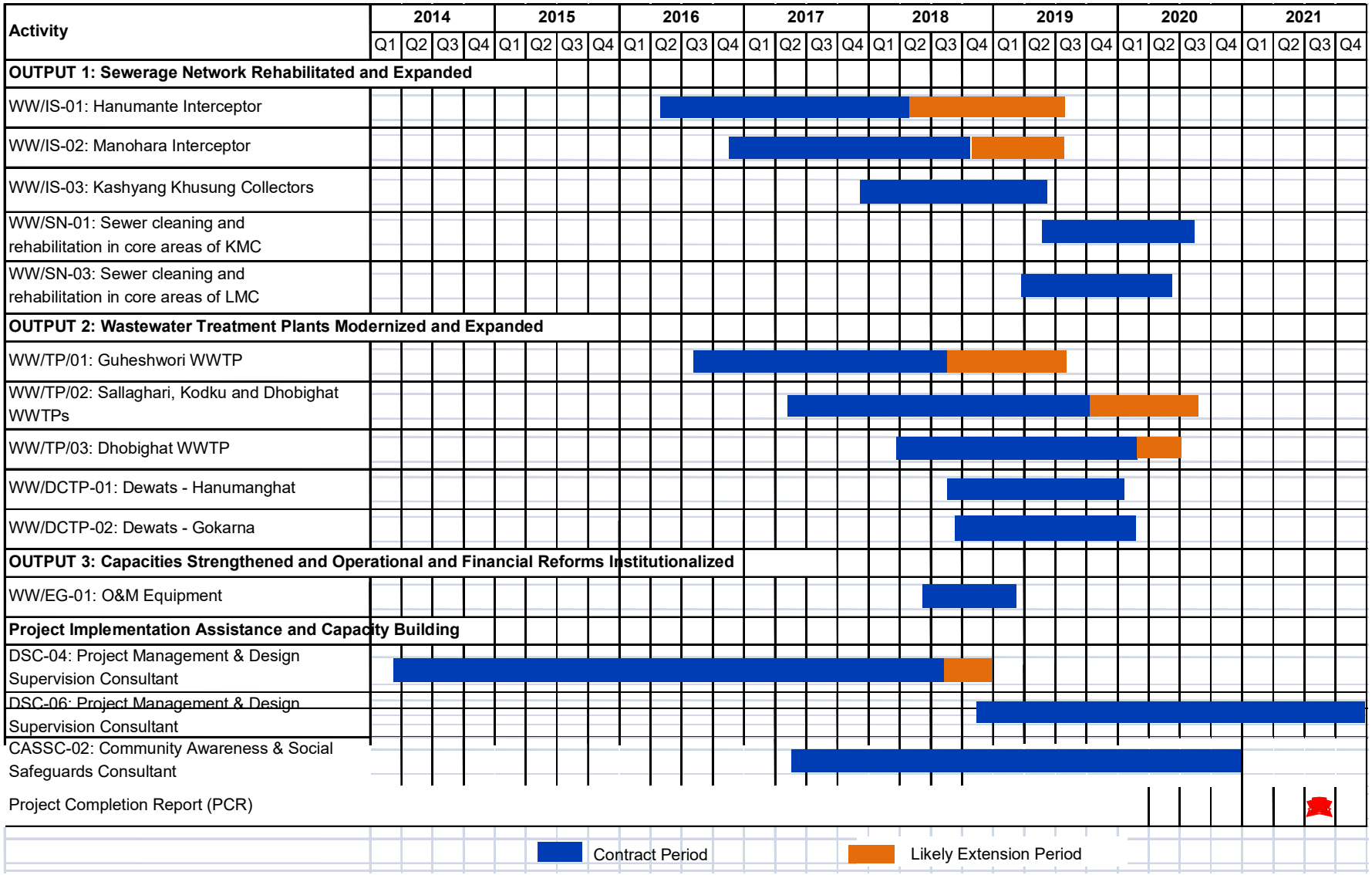
202. Under the General Manager of KUKL, there is a Technical Division (headed by a Deputy Technical Manager). Under the Technical Division, there are 10 Branch Offices in the Valley headed by a Deputy Manager each. Before operation, KUKL/PID/DSC, with the help of the Safeguards Unit and the Technical Division of KUKL will develop detailed work plans for implementing mitigation measures and monitoring plans based on the EMP.

203. Before construction, KUKL/PID has develop detailed responsibilities and requirements for contractors and has provided detail cost estimates of mitigation measures and environmental monitoring in the construction contracts. KUKL/PID will also detail the responsibilities of their environmental management offices and prepare their work schedules.

204. Before operation, KUKL/PID will develop detailed work plans for environmental management and monitoring during operation based on the EMP. These work plans will be submitted to the concerned persons to help them supervise implementation.

Proposed Project Implementation Schedule

Table III-30: Project Implementation Schedule



IV. DESCRIPTION OF THE ENVIRONMENT

A. Kathmandu Valley

115. Kathmandu Valley (Figure IV-1) lies between latitudes 27^{0}35' to 27°48'N and longitudes 85^{0}12' to 85°33'E. The altitude of the district ranges between 1, 372 m and 2,732 m above mean sea level. The major rivers flowing in the district are the Bagmati River, Bishnumati River, and Manohara River. The length of Bagmati River within Kathmandu Valley is 28 km. The Bishnumati, Manohara, Dhobikhola, Nagmati, and Balkhu rivers are the main tributaries of the Bagmati River. The Bagmati River is important both for water consumption and for religious purposes. One of the most famous temples of the Hindus (the Pashupati Nath Temple) is located in the banks of the Bagmati River.

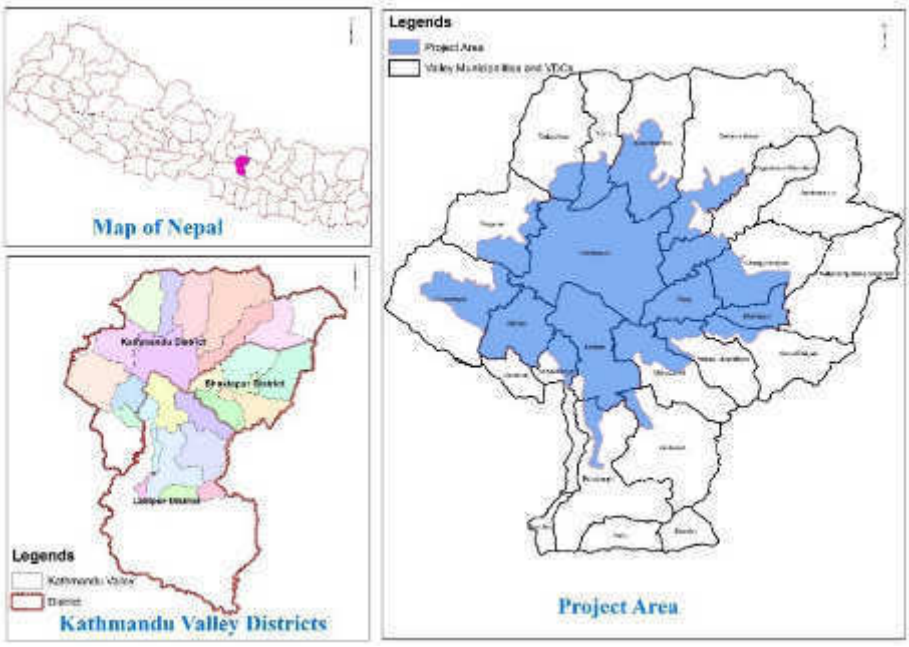


Figure IV-1: Kathmandu Valley and project area.

116. Bhaktapur, one of the adjoining cities of Kathmandu, is located between latitudes 27°37' to 27°44'N and longitudes 85°02' to 85°32'E. It is bounded by Kavrepalanchowk in the east, Kathmandu and Lalitpur in the west, Kathmandu in the north, and Kavrepalanchowk and Lalitpur in the south. The average elevation ranges from 1,372 m to 2,166 m above mean sea level. Rivers and streams are the predominant water resource in the Bhaktapur district. The main rivers are the Hanumanate and Manohara rivers. The Bagmati River does not flow through Bhaktapur; both the Manohara and Hanumante rivers are the major tributaries of the Bagmati River.

117. Bhaktapur is one of the three historic royal towns in Kathmandu Valley (15 km from Kathmandu) with rich architectural and urban heritage. It was founded in the 8th century A.D. and has remained relatively well preserved. The city is inhabited by 83,893 people. The main occupation of its inhabitants is agriculture; crafts (weaving, wood carving, metal crafts, clay work, and stone carving) and businesses are secondary occupations. The Bhaktapur Durbar Square and the Changunarayan Temple are among the seven world heritage sites in Kathmandu Valley.

118. Lalitpur is another adjoining city of Kathmandu and is located between latitudes 27° 22 to 28°50'N and longitudes 85°14' to 85°26'E. It is bounded by Kavrepalanchowk in the east, Makwanpur in the west and south, and Bhaktapur and Kathmandu in the north. Bagmati River

serves as boundary between Lalitpur and Kathmandu. The major tributary of the Bagmati River in the Lalitpur district is the Nakkhu Khola.

119. The Lalitpur sub-metropolitan city, popularly known as Patan, is located about 5 kilometers southeast of Kathmandu. Lalitpur is extremely rich in arts and architecture and boasts of the largest community of artisans, especially metal and wood workers. It has a large number of sacred buildings, temples, pagodas, *Stupas* and *Shikharas,* monasteries, maaths and *Chaityas.* UNESCO has enlisted the conglomerate of the buildings in Patan Durbar Square as a world heritage site, one of the seven heritage sites in Kathmandu Valley.

120. Kathmandu Valley is accessible by major roads to different parts of the country and to India in the south and Tibet in the north. Kathmandu has an airport that caters to national and international airlines to many parts of the country and abroad.

B. Physical Resources

1. Topography

121. Kathmandu Valley is about 1,300 m ranging from 1200 to 2300 m above mean sea level with an area of about 340 km^2. The valley has a bowl-like structure surrounded by high hills. The altitudes from the Valley floor vary between 500 m and 1,400 m. It lies between the Himalayas in the north and the Mahabharat range in the south. The prominent boundary features of the Valley are Phulchowki Hill (3,132 m) in the southwest, Shivapuri (2,713 m) in the north, Chapa Devi (2,400 m) in the southwest, and Nagarjun (2,100 m) in the west. The major rivers flowing into the district are the Bagmati River, Bishnumati River, Dhobikhola and Manohara River.

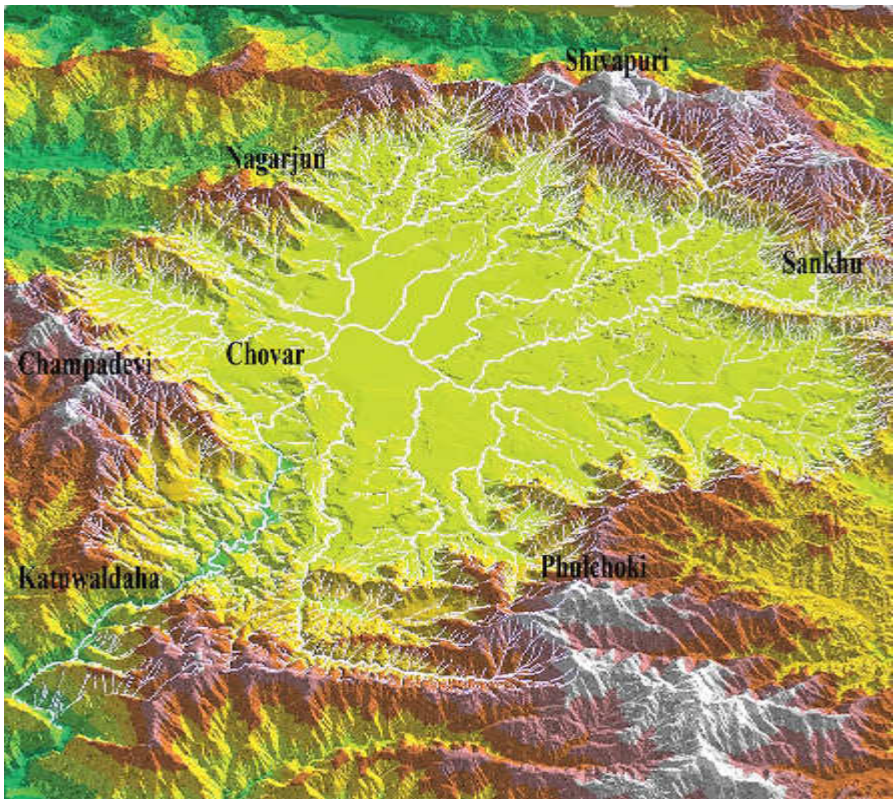


Figure IV-2: Topography of the Kathmandu valley

a. Geology and Soil

122. Kathmandu Valley is a synclinal tectonic basin consisting of fluvio-lacustrine deposits from the Pleistocene age resting on top of Precambrian metamorphic bedrock. In Kathmandu Municipality, the Gokarna (to the northeast) and Kalimati (to the

southwest) formations are predominant. Bhaktapur City is located on a hill that is part of the Kalimati formation. In Latitpur Municipality, the Kalimati and Chapagaun formations are predominant. The Gokarna formation typically consists of light to brownish-grey fine laminated and poorly graded silt sand with intercalation of clay of variable thickness. Shallow SP sandy soils, which are highly prone to liquefaction even under small to moderate intensity earthquakes (MMI = VII-VIII), are often found within the Gokarna formation.

123. The Kalimati formation is grey-to-dark silt clay and clayey silt. Organic clay, fine sand beds, and peat layers are commonly found. SM silty-sand soil layers intercalated with silt or clay layers are often found from 5 to 15 meters down. Such layers are prone to liquefaction under moderate to high intensity earthquakes (MMI = VIII-IX).

b. Climate

124. The climate of Kathmandu Valley is sub-tropical cool temperate with maximum of 35.6°C in April and minimum of –3°C in January. The annual average humidity is 75%. The temperature in general is 19°C to 27°C in summer and 2°C to 20°C in winter. The monthly average maximum temperature is 28.9 °C and monthly minimum temperature is 13.8 °C. The average rainfall is 1465 millimeters, most of which falls during June to September.

c. Water Resources

2. Surface Water

125. Nepal has many small to large size rivers, which flow from north to south. It has over 6,000 rivers with a combined length that exceeds 45,000 km. About 1,000 of these rivers are more than 10 km long and 100 are more than 160 km long. The surface water available is estimated to be around 224.7 billion cubic meters (m^3) per annum. The flow rate is around 7,125 cusecs. Nepal receives a yearly average precipitation of more than 1,500 mm.

126. The Bagmati River forms a medium-sized river basin with a catchment area of 3,700 km^2 at the Nepal-India border. It extends from latitudes 20^0 42' to 27^0 50'N and longitudes 85^0 02' to 85^0 58'E. It originates from the Shivapuri hills in the Mahabharat range of mountains and flows down south into the Terai plains before crossing the Indo-Nepal border. Along its course the river passes through eight districts, namely, Bhaktapur, Kathmandu, Lalitpur, Kavrepalanchowk, Makwanpur, Sindhuli, Rautahat, and Sarlahi. The major tributaries of the Bagmati River are Manohara, Bishnumati, Kulekhani, Kokhajor, Marin, Chandi, Jhanjh, and Manusmara. Kathmandu Valley comprises 15% of the basin area in Nepal. The basin as a whole can be divided into three parts:

(i) upper Bagmati basin comprising Kathmandu Valley plus the upper part of the Nakhkhu Khola and Dakshinkali area,
(ii) middle Bagmati basin comprising the remainder of the basin in the hills including the Kulekhani Khola, and
(iii) lower Bagmati basin comprising the basin in the Terai, plus some tributaries which originate in the Shiwaliks.

127. Rainfall occurs from the months of June through September due to the southeast

monsoon. The humid monsoon air stream blowing from the Bay of Bengal is forced to rise as it meets the Himalayas. As a result, heavy rainfall occurs in some sections of the southern Himalayan slopes. Rainfall is also high along the Chure range. Regions close to the Indian border receive about 1,500 mm of rain in a year, while at the foothills of Chure the annual rainfall reaches 2,000 mm. On the northern side of the Chure the rainfall diminishes again. In the lee-ward side, rainfall is reduced due to rain shadow effects. Orographic effect is pronounced and governs the rainfall pattern.

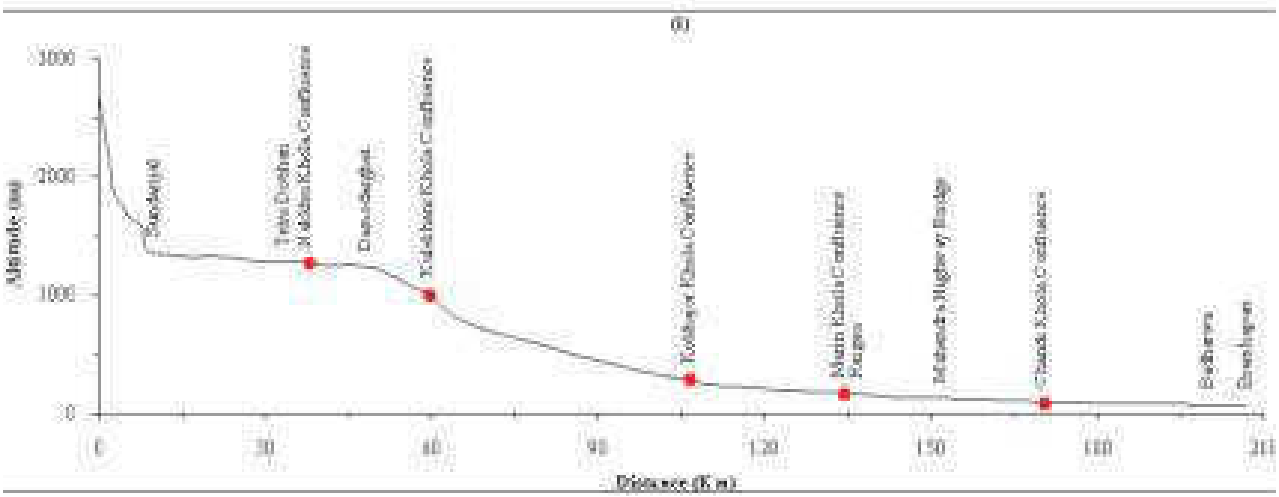
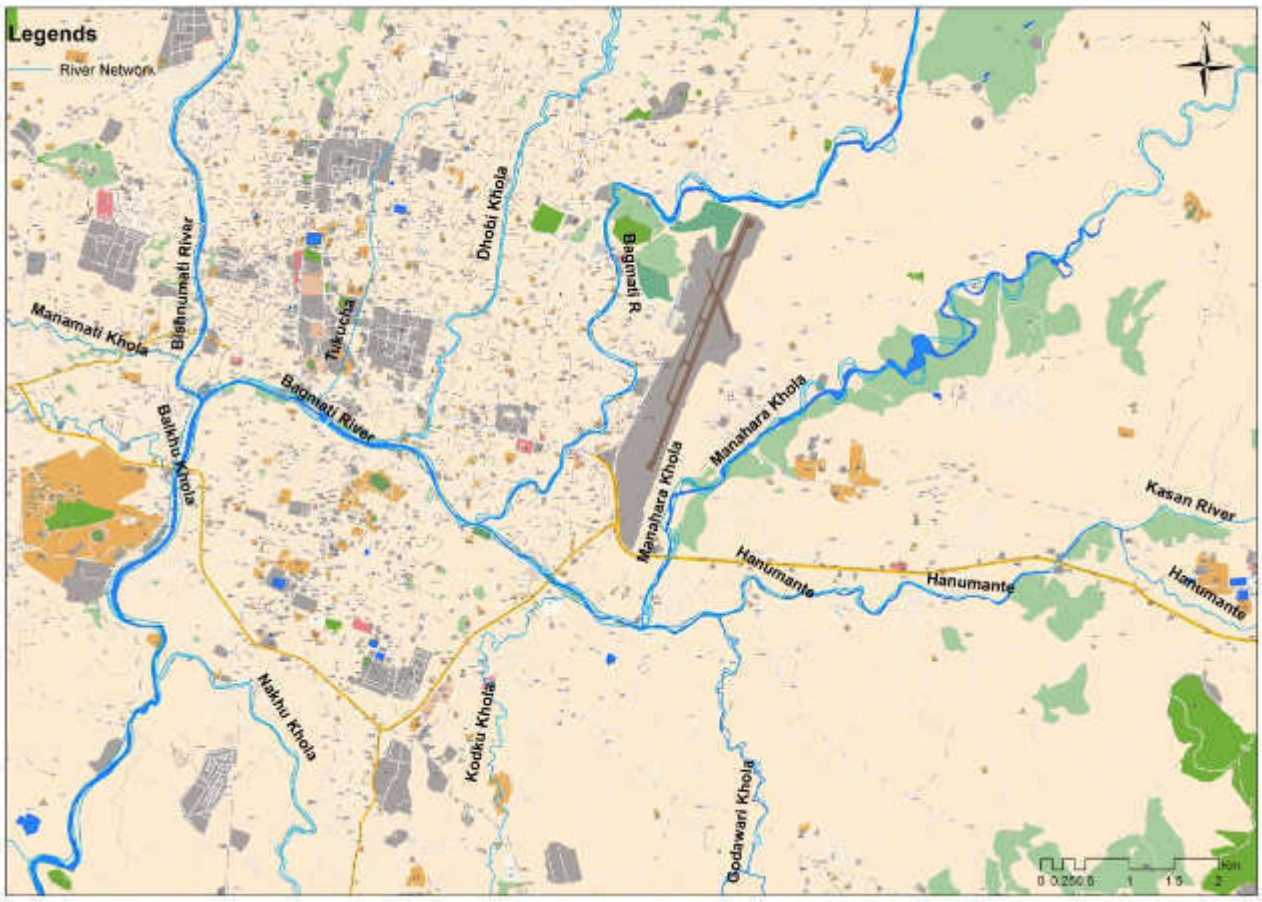


Figure IV-3: Longitudinal Profile of the Bagmati River Basin

Source: DWIDP/SILT/ERMC/TECHDA. 2005. Preparation of Water-Induced Hazard Maps of Bagmati River Basin



128. The major tributaries of the Bagmati River inside the Kathmandu Valley are Bishnumati, Balkhu, Tukucha, Dhobi Khola, Manohara, Kodku, and Nakhu Khola. These tributaries are highly polluted. The municipal wastes and industrial effluents are directly discharged into these rivers and have made the water unusable for human and ecological needs along most of the course. In addition, Kathmandu Valley is facing a severe shortage of water due to rapid urbanization. The annual groundwater use for domestic and industrial purposes in the valley is almost two times the annual rechargeable groundwater available. The Bagmati River has a high religious value. It also adds to the aesthetics of the valley as it passes through, along with its tributaries, the major three cities of the valley.

3. Surface Water Quantity

129. Kathmandu Valley has a chronic water shortage. The sole water utility operator, Kathmandu Upatyaka Khanepani Limited (KUKL) has not been able to meet water demand of rapidly growing population of urban and semi urban areas of KV within its service area. The present water demand is estimated to be 350 MLD by KUKL in 2012 while the supply is limited to about 150 MLD in wet season and about 90 MLD in dry season. There is thus a large disparity between demand and the supply. KUKL is adapting intermittent supply to cope with this shortage and customers are sometimes supplied with drinking water for only about an hour once every six days during wet season, and as little as 1-2 hours once every eight days during dry season in some locations. The demand for drinking water is increasing by about 6% annually.

130. The existing system taps water from 35 surface water sources and 59 deep tube wells located in different parts of the valley. The total production of water from all these sources is about 150 MLD in wet season and 90 MLD in dry season with an average production of about 120 MLD throughout the year. During the wet season, surface water constitutes about 90% of water production while this drops down to about 70% during dry season. The groundwater is a major source of water during dry season and constitutes about 30% of water supplied by KUKL.

Figure IV-4:River System of Kathmandu Valley

131. As the water utility has not been able to meet water demand, many private and government institutions and industries have constructed their own deep tube-wells to use groundwater directly. KVWSMB estimates that the total quantity of groundwater being extracted in 2011 is 81.6 MLD, out of which 31.6 MLD is being used by KUKL for municipal supply and the balance (50 MLD) is extracted by private sector for uses in hotels, industries, bottled water manufacturing, tanker supplies and new housing colonies.

132. Tanker water supply is a flourishing business in Kathmandu Valley and is complementing the meagre supply of water by the utility. Their supply areas are mainly urban core and newly developed semi-urban areas where there is high density of hotels, hospitals and other institutions. There are 700-800 water tankers in operation being operated by about 216 water tanker entrepreneurs. Most tanker companies have their own water sources and use both surface as well as groundwater source, but predominantly groundwater source. The combined production of these companies is about 12.58 MLD (11.10 MLD groundwater and 1.48 MLD surface water) in the dry season and about 6.36MLD (5.44 MLD groundwater and 0.92 MLD surface water) during the wet season. Research conducted in 2012 indicated that the total amount of water supplied through tankers is about 25.58 MLD in dry season and 15.36 MLD in

wet season. This supply constitutes about 8% of water demand or about 44% of water reaching consumers from KUKL supplies.

133. The shallow wells are a common source of water used to supplement inadequate public supply for domestic use. Most houses in Kathmandu Metropolitan City have either dug well or shallow tube-well (Rower pump). In 2009, the number of houses possessing a private well was about 74.3 % in Kathmandu Metropolitan City and 20.2% in Bhaktapur Municipality.

134. The other sources commonly used are bottled water, stone spouts, rain water harvesting arrangement and other springs and rivers.

135. The present consumption of water in Kathmandu Valley varies between municipalities and the availability of water. The population of KMC and LMC has higher water demand than other smaller municipalities. The population with private tube-wells has significantly higher consumption than people without them. The consumer survey carried out in 2009 showed that every house in Kathmandu with a private tube-well consumed 98 lpcd in average whereas a house without private well consumed only 47 lpcd. The analysis of data from the baseline survey showed that the total water consumed for domestic purposes (from all sources) in Kathmandu valley is about 107.43 MLD. Table 4-2 presents the breakdown of water consumption in five municipalities and the VDCs (Consumer Survey, 2009).

136. The unconstrained water demand in the five municipalities and the VDCs is estimated by the baseline survey study to be in the range of 100-120 lpcd for fully plumbed connections, 50 lpcd for yard taps and 25 lpcd for public stand post. These demand values have been used for forecasting post-Melamchi water demand (year 2020 water demand) while preparing the Capital Investment and Asset Management Program for Kathmandu Valley. The CIAMP has assumed the water demand to grow with economic growth and availability of water. The water consumption in the year 2025 in Metropolitan Kathmandu is expected to be 135 lpcd for fully plumbed, 70 lpcd for yard tap and 45 lpcd for public stand post. The total water demand within the service area in Kathmandu Valley is estimated in CIAMP to be 445 MLD and 685 MLD in the year 2020 and 2025 respectively.

Table IV-1: Water Consumption by consumers in Kathmandu Valley from all sources

Municipality Name	Population (Year [illegible])	Population Served by KUKL	Population Served	Population with Private Well in the Compound			Population without Private Well in the Compound			Total Water Consumption
				Percentage	Per Capita Consumption	Total Consumption	Percentage	Per Capita Consumption	Total Consumption	
		(%)	(No.)	(%)	(lpcd)	(MLD)	(%)	(lpcd)	(MLD)	(MLD)
Kathmandu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lalitpur	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VDCs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]		[illegible]			[illegible]			[illegible]	[illegible]

Source: Consumer Survey, 2009

4. Surface Water Quality

137. The BOD_5 level in different stretches of the Bagmati River at different seasons provides a clear indication of high level of pollution at all seasons of the year (BOD_5 levels range from 1.7 to 239.4 mg/l in the pre-monsoon, 2.1 to 84.7 mg/l in the monsoon, and 2.3 to 119.4 mg/l in the post-monsoon seasons). The main reason for the deteriorating water quality of the Valley's rivers is discharge of untreated sewage in the urban areas of Kathmandu, although solid waste dumping along the river is also a contributing factor.

138. Water treatment plants were installed from the very beginning of system development in order to improve the raw water quality and make it safe for drinking purpose. Balaju water treatment was built as a component of Tri Bhim Dhara system and Maharajgunj water treatment plant as a component of Bir Dhara system. With the expansion of the networks, more water treatment plants were built. There are 21 water treatment plants (5 major and 16 smaller) in Kathmandu Valley water supply system with a total treatment capacity of about 85 MLD. Most of WTPs are capable of treating surface water and groundwater containing a high content of suspended solids, iron and ammonia. Most of water treatment plants are in poor state of maintenance and have not been consistent in producing acceptable water quality.

139. Bacteriological water quality deterioration during transmission is a significant problem due to ingression of polluted water into water supply pipe from leaking sewers during intermittent water supply. Pollution of drinking water is now very frequent and KUKL receives many complaints about it. Almost every report on drinking water quality of Kathmandu reveals that most of water supply is contaminated with bacteria. The chemical quality of most of the water is within WHO guidelines.

Table IV-2: Comparative *Analysis and Projection of BOD and DO at different locations in Kathmandu* Valley *along the Bagmati River in 2014, 2020 and 2030.*

Location	BOD (mg/L)				DO (mg/L)		
	2014	2020	2030		2014	2020	2030
Gokarna	15.07	16.72	20.10		6.01	6.01	5.85
Gaurighat	33.06	9.29	42.32		5.38	5.19	4.72
Minbhavan	86.46	97.05	109.03		2.49	2.36	2.18
Teku	117.61	131.4	148.04		1.31	1.17	1.05
Dhobighat	118.0	131.98	148.93		1.013	0.92	0.82

Source: Mishra, B.K., et al. Assessment of Bagmati river pollution in Kathmandu Valley: Scenario-based modelling and analysis for sustainable urban development. Sustain. Water Qual. Ecol (2017)

140.

141. *Table IV-2* showed the comparative plots of monthly DO and BOD values at five locations on the Bagmati River from upstream to downstream areas. In general, there are consistent seasonal variations in DO and BOD levels strongly associated with river discharge as DO and BOD approach 0 mg/l and 200 mg/l during the dry months of the year. The higher concentrations of DO and BOD in the dry months are also associated with the lower capacity for natural self-purification and dilution of pollutants due to reduced flows. Although it was believed that the river water pollution will be largely sorted out after the establishment of the new/rehabilitated WWTPs, plots of 2020 and 2030 show that DO and BOD values will remain

far beyond acceptable limits. These data demonstrate that the current, as well as new/rehabilitated wastewater treatment plants, are largely inadequate to alleviate the Bagmati river pollution. By 2030, river water pollution will be much worse. There will be an increase of wastewater generation due to the greater population and socio-economic development despite rehabilitation, up-gradation and new wastewater management systems. Therefore, the new/rehabilitated wastewater infrastructures need to be expanded further with the increase of population, lifestyle and other socio-economic development activities resulting in a significant increase of wastewater. The quantity of wastewater generation is closely connected with management or pattern of water consumption. Thus, the simulation results of the WEAP model with adaptation scenarios can contribute to the improvement of water consumption pattern. One of the alternative measures for reducing water consumption and wastewater generation could be changes in the water utility pricing system. Alternative pricing such as an increase in water utility service fee (sum of water supply and sanitary service charges) can help in optimal use (reduction) of water consumption and also increase revenue for sustainable operation and management of water infrastructures. Water quality simulation in this study was based on the mean behaviour of the system. However, the wastewater generation rate, as well as water quality parameters, may be significantly different depending on the location, community, catchment, daily variation in streamflow in the rainy season and various others. Obviously, in 2020 and 2030, if there are no drastic measures to control pollution sources, Bagmati River water quality will be no longer eligible to supply for any practical purposes. Therefore, to ensure the water quality in future eligible for different uses, it is required now to have timely solutions to solve this problem (Mishra, B.K., et al.).

5. Groundwater

142. The groundwater aquifers of Kathmandu Valley are divided into three districts: Northern (157 km^2 with 59 km^2 recharge area), Central (114 km^2 with about 6 km^2 recharge area), and Southern (55 km^2 with about 21 km^2 recharge area) (Dixit and Upadhya 2005). The heavy extraction of groundwater to meet the domestic as well as commercial demands is alarming because it depletes the groundwater level. There is haphazard extraction of water from both shallow and deep aquifers in Kathmandu Valley at present. According to the hydro-geological conditions of Kathmandu Valley and the recharge rate of the basin, only 15 MLD of groundwater can be safely extracted in a day (JICA 1990). This rate is being exceeded by more than 70% by the Nepal Water Supply Corporation (NWSC) tube wells alone. Due to the increase of built-up areas, groundwater recharge is reduced with the rerouting of the natural drainage. The unsustainable extraction of groundwater causes land subsidence, which is already evident in many cities in Asia (e.g., Bangkok).

143. It is estimated that the groundwater of Kathmandu Valley is decreasing at an average rate of 2.5 meters per year. The depletion varies by location as the geological structure within the Kathmandu Valley is diverse. If the current rate of groundwater extraction continues, water will be sufficient for the next 90 years only (http://guthi.net).

144. Many households have installed rower pumps to extract groundwater from the shallow aquifer when NWSC could not meet their demand, but the bacteriological quality of the water poses some concern and has to be looked into. Due to the necessity of stopping groundwater mining, it is urgent to enact a law and formulate rules and regulations on the extraction of groundwater in Kathmandu Valley.

6. Groundwater Quality

145. Of the 57 deep tube wells tested, many have exceeded the country's standards for color, turbidity, ammonia, iron, and manganese. Two of the wells exceeded the arsenic standard. In some wells, ammonia concentration was found to be extremely high (50 fold above the threshold value of 1.5 mg/l). Twenty of the 57 wells showed bacterial contamination (ENPHO, 2009).

7. Melamchi and Other Water Supply Projects

146. Major infrastructural development works are on-going in Kathmandu Valley for augmentation of water supply, and expansion and rehabilitation of distribution network. Melamchi Water Supply Project (Melamchi Water Diversion Subproject 1), which will bring in170 MLD water from Melamchi River to Kathmandu Valley in the first phase, is under implementation. The subsequent phases of Melamchi project would bring in 170 MLD water from Yangri Khola in the second phase and 170 MLD water from Larke Khola in the third phase. The Melamchi water diversion project involves construction of about 27.5 km tunnel, river intake and a de-silting basin. The water treatment plant proposed at Sundarijal is under construction. The construction work of the project has been on-going since April 2009. Although the originally scheduled completion date of tunnel construction is September2013, it is now expected that the project will be completed by April 2016.

147. KUKL is currently implementing Kathmandu Valley Subproject 2 of Melamchi Project (Loan 1820). It has completed some works for immediate improvement of water supply service in Kathmandu Valley. KUKL PID is now implementing distribution network improvement works and other related activities.

C. Existing Wastewater System

148. This section provides an overview of the wastewater services. It covers issues relating to the wastewater collection network and conveyance system. It includes the neighborhood system, main collectors and interceptors which ultimately convey wastewater to the treatment plants. The issues concerning the wastewater treatment systems have been dealt in the separate reports under different packages.

1. Development of Sewer System in Kathmandu Valley

149. The first sewers in the Kathmandu valley were constructed around 1800 AD during Malla period for surface drainage and kitchen sullage and the sewerage system of the core areas of the valley between 1898 and 1950 during Rana regime. These were combined sewers. These Rana sewers were brick sewers typically 600 m circular sections or 1050 x 1050 mm ovoid sections. These were constructed with a flushing system using gates to allow sudden release of flows.

150. After the widespread introduction of the water flush household toilets in the beginning of 1950, the houses of adjoining sewers started discharging domestic sewage into these sewers. Under the three IDA projects, the first project undertaken during (1976 - 1983) and second (1980 – 1985) were constructed as separate sanitary and storm water systems. The first IDA project during 1976-83 laid down approximately 26 km of sanitary sewers including cleaning of some Rana sewers. Also, in the IDA projects two wastewater treatment plants (WWTPs) were constructed at Balkumari (now known as Kodku) and Sundarighat (now known as Dhobighat).

D. Ecological Resources

1. Forest and National Park

151. Rice, wheat, corn, vegetables, and a variety of fruit including bananas and oranges are grown in the fertile Valley, which supports a relatively high percentage of the hill population.

152. However, no any forests, national parks and protected area is existed within the proposed WWTP project locations.

E. Socio-economic Profile

1. Social and Household Profile

153. **Social classification**. The majority of the people living in the valley are Hindus followed by Buddhist. The number of people with other religions is minimal. Households are divided into different ethnic groups such as Newars, Brahmins, Chettris, Tamangs, and Magars. Newars are the prominent inhabitants followed by Brahmins, Chettris, Tamangs, and Magars. These ethnic groups are not of the same level of socio-economic development. In Kathmandu Valley, Newars are considered as advanced indigenous people's group. Besides Newars, Brahmins and Chhetris are the major ethnic groups. Similarly, Tamangs and Magars comprise a small percentage of the total population of the Valley.

154. The Kathmandu Valley is bowl cup shaped which is surrounded by the mountains. Its administrative boundary has not been defined. The boundary of the Kathmandu Valley developed from the map study along with the municipalities within the Kathmandu Valley are shown in Figure IV-5.

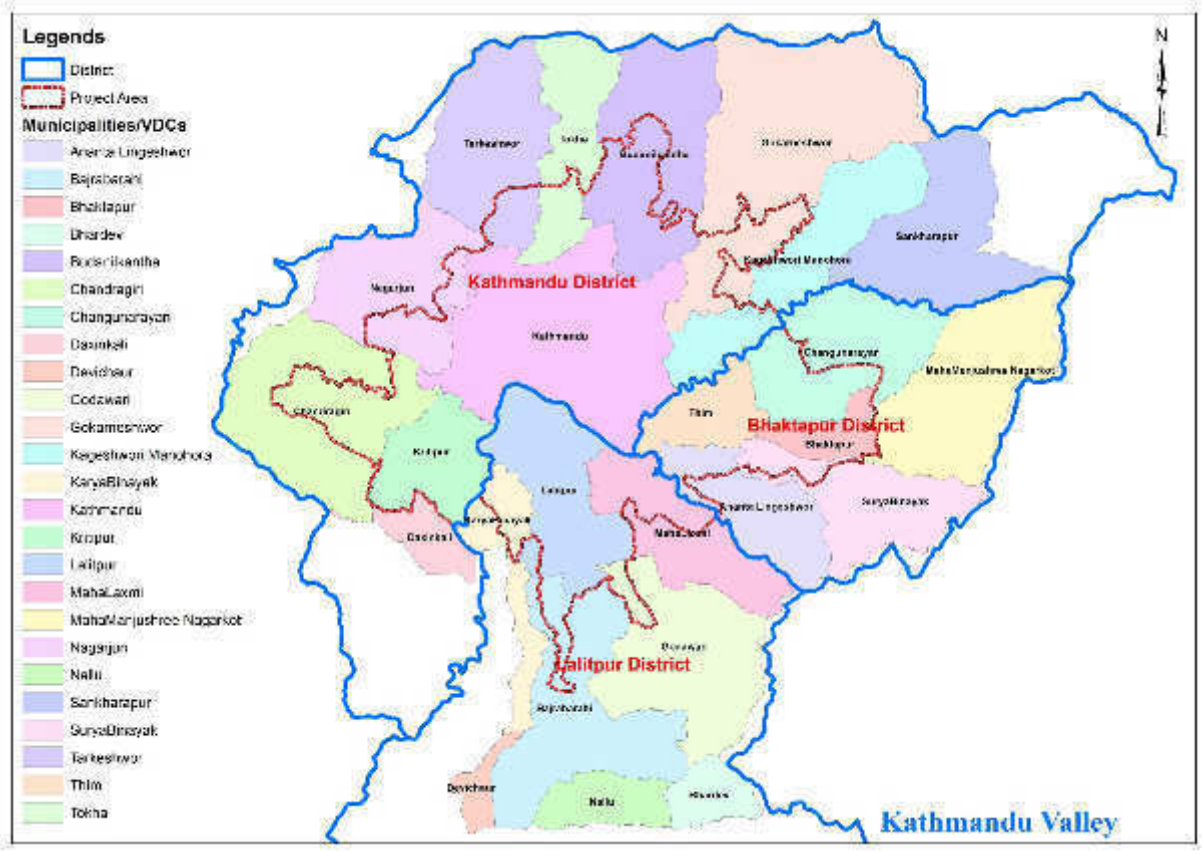


Figure IV-5: Kathmandu Valley Boundary

155. The Kathmandu Valley covers the areas of the Kathmandu, Lalitpur and Bhaktapur districts. The five cities of Kathmandu Metropolitan, Lalitpur Metropolitan, Bhaktapur Municipality, Kirtipur Municipality and Madhyapur Thimi Municipality in essence cover the core urban area of the valley with the highest population concentration. The government has recently formed the eleven municipalities in the Kathmandu district, three municipalities and one rural municipality in Lalitpur district and four municipalities in the Bhaktapur district by combining the VDCs of the respective district with the municipality. The 2011 census population and land areas coverage of these municipalities are presented in Table IV-3.

Table IV-3: Population and Land Area of Kathmandu Valley

Municipalities	Area (Hectare)	Population (2011)
Kathmandu Districts		
Kathmandu Metropolitan City	5,194.15	975,453
Kirtipur Municipality	1,539.35	65,602
Gokarneswor Municipality	5,669.47	107,238
Dakshinkali Municipality	688.14	5,449
Tarkeshwor Municipality	2,896.13	75,048
Shankharapur Municipality	2,878.62	17,166
Chandragiri Municipality	4,001.70	82,805
Kageswori Manohara Municipality	2,723.68	60,237

Municipalities	Area (Hectare)	Population (2011)
Tokha Municipality	1,872.95	98,897
Nagarjun Municipality	2,649.06	65,788
Budhanilkantha Municipality	3,428.69	107,547
Lalitpur Districts		
Lalitpur Metropolitan City	3,667.28	284,922
Godawari Municipality	7,647.94	71,888
Mahalaxmi Municipality	2,197.03	61,943
Konjyosom Rural Municipality	1,488.00	4,078
Bhaktapur Districts		
Bhaktapur Municipality	670.61	81,748
Madhyapur Thimi Municipality	1,125.98	83,036
Suryabinayak Municipality	4,004.26	76,907
Changunarayan Municipality	6,080.08	55,019
Total	**60,423.13**	**2,380,771**

Source: CBS, 2011

156. The total population of the Kathmandu Valley in the year 2011 is 2,380,771 and covers an area of 60,423.13 hectares. The five cities of Kathmandu Metropolitan, Lalitpur Metropolitan, Bhaktapur Municipality, Kirtipur Municipality and Madhyapur Thimi Municipality have 63% population of the Kathmandu Valley covering 20% of the Valley.

157. **Age**. The economically active age group (from 15 to 44 years old) constitutes about 56% of the project district's population. The other main age group is from 5 to 14 years old. Only about 5% of the population are 60 years and above. There are no significant differences in the age distribution of population in KUKL service areas.

158. Religion. Kathmandu's present demography is very cosmopolitan in which Newars; the indigenous people of Kathmandu still comprise a large segment of the population followed by Bramhin and Chhetri. Other ethnic groups like Sarki, Damai, Dalit, etc. are in minority. But now many ethnic groups are migrating from other districts of Nepal and found mixed ethnic groups in Kathmandu valley. Kathmandu's culture has been inspired by the convergence of Hindu and Buddhist. Hindu and Buddhist are the main religion with Christian and Muslims as minors.

2. Employment

159. The economy of Kathmandu Valley is based on trade, commerce, and manufacturing industries (e.g., carpets and garments). Other important sectors are agriculture, education, transport, and hotels and restaurants. Tourism is also a key component of the Valley's economy. However, in the rural areas, the economy is still based on agriculture.

160. Kathmandu Valley has developed as a centre of trade links with India and Tibet (People's Republic of China). According to the Economic Survey 2010-2011, Nepal in fiscal year 2009-2010 exported 71% of its goods to India and 29% to countries such as the United States, United Kingdom, Italy, Germany, Canada, and Japan. The main export commodities are ready-made garments, woolen carpets, woolen and pashmina goods, and handicrafts of which

most are manufactured in Kathmandu Valley. Nepal imported 68% of goods from India and the rest, from other countries. The major import items are petroleum products, medicines, electronic goods, gold, transport equipment, and fertilizers. A significant share of imported goods is consumed in the valley. Kathmandu Valley is the entry point for the majority of tourists. In 2009, a total of 602,867 tourists arrived in Nepal, of which, more than 80% entered through the Kathmandu international airport.

161. About 53% of the total population aged 10 years and above in the valley are economically active (Census 2001). They are engaged in agriculture and forestry (36%), manufacturing (17%), commerce (16%), construction (4%), and transportation/ communication (3%).

162. Table IV-4 summarizes the economic activities in the urban areas of Kathmandu Valley. About 34% of the households are engaged in small-scale non-farm activities. The Lalitpur Municipality has the highest percentage (50%), whereas the Kirtipur Municipality has the lowest (13%). Among the households engaged in non-farm activities, nearly 45% are engaged in trade and business followed by services (32%) and manufacturing (9%). Nearly 50% of the households in Kirtipur and Kathmandu are engaged in trade and business.

Table IV-4: Household in Non-farm Economic Activities in Kathmandu Valley

Municipalities	Share of Households Engaged in Non-farm Activities (%)	Type of Activities				
		Manufacturing	Trade/ Business	Transport	Services	Others
Lalitpur	50.18	13.25	33.22	4.29	42.37	6.86
Bhaktapur	40.83	13.24	38.55	4.26	26.54	17.40
Madhyapur Thimi	35.02	11.39	41.88	4.48	23.26	18.98
Kathmandu	31.57	6.86	49.49	3.49	30.26	9.90
Kirtipur	13.34	9.72	51.42	2.84	22.83	13.19
Total	34.43	9.02	44.66	3.76	32.41	10.14

Source: CBS, 2003

163. According to the 2001 Census and the Nepal Human Development Report 2004, the poverty status and human development index of Kathmandu Valley was lower than the national level (Table IV-5).

Table IV-5: Kathmandu Valley Development Indicators

District	Human Development Index (HDI)	Human Poverty Index (HPI)	Gender-related Development Index (GDI)
All Nepal	0.471	39.6	0.452
Kathmandu	0.652	25.8	0.635
Lalitpur	0.588	25.0	0.569
Bhaktapur	0.595	29.9	0.578

Source: Census 2001; UNDP. 2004. Nepal Human Development Report.

3. Slums and Squatter Settlements

164. The rapid population growth has created a number of slums and squatter settlements in Kathmandu Valley. *Table IV-6* summarizes the findings of a survey conducted by LICSU, KUKL

in 2008. There were 39 squatter settlements and 137 slums in the valley with 40,237 population and 8,846 households. Of these, 22% have no access to piped water supply and none have adequate sanitation.

Table IV-6: Slums and Squatter Settlements in Kathmandu Valley

Type of Residence	No. of Households	Total Population	Average Household Size	Share of Households Without Piped Water Supply
Slums				
Bhaktapur Municipality	754	3274	4.34	32
Madhyapur Thimi Municipality	382	1981	5.19	85
Lalitpur Sub - Metropolitan	391	1,866	4.77	62
Kathmandu Metropolitan	3,784	16,575	4.38	58
Kirtipur Municipality	1,674	7,767	4.64	64
Squatters				
Kathmandu Metropolitan	1,861	8,774	4.71	95
Total	**8,846**	**40,237**	**4.67**	**66**

Source: Mapping of Slums, Squatters and Stand Posts in Kathmandu Valley updated by LICSU, KUKL, June 2008, AVIYAAN Consulting (P) Ltd.

4. Economic Development and Prospects for Growth

165. Compared to the rest of Nepal, Kathmandu Valley fares better because it has basic facilities such as water supply, sanitation, electricity, bottled gas, telecommunications, roads, education, security, and transportation. The valley is also the centre for several major industries such as textile, food & beverage, non-metallic mineral products, publishing, and printing. Such facilities and opportunities are a huge attraction to the rural poor resulting in high migration rates into the Valley; hence the rapid population growth and demand for urban services, especially water supply, within the Valley.

166. The valley's annual industrial output is estimated to be NRs.14.6 billion ($190 million), which is nearly 9.4% of the total national industrial output. The industrial sector employment in the valley is about 37,500, which is 22.1% of the national employment in the sector. Similarly, indirect employment in the industrial sector is about 38,900, which is about 21.9% of the national figure.

167. Being the capital city and a commercial center for the country, Kathmandu and its surrounding valley is developing and urbanizing fast, compared to the rest of Nepal. It is the most important urbanized area in Nepal. New products and services are first introduced in the Valley, giving the inhabitants access to modern equipment and technology. An indication of confidence in economic growth is the high demand for new housing real estate and the number of new vehicles on the roads, which is rising rapidly. In addition, there are plans for major transportation improvements such as the Kathmandu outer ring road and the new link road to India via Terai.

5. Access to Site

The site for Dhobighat WWTP can be accessed from road at left bank of Bagmati river where Chakra path 1 on Ring road and the distance from Charkra path 1 to access road is

approximately 2 km. The site of Kodku WWTP can be accessed by following the road on left bank of Hanumante river from Balkumari bridge on Ring road. The site is located approximately 400 meter downstream from Balkumari bridge. The site of Sallaghari WWTP is close to Khasyan Khusun Kola and located at the intersection between Bhaktapur road and Nagarkot road.

Table IV-7 Treatment and flow rate of planning WWTP

Parameter	Dhobighat	Kodku	Sallaghari
Treatment area, m^2	304,000	65,000	22,000
Population, people	955,000	304,000	122,000
Flow rate, MLD	110.0	35.0	14.2
Average flow rate of 2^{nd} package, MLD	37.0	17.5	14.2

6. Land Use

168. The land use and land cover statistics (Table IV-8) derived from the 1992 topographical sheet show that almost 50% of the Bagmati watershed is occupied by forests. The Midlands and the Mahabharat Ranges are characterized mainly by deciduous and coniferous forests, while hardwood and mixed hardwood forests characterize the Shiwaliks and the low-lying areas of the Midlands and the Mahabharat Range. Next to the forests are cultivated lands, which cover about 37% of the total area. Agricultural activities are confined mainly in the river valleys and the gentle slopes of the hilly region. Built-up areas occupy an insignificant portion, less than 1%, of the total area. The metropolitan city of Kathmandu, sub-metropolitan city of Lalitpur, and municipal cities of Bhaktapur, Madhyapur Thimi, and Kirtipur are the major built-up areas in the watershed.

Table IV-8: Land Use and Land Cover in the Bagmati River Basin

Land Use/Land Cover	Area (ha)	Percent
Forest	186,340	49.6
Cultivation	141,986	37.8
Sand	18,118	4.8
Bush	13,367	3.6
Grass	5,241	1.4
Channel	4,441	1.2
Built-up area	2,378	0.6
Barren land	1,264	0.3
Orchard	785	0.2
Scattered tree	551	0.1
Nursery	360	0.1
Pond or lake	141	0.0
Others	628	0.2

Source: DWIDP/SILT/ERMC/TECHDA. 2005. Preparation of Water-Induced Hazard Maps of Bagmati River Basin.

F. Infrastructure

1. Transportation

169. Long-distance bus services from Kathmandu provide services to the people throughout the country. Private transport includes buses, microbuses, vans, cars, jeeps, and three-wheelers operated by petroleum, liquid petroleum gas (LPG), and batteries. The total length of roads in Kathmandu, Lalitpur and Bhaktapur is 813,337 and 181 km, respectively, or a total of 1,331 km of roads within the Kathmandu Valley (Department of Roads 2004).

170. The Tribhuvan International Airport is just 30 minutes away from the town centre. There are numerous daily flights from Kathmandu to international destinations as well as regular flights to many areas of the country. Many international airlines fly to the Kathmandu international airport.

2. Drinking Water Supply

171. Not all households and people in the Valley receive safe drinking water. Various sources of drinking water for households are shown in Table IV-9.

Table IV-9: Sources of Drinking Water

	Kathmandu Metropolitan City		Lalitpur Sub-metropolitan city		Bhaktapur Municipality		Madhyapur Thimi Municipality		Kirtipur Municipality	
	HHs	%	HHs	%	HHs	%	HHs	%	HHs	%
Tap	163,339	64.2	33,378	61.2	15,998	90.7	13,431	66.2	14,734	75.8
Tube well	18,574	7.3	801	1.5	107	0.6	1,412	7.0	47	0.2
Covered well/kuwa	10,890	4.3	6,045	11.1	444	2.5	2,085	10.3	382	2.0
Uncovered well	1,341	0.5	940	1.7	217	1.2	602	3.0	52	0.3
Spouts	4,830	1.9	2,708	5.0	350	2.0	1,389	6.8	754	3.9
River/stream	52	0.0	38	0.1	4	0.0	2	0.0	3	0.0
Others	53,275	21.0	10,242	18.8	425	2.4	1,263	6.2	3,350	17.2
Not stated	1991	0.8	429	0.8	94	0.5	118	0.6	119	0.6
Total	254,292	100.0	54,581	100.0	17,639	100.0	20,302	100.0	19,441	100.0

Source: CBS, 2011.

172. Based on the 2005 data of the Department of Drinking Water and Sewerage, the number and percentage of the population receiving water by district and for the Kathmandu Valley are shown in Table IV-10. It shows that less than 75% of the population receives piped drinking water supply from the then Nepal Water Supply Corporation (now KUKL).

Table IV-10: Population Receiving Drinking Water

District	Estimated Population in 2005	Beneficiary Population in 2005	Percentage
Kathmandu	1,246,110	947,630	76.05
Lalitpur	366,010	286,250	78.21
Bhaktapur	244,130	152,270	62.37
Total	**1,856,250**	**1,386,150**	**74.67**

Source: NWSC. 2005.

3. Surface Drainage, Sanitation, and Sewerage

173. Storm water drainage systems function in the valley through side drains but not well enough. The sewers of Kathmandu are largely a combined sewer/drainage system. For many years, reports on Kathmandu sewerage have highlighted the value of separating storm water and sanitary sewage, but the process has not yet started. The increased use of plastic bags has also worsened the problem as plastics frequently clog the drains.

4. Electricity

174. Not all households in the valley have electricity, but the overall proportion of households connected to electricity is high at roughly 95%. Based on the Nepal Human Development Report 2001 (UNDP 2002), about 96.81%, 87.64%, and 96.41% of households in Kathmandu, Lalitpur, and Bhaktapur, respectively, have electricity.

5. Educational Institutions

175. Kathmandu Valley has long been considered the center for higher education in Nepal. In 2007, it had 6,106 high schools and 474 higher secondary, college, and university-level educational institutions. The number of students enrolled during the period at in high school and higher education level was 573,779 and 156,828 respectively (ICIMOD, MOEST, UNEP 2007).

176. Education has been progressing continuously, specifically in the Kathmandu Valley and as a result, educational institutions, levels of education, and fields of study have been increasing. Table IV-11 shows the number of schools by level for the three districts.

Table IV-11: Total Number of Schools by Grade and Level

	Primary	Lower Secondary	Secondary	Higher Secondary
Kathmandu	920	671	514	148
Lalitpur	277	147	108	47
Bhaktapur	243	137	85	9
Total	**1,440**	**955**	**707**	**204**

Source: Compiled from NIDI 2006; ICIMOD, Ministry of Environment, Science and Technology (MOEST), United Nations Environment Programme (UNEP) 2007.

177. Tribhuvan University, the national university, has five institutes (Engineering, Agriculture and Animal Sciences, Medicine, Forestry Science, and Science and Technology) and four faculties (Law, Management, Education, and Humanities and Social Sciences), which offer almost all the popular disciplines at different academic levels, including master's and doctorate.

178. There are 3 medical and more than 12 engineering colleges offering up to master's level education. The Council for Technical Education and Vocational Training is another regulatory body monitoring the curriculums for technical and vocational training as well as diploma courses in different subjects to produce skilled manpower.

6. Health Facilities

179. Kathmandu is the center for all types of health services (general medicine, surgery, heart care, orthopaedic care, kidney care, dental care, children's care, eye care, mental care, neurology, etc.). The number of health facilities owned by the Government or provided by local

and international NGOs and the private sector is relatively higher (and with better services) in Kathmandu than in Lalitpur and Bhaktapur districts. However, the ratio of health institutions to the population served is higher in Kathmandu at 1: 9,574 compared to 1: 5,637 in Bhaktapur or 1: 4,119 in Lalitpur.

7. Communications

180. There are 3,991 post offices in Kathmandu Valley, including the general post office, regional postal directorates, district post offices, area post offices, and other post offices. A number of private postal care companies provide a wide range of postal services (ICIMOD, MOEST, WNEP, 2007).

181. The telecommunication system in Kathmandu Valley is excellent. As of 2005-2006, the Nepal Telecommunications Authority had issued basic telephone service license to two agencies, cellular mobile service license to two agencies, and internet licenses to 38 agencies (more than 50,000 customers) (ICIMOD, MOEST, UNEP, 2007).

8. Physical Cultural Resources

182. The project area does not comprise any physical cultural resources. As all the proposed available land area is well defined and own by GoN.

G. Economic Characteristics

1. Industries

183. Kathmandu Valley has many traditional cottage industries: textile weaving or handlooms, brick and tiles, pottery, handicrafts, precious ornaments, traditional food processing and preservation (e.g., rice milling, beaten rice, oil milling, sweetmeats, and traditional dairy products), wooden furniture and carving, bamboo crafts, traditional textile printing and dyeing, traditional art and paintings, copper and brass metal utensils, herbal medicines, forges, and leather crafts.

184. Kathmandu Valley has three industrial districts, namely, Balaju Industrial District, Patan Industrial Estate, and Bhaktapur Industrial Estate. Public sector brick factories, leather tanning, and shoe manufacturing are also found in the valley. Food and beverages, plastic products, construction materials, carpets, and readymade garment industries have flourished. However, the number of industries and employment provided by them has decreased drastically over the last decade. Industries are concentrated along the Kathmandu-Bhaktapur and Kalanki-Thankot roads. Most of the polluting industries such as textile dyeing, tanning, and distilling have been closed or transferred to places outside the Valley.

185. Of the remaining industries in the valley, the main polluting industries are only small scale. These include brick kilns, wool dyeing and carpet washing, textile dyeing, pottery, polyurethane and rubber foam, beaten rice, dairy products, metal casting, metal craft industries and gold plating; and alcoholic and non-alcoholic beverages.

186. With the worsening industrial pollution and rising awareness of the general public about the adverse impact of pollution, complaints have increased and measures have been taken to address them. The Industrial Promotion Board formulated an industrial location policy. There have been revisions to the policy and the latest location policy for industries specifies the following:

(i) List A: Types of industry that can be established in municipal areas of the Valley
(ii) List B: Types of industry that are not allowed in the Valley
(iii) All types of industry that have pollution prevention and safety measures can be established inside any designated industrial district (ICIMOD, MOEST, UNEP, 2007)

2. Agricultural Development

187. Rice is the main crop in the rural areas of Kathmandu and Bhaktapur, whereas maize is the prominent cereal crop of Lalitpur. The other cereal crops in the project districts are millet, wheat, and barley. Other agricultural produce such as lentil, soya bean, pea, and black gram are the main pulses grown, as well as potato and oil seeds.

188. Raising livestock is the second most important activity. Most of the households in the rural areas rear animals for income, food, or draft power. Goats are the most common, followed by cattle and buffaloes; their products have a ready market in the city area.

189. The population growth in Kathmandu Valley is bringing considerable changes to farming. Rapid urbanization and the introduction of new agricultural technologies have encouraged farmers to change their cropping patterns from traditional (low-value crops) to new crops (high-value crops). Land under cultivation of green leafy vegetables is increasing rapidly in the urban and semi-urban areas.

190. The increasing population growth and haphazard housing construction have resulted in the rapid decline of agricultural lands. If the current trend continues, there will be no more lands left for agriculture in the Valley. According to the District Agricultural Office, agricultural lands in Kathmandu will be reduced from 64% in the year 2041 to 41% in 2066(http://www.gorkhapatra.org.np/rising.detail.php?article id=28619&cat id=27).

3. Development Organizations

191. The Social Services' National Coordination Council regulates and supervises NGOs, while the Social Welfare National Coordination Council (SWNCC) deals with most of the funding agencies. There are 7,004 active NGOs in Kathmandu Valley registered with the Social Welfare Council (SWC). Kathmandu has 5,969, Lalitpur 856, and Bhaktapur 179 NGOs. According to SWC, there are 157 international NGOs across the country; of these, almost all have head office in Kathmandu Valley and more than 80% are working in the Valley (ICIMOD, MOEST, UNEP 2007).

192. There are also various NGOs working in the water and sanitation sector in the Valley. These organizations have focused mostly in slums and squatter settlements and rural areas. They have constructed water tanks of 5 m^3 capacity and a number of latrines/toilets with drains for the communities. The major NGOs working in the water and sanitation sectors are:

(i) Lumanti Support Group for Shelter
(ii) NGO Forum for Urban Water and Sanitation
(iii) Centre for Integrated Urban Development
(iv) Environment and Public Health Organization (ENPHO)
(v) Nepal Water forHealth (NEWAH)
(vi) Action Aid
(vii) Water Aid
(viii) Plan International

(ix) UDLE (Urban Development through Local Efforts)
(x) Red Cross.

4. Cultural Heritage

193. Kathmandu Valley is known for its ancient art, culture, craftsmanship, and numerous monuments of historic and archaeological importance that have been described by UNESCO as a "living heritage site." There are many temples, palaces, monasteries, and stupas that are centuries old. UNESCO has classified seven sites as world heritage sites within the Kathmandu valley. However, there is no any cultural sites within and near by the proposed Sallaghari, Kodku and Dhobighat WWTP.

H. Major Environmental Problems

194. The environmental problems of Kathmandu Valley are many.

195. **Air quality, traffic management, and noise pollution**. The emissions of the increasing number of vehicles (274,000 as of 2004-2005) account for about 38% of the air pollution in Kathmandu Valley. Industrial emissions also contribute substantially to air pollution (KVEO 2007).

196. Kathmandu Valley is particularly vulnerable to air pollution because of its bowl-shaped topography that restricts air movement. The situation is worse during the winter when temperature inversion during the night and early morning traps a layer of cool air under a layer of warmer air, trapping pollutants close to ground level for extended periods. Besides the topography, the relatively high elevation of the Valley also results in increased vehicular emissions.

197. Vehicular emissions have become the main source of air pollution in Kathmandu Valley. An inventory of emission sources by the then Ministry of Forest and Environment (MoFE) indicated that exhaust fumes had increased more than four times in the 8 years between 1993 and 2001. According to a more recent inventory, vehicular emissions are responsible for 38% of the total particulate matter < 10pm (PM_{10}) emitted in Kathmandu Valley, compared to 18% from the agricultural sector and 11% from brick kilns (Gautam 2006; Table 14). Increase in emissions is mainly due to the increase in the number of automobiles, as well as poor transport management and poor vehicle maintenance.

Table IV-12: Comparison of Emission Inventories in 1993, 2001, and 2005

Sources	TSP (tons/year)			PM_{10} (tons/year)		
	1993	**2001**	**2005**	**1993**	**2001**	**2005**
Mobile Sources						
Vehicle exhausts	570	1971	NA	570	3,259	4,708
Road dust re-suspension	1,530	7,008	12,239	400	1,822	3,182
Subtotal	*2,100*	*8,979*	*12,239*	*970*	*5,081*	*7,890*
Stationary Sources						
Industrial/commercial fuel	582	NA	NA	292	NA	NA
Domestic fuel combustion	2,328	NA	630	1,166	NA	347
Brick kilns	5,180	6,676	1,850	1,295	1,688	1,437

Himal cement	6,000	3,612	0	800	455	0
Stone crushers	NA	NA	1,720	NA	NA	372
Industrial boilers	NA	28	28	NA	15	15
Fugitive Emissions						
Refuse burning	385	687	172	190	339	172
Agricultural sector	NA	NA	NA	NA	NA	2,337
Cremation	NA	NA	NA	NA	NA	79
Total	**16,575**	**19,982***	**16,797**	**4,712**	**7,580**	**12,649**

NA = not available, PM = particulate matter, TSP = total suspended particles.

* In original report 19,884

Source: Shah and Nagpal 1997; Gautam 2006; MOEST 2005; and http://www.nepalnews.com.np/contents/englishweekly/sundaypost/2003/mar/mar16/2ndpage.htm

198. Recently, a study on traffic noise in Kathmandu Valley was carried out. The noise levels in Kathmandu City range from 79 decibels (dB) to 112 dB, higher than those of the major cities in India. The rate of increase of noise level in Kathmandu City was found to be 1 dB per year.

199. The permissible level for road traffic noise is 70 dB. An earlier study listed Kupondol Height, Thapathali, Sahidgate, Koteshwor, Gwarko, Gongabu, and Gyaneshwor as hazardous areas because their noise levels were found to be beyond 80 dB. The present study indicated that noise levels in Kathmandu were beyond the permissible values.

200. Three different types of noise areas were identified for Kathmandu Valley, although there is no data available on the noise levels produced from the existing WWTPs:

(i) Low noisy areas: Noise levels below 70 dB.
(ii) Moderate noisy areas: Noise levels between 70 dB and 80 dB; include Hotel Shangrila, Gairidhara, Galkhupakha, Gausala, Satdobato, Balkhu, Swoyambhu, Pulchwok, and Maitidevi.
(iii) Hazardous areas: Noise levels were beyond 80 dB; include Putalisadak, New Baneshwore, Kalanki, Narayan Gopal Chowk, Tripureshwor, Kalimati, and Koteshwore.

201. A survey showed that the frequency of health problems arising from noise pollution increases with the degree of noise levels. About 95% of tested affected people come from hazardous areas, 88% from moderate noisy areas, and 62% from low noisy areas.

202. **Settlement patterns**. Kathmandu Valley is developing haphazardly with the rapid increase of its population. It was estimated that by 2025, its population will be nearly 4.0 million, from only about 1.3 million in 2001. The valley's fertile lands are getting fragmented and residential houses are being constructed unabatedly. This kind of growth has created problems on transportation, electricity supply, drinking water supply, and river pollution.

203. **Water resources**. Extensive deterioration of river water quality (Appendix 2/3) and quantity in urban areas due to excessive pollution loads has already taken place. Increasing demand for drinking water has placed a heavy strain on already insufficient supply and has created water scarcity. Almost all major rivers have been tapped at source for drinking water. The current water supply is only about 131 MLD during the rainy season and 94 MLD during dry season of the estimated daily demand of 350 MLD. In the dry season, 60%-70% of the water

supply comes from groundwater.

204. **Waste management**. The main policy for waste management in Nepal is stated in the Solid Waste Management National Act enacted in 2011. The daily solid waste generation is assumed to be 0.25 kilogram per person per day (kg/p/d). Studies have revealed that the composition of solid waste in Kathmandu is mainly organic (58% to 66%) with 5% plastics. The use of plastic bags has increased over the years and since they are non-biodegradable (taking 400 to 1,000 years to biodegrade fully), its use should be discouraged or even banned. These plastics litter the streets and rivers, clog the drains, fill up landfill sites, get stuck on trees, and ultimately spoil the aesthetics of the natural environment. Animals mistake them for food and eat them and die as they obstruct the digestive systems. People even burn them, unaware of the effect of the toxic fumes. Furthermore, they are made from polyethylene, a product of petroleum, a non-renewable resource (www.reusablebags.letseegreener.co.uk, www.natural-environment.com).

205. A major issue in Kathmandu Valley is the accumulation of huge amounts of solid wastes due to the various demands of the people near the landfill site who obstruct the trucks carrying the solid waste. Another major issue is the dumping of hazardous and infectious wastes from hospitals and nursing homes together with domestic solid wastes.

206. Most of the plastics and reusable materials like bottles, metals etc. are picked up by scavengers daily who are helping the municipality by reducing the waste volume. Tourism is Nepal's topmost industry and if it is to thrive, solid waste management should be tackled well in all the municipalities and be given top priority.

207. The PPTA Team has estimated that nearly 25% of the generated solid waste is spread to open water ways. The five municipalities generate approximately 650 tons of solid waste daily, of which more than 70% comes from the Kathmandu Metropolitan City. The final disposal sites are always controversial and opposed by the local people and most of the solid waste is disposed of at the river banks and in open areas.

208. **Natural disaster preparedness**. Earthquakes and landslides are identified as the two most prominent potential natural disasters in Kathmandu Valley. The Valley is located in a seismic zone; lack of public awareness about earthquakes, lack of adequate planning, and lack of coordination are the main factors that impact negatively on disaster preparedness. Excavation of slopes, deposition of loads on slopes, deforestation, irrigation, mining, and water leakage are the main human activities causing landslides.

209. **Water quality.** Deterioration of water quality during transmission is a problem in almost all urban areas due to the ingress of polluted water into the pipes (intermittent supply), leakage, absence of chlorination, and absence of monitoring of water quality. Almost all available reports on drinking water quality of Kathmandu reveal that most of the urban water supply has bacterial contamination (Table 15). The chemical quality of most of the water is within the World Health Organization (WHO) guidelines.

Table IV-13: Water Quality of Different Water Sources in Kathmandu Valley

Parameters	Water Sources				WHO
	PTW	PUTW	Well	SS	GV
PH	6.5-8.2	6.5-7.5	7.5	7.5	6.5-8.5
Temp (°C)	13-18	12-15	15-18	15-18	25

Parameters	Water Sources				WHO
	PTW	PUTW	Well	SS	GV
Iron (mg/l)	ND-0.2	0.2	0.2	0.3	0.3=3.0
Chlorine (mg/l)	ND	ND	ND	ND	0.2
Chloride (mg/l)	10-30	22-45	22-45	23-45	250
$N\text{-}NH_4$ (mg/l)	ND-0.2	0.2	0.2	0.2	0.04-0.4
PO_4 - P (mg/l)	0.1	0.1	0.1	0.1	0.4-5.0
Coliform bacteria (source)	+/-	+	+	+	-
Coliform bacteria (consumption)	+				-
E.coli cfu/100 ml	10-131	3-20	48-200	58	0

Note: PTW = private tap water, PUTW = public tap water, SS = stone spout, WHO GV = World Health Organisation guideline value.
Source: Pradhan et al. 2005.

210. **Health and sanitation**. Individual septic tanks and soakpit systems and some pour flush latrines and pit latrines do exist in urban areas (the pollution of groundwater due to the leachate does exist but has not yet been quantified), but most of the effluent reaches the municipal drains, and ultimately the rivers or agricultural lands. People without toilets defecate in open fields and river banks. Public latrines hardly exist in urban towns and if they do, they are so poorly maintained (personal observation). There are only 18 public toilets in Kathmandu City, which has a population of around 2 million. They are ill-maintained as well and far below standards thereby turning the main town areas into open defecation places (Sedhai, R. 2012).

211. The Bagmati River is the main river system with tributaries that drain the Kathmandu Valley. The visible pollution of the Bagmati and its tributaries within the city reaches due to discharge of untreated domestic sewage, dumping of solid wastes, washing of vehicles, sand quarrying, and discharge of untreated industrial and hospital wastes, is severe (Bagmati Action Plan 2009-2014, 2008, Annex 2).

212. Sanitary conditions within Kathmandu Valley are hazardous (Halcrow Fox and Associates, 1991). A visual tour of the valley is sufficient to conclude that rivers, drains, and streams are highly polluted with sewage and industrial wastes. The use of septic tanks, pit, or pour-flush latrines is common. Bhaktapur and Greater Kathmandu have sewerage systems and sewage treatment plants, but the treatment plants in Greater Kathmandu are not functional. Many sewers overflow as there is no regular cleaning and maintenance. This report adopts the findings of UN-Habitat (2009) that overall, 30% of houses have a septic system. UN-Habitat estimated that there are 77,000 septic systems in the Valley. Only 35% have a soak-pit associated with a septic tank. The remaining tanks presumably discharge septic tank effluent directly to surface flows.

213. Storm water drains that were constructed more than 60 years ago in the core areas of Kathmandu are being used as combined sewers (Many reports, including the 2010 Conceptual Wastewater Master Plan mention this).

214. The majority of households in the valley districts have toilet facilities: about 81% in Lalitpur, 90% in Bhaktapur, and 92% in Kathmandu (CBS 2001). Most of the households' toilets do not have septic tanks and they are directly connected to the sewerage lines that discharge waste to the nearby river. For households with septic tanks, a municipal service is available for emptying the septic tanks on request. The Ministry of Forest and Environment is mandated to regulate unauthorized dumping. Domestic wastewater makes up approximately 93% of the total wastewater generation by the cities; the remaining 7% is industrial wastewater.

215. The existing sewage treatment plants within the valley are not functioning, except the existing Guheswari treatment plant. The newly expanded residential areas are usually devoid of sewers. In a few cases, however, sewage is channelled through hume pipes connecting to nearby rivers. Due to the direct discharge of untreated sewage and wastewater into the rivers, all the rivers in the Valley have been turned into open sewers. It is estimated that about 50,000 kg of BOD_5 per day is produced in the Valley. An average of 20,846 kg BOD/day has been recorded for the Bagmati River at the outlet, constituting 42% of the total BOD load produced (CEMAT 2000).

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

216. The Rapid Environmental Assessment is in Annex 1.

217. Environmental impacts on the physical, biological, and socio-economic and cultural environments during design, construction, and operation phases are discussed here in detail together with the mitigating measures. Most of the impacts will be localized, not greatly significant, and relatively small during construction and operation. All the WWTPs lie on government-owned land and the laying of sewers will be done in the RoWs of existing roads and river banks, thereby land acquisition will not be required and will not directly impact the existing biodiversity values.

218. Separate EMP table has been prepared for each WWTPs. The summary of anticipated environmental impacts and the corresponding mitigation measures are shown in Table V-1.

A. Design Phase

1. Environmental impacts due to project design

219. One of the most important activities before construction is the identification of the likely adverse impacts and their mitigation measures before construction works commence.

220. Identification of erosion-prone areas prior to construction is important to prevent or minimize soil erosion, sedimentation, and slope instability. To mitigate these adverse impacts, it is necessary to incorporate drainage plans into the project design, identify measures and sites for handling excessive spoil materials, and stabilize unstable areas.

221. Air quality dispersion modelling for all WWTP sites need to be conducted as part of the design phase to determine appropriate odour management measures that will need to be established. Since the WWTPs to be established will employ activated sludge process, odours will already be minimal in comparison to odours emitted from waste stabilisation ponds. However, since all the WWTPs will be established <100m from the nearest dwelling additional odour management measures will need to be implemented. These may include covering the inlet works as typically majority of the odours are emitted from raw sewage, Wastewater sludge reduction measures using the latest available appropriate technologies should be used in the design. No trees will be cut and only overgrown grass will be cleared. To produce energy, sludge gasification will be used. Green buffer zone will also be proposed around the project area during detail design to avoid or minimize noise and odours for the construction and operation of the WWTPs.

222. During the preparation phase, the land areas required by the project should be demarcated and sign posted accordingly. Ongoing consultation with affected communities should be conducted and due notifications to any interruptions as a result of construction should be provided in a timely manner.

223. Haphazard construction of camps for workers without basic amenities could result in social stress and the degradation of the local environment. Therefore, it is very important that these camps be provided with sanitary amenities at designated areas. As Nepal has no standards regarding the number of ablution blocks to be constructed in temporary labour camps, the 2009 IFC Guidelines (Appendix 8), that is, 1 toilet for every 15 persons (separate for men and women) will be followed. In Kathmandu, most of the labour will be local people who will

not stay in the camps.

224. An employment policy that avoids depriving the local communities of opportunities should be prepared to prevent tensions and dissatisfaction. The local people, especially the project-affected families and women above the age of 16 (Children's Act 1992), should be given first preference in employment. Wages should be settled based on the District Wage Evaluation Committee resolution or guidelines and the list of employees submitted to the Design and Supervision Consultant.

225. Detailed traffic plans should be prepared to help in mitigating traffic congestions and disturbance to pedestrians and businesses. A traffic management planning document that can be easily used by contractors to develop detailed plans should be formulated. Refer to Appendix 9 of the IEE prepared for NEP: Kathmandu Valley Water Supply Improvement Project (http://www.adb.org/sites/default/files/linked-docs/34304-043-nep-ieeeab.pdf).

226. All the WWTPs should have buffer zones. As land areas for the WWTPs have already been defined and residents are nearby, it is suggested that a minimum of 30 m green buffer zone along the site boundary with trees with thick foliage be planted to minimize nuisance due to odour, noise, lights, and improper operation and maintenance (O&M).

B. Construction Phase

1. Physical Environment

Soil erosion and slope stability due to excavation

227. Impacts likely to occur from the improvement and construction of sewerage systems will include trench excavations and topsoil stripping, which may induce soil erosion and slope instability. However, there is very less impact of soil erosion and slope stability within the WWTP project area. This is will be an issue particularly near the rivers where interceptors will be constructed. Haphazard disposal of spoil materials may create erosion problems, disturbances to the existing drainage lines, and changes to the existing land use practices. Mitigating measures to be used are separate stockpiling of topsoil in a safe yard for further use, spoil disposal at designated and stabilized sites, compaction of the backfill of excavated areas including replacement of topsoil, avoiding work during the rainy season as much as possible, mulching to stabilize exposed areas, use of bioengineering techniques (e.g., re-vegetating areas promptly), providing channels and ditches for post-construction flows, lining of steep channels and slopes (e.g., use of jute netting), preventing off-site sediment transport using settlement ponds, and silt fences.

Change in river hydrology and morphology

228. The construction, rehabilitation, and operation of the WWTP will not have any significant change in river hydrology and morphology. Water pollution problems could occur because of the dumping of spoil materials into the river, excavation of boulders from the river channel, direct disposal of liquid wastes, and leakage of oil and lubricants. Quarrying/mining activities in river/streams for extraction of construction materials shall not be done to avoid changing the river cross sections and longitudinal profiles and should be done in approved sites only.

Water and land pollution

229. Dumping of wastes or discharging wastewater effluents from toilets into the river can pollute the river water, making it unhealthy for downstream users. Mitigation measures to be used include avoiding construction of labour camps facilities within the drainage area, providing designated areas with collection of bins for wastes, providing toilet facilities and prohibiting open

defecation, and prohibiting washing of vehicles next to rivers and streams.

230. Pollution of land and water could also be mitigated by observing proper storage of construction aggregates, hazardous toxic materials, lubricating oils, used tyres, and exhausted batteries; and segregating and disposing of chemical containers, packaging materials, plastic bags, etc. Used oil and lubricants should be recovered and reused, or removed from the sites. Storage areas for fuels and lubricants should be away from any drainage leading to water bodies. All fuel use areas (e.g., generator) must have drip basins installed to prevent any leakages and recycled. All fuelling, repair, and maintenance work should be done on a concrete surface provided with a catch tank that can be cleaned and all spilled fuel recovered and recycled. Provision of training on the safe handling of toxic materials and occupational health and safety measures during construction could help in mitigating many of the adverse impacts mentioned above.

Pollution due to air, noise, and vibrations

231. Earth excavation, construction materials stockpiling, aggregate crushing, drilling, quarrying, and plying of vehicles will produce dust (TSP, PM_{10}), hydrocarbons (CO, CO_2, CH_4), SO_2, NO_X, H_2S, etc.), noise, and vibrations. Plying of trucks on non-metallic roads will produce huge amounts of dust that can deteriorate the air quality and increase the noise levels to above 90 dB. Appendix 4 gives the national ambient air quality standards for Nepal. The proposed project will be constructed within the project boundary surrounded by temporary fencing wall. There will be very less impact upon local residence due to air, noise and vibration during the time of construction. However, plying of construction vehicles likely to generate noise, dust, hydrocarbons at the vicinity of the project area.

232. Mitigating measures to be employed include the following: (i) dust suppression on roads or at open sites by sprinkling water as required at regular intervals; (ii) covering earth stockpiles using plastic sheets or cement jute bags; (iii) routine monitoring of sound and vibrations at regular intervals; (iv) limiting vehicle speeds and banning power horns; (v) seeing that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS; (vi) fitting of mufflers in vehicles to control noise; (vii) regular maintenance of vehicles; (viii) prohibiting the operation of crushing plants and construction vehicles between 7 p.m. and 6 a.m. in residential areas; (ix) compensating the damages caused by vibrations to buildings, and (x) providing ventilation in confined working areas. Appendix 6 gives the recommended standards for vibration in construction sites.

233. Adverse impacts could be caused due to inadequate buffer zones around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities. Adequate mitigating measures (including developing buffer zones around the treatment plants) should be included in the project design. Noise should be monitored as provided for in Appendix 5. As land areas for the WWTPs have already been defined and there are residents nearby, it is suggested that a minimum of 30 m green buffer zone along the site boundary with trees with thick foliage be planted to address nuisance due to odour, noise, lights and improper O&M.

Pollution prevention and abatement

234. Contractor will install temporary fence prior to the start of construction activity along the boundary of the proposed treatment plant areas to protect the area entering unauthorized person and to maintain safety. Contractor will provide all safety apparels to labours in order to maintain safety. Safety signage and project information board will be installed within the project area. Further, traffic management plan and construction management plan will be prepared prior to the construction. Vehicle speed will be maintained within and outside the project area for

the plying of construction vehicles avoiding accident.

2. Biological Environment

235. Although most of the construction and improvement works will take place in urban areas, there will be some impacts on the ecological resources (loss of trees and vegetation, damages to fisheries and riverbed aquatic ecology) due to construction of project structures vegetation clearance for construction activities, and construction activities at pipeline crossings over riverbeds.

236. Mitigation measures consist of the following: (i) cutting only the trees that are marked and will be agreed with contractor in a piece meal approach for removal and planting and rearing tree saplings at the rate of 25 saplings for each cut tree; (ii) providing LPG/kerosene to the workforce; (iii) stockpiling the cut trees and obtaining permission from concerned authorities for their use; and (iv) compensating all the affected private trees. To save the fisheries and riverbed aquatic ecology, disposal of construction materials and solid wastes generated from the camps into the rivers shall be avoided and river diversions and bunding of sections should be carried out.

3. Socio-Economic and Cultural

***Environment* compensation**

237. The contractor's temporary land use and housing acquisition and compensation to affected people are two of the most important aspects of any construction project. The mitigation measures include the following: (i) compensation for crops destroyed along the sewer alignment according to the Government's rules; (ii) establishment of a "grievance redress committee"; (iii) restoration of temporary sites to their natural or stable conditions as agreed with the land owners; (iv) planting endemic vegetation in exposed areas of temporary sites; (v) making sure that the proponent reports in writing that temporary areas have been vacated and restored to pre-project conditions before acceptance of the works; (vi) provision of disturbance and rehabilitation costs to local businesses; (vii) protection of the traditional rights of the local people; (viii) compensation for any loss of crops, trees and other natural resources; and (ix) establishment of a technical committee to assess the compensation for damages caused by vibrations of construction equipment and vehicles (photographs of the damaged structures should be taken and compared to the baseline photographs taken before construction).

Reinstatement of damaged community services and infrastructure

238. Construction activities could have adverse impacts on community services and infrastructure. Any adverse impacts (e.g., cracks in buildings and structures during trenching, use of rollers for compaction and pneumatic drills, and unusable access roads) on community assets such as, temples, bridges and irrigation channels, electricity poles, telephone lines, drinking water pipes, sewerage lines, roads, etc. will be mitigated, compensated, reinstated, or relocated to the satisfaction of the community. Mitigation is to be done through coordination with concerned utilities personnel and the local people, detailed design drawings, geotechnical testing in sensitive areas, and traffic management and emergency response plans. When excavating trenches for the installation of new sewers in heritage sites (e.g. Patan and Kathmandu Darbar Squares) manual labour shall be employed and the use of mechanical equipment avoided.

Influx of outside workers, money, and unwanted activities

239. Alcohol abuse, gambling, prostitution, and other social disharmony are likely to occur in

the construction site. There will be an influx of workers to the project site with their immediate family members. This can increase crime and social stress, create unwanted congestion, and exert pressure on the limited local resources. The mitigation measures to be carried out consist of prohibiting gambling and alcohol consumption in construction camp sites; instructing the outside workforce to respect the local cultures, traditions, rights etc.; and providing security in the camps.

Health and safety

240. There could be adverse impacts on the health and hygiene of the workers due to unsafe working conditions, accidents, fire hazards, transmission of communicable diseases etc. To mitigate these adverse impacts, these should be undertaken: (i) provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce; (ii) launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards; (ii) make available first aid kits, ambulance, and fire extinguishers in camp sites; (iii) provide personal protection equipment to all construction workers and compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries; and (iv) provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory. Another significant impact is the effect on people and communities, particularly health, if water supply is interrupted for extended periods during works on the sewer networks. If water supply has to be stopped, notice should be given to the affected people and alternative provisions of potable water arranged.

Occupational Health and Safety

241. The potential occupational health and safety impacts or hazards are likely during the time of construction and mitigation measures for the laying of drinking water pipes and sewers as well as construction of WWTPs are given in Table V-1. Before construction begins, the contractor will inform and provide training to its workers on occupational health and safety and mitigation measures to be used during construction. The training must be done in Nepali (or local language of the workers) with handouts distributed and information posted in conspicuous places. As most of the workers would be uneducated, pictorial presentations depicting the hazards and the mitigation measures should be used during the training. Appropriate signage providing safety messages including restrictions to public access need to be erected at construction sites.

Community Health and Safety

242. The contractor should be aware of the adverse health and safety impacts of the construction works on communities along the construction areas. There is an increasing number of houses and rapid urbanization at the vicinity of all the proposed WWTP sites rendering direct disposal of waste water into the Bagmati River resulting detrimental impact upon river ecology. However, the contractor will be fully aware upon the health and safety impacts upon the adjacent communities during the time of construction. The WWTP sites will ply more numbers of construction vehicles carrying construction materials. Existing traffic around the vicinity of all WWTP sites will not be affected due to construction vehicles. Contractor will be responsible to manage and control traffic around the WWTP sites. Safety signals and traffic signals will be installed at entry gates and major junctions if required around the WWTP sites. Any sort of grievances if recorded from the locals will be resolved by grievance redress committee formed. The committee will be comprising a person from local elected body. The detail of the grievance redress mechanism is presented in the chapter VIII.

Dislocation of archaeological artefacts

243. Kathmandu Valley has a rich and varied cultural heritage, including many temples, ghats, stupas, and shrines. The archaeological and cultural sites should be protected and in case of relocation, the local communities must be consulted. There is a risk that any work involving ground excavation could uncover and damage archaeological and historical remains. If there are any chance finds, work has to be stopped immediately, the Chief District Officer contacted immediately, and the findings reported in writing to the Department of Archaeology within 35 days, according to the Ancient Monuments Protection Act, 1956 and Rules, 1989.

244. The Ancient Monuments Preservation Rules 2046 (1989) states:

> ”4.1.1 Pursuant to Sub- section (5) of Section 3 of the Act, any person or Association willing to install telephone and electricity, to dig the land for drinking water and sewerage, to construct and repair the road, to shoot a film, cinema, to celebrate festival and fare, to dance or to park vehicles or to place the poster and photograph, shall have to submit an application to the Department, for its approval in format as prescribed in Schedule- 1.”
>
> "4.3.2 If the Local Officer found any information of finding of any archaeological object in his working District he shall have to fill the description of such object in the form as prescribed in Schedule-4 within 35 days from the date of finding of such object, and, if possible, the photograph of such project also shall have to be sent to the Chief Archaeology Officer”.

245. Two areas fall under the UNESCO Heritage sites (Kathmandu Durbar Square, and Patan Durbar Square) where wastewater improvements are planned. Prior permission will have to be taken from the Department of Archaeology as stated in The Ancient Monuments Preservation Rules 2046 (1989) Section 4.1.1 above.

Traffic management

246. Traffic congestion and temporary disruption to local access due to open trenches, excavation across roads, or road closures due to construction could have impacts on pedestrians, vehicles, and businesses. To mitigate these, traffic management plans should be developed for key areas along the construction site. There should be a traffic management planning document that can be easily used by contractors to develop detailed plans. Refer to (Appendix 9). Advance local public notifications of construction activities, schedules, routings, and affected areas including road closures should be made. Erect signage in Nepali and English languages. Use steel plates or other temporary materials across trench facilities in key areas such as footpaths or livestock routes; arrange for pedestrian access and sidewalks and parking areas; and arrange for night-time construction for activities in congested or heavy day-time traffic areas. Arrange for onsite "grievance handling.” Undertake trench closure and facilitate rehabilitation as quickly as feasible. Coordinate with the Kathmandu Metropolitan Traffic Police Division, the authority in charge of traffic management. Obtain permission from the Department of Roads for digging in the main urban roads and from the municipalities for digging in inner urban roads.

C. Operation Phase

247. The release of untreated wastewater or sewage could cause downstream pollution and adversely impact the aquatic ecosystem and pose health risks to humans. The following should be undertaken to address the impacts: Treat the wastewater to meet the prescribed effluent standards of BOD_5 or less before releasing it to the receiving waters. Regularly monitor the quality of the treated wastewater and that of the receiving water both upstream and downstream

(Appendix 3). Operate the WWTPs using a risk management-based approach to ensure optimal operation of the plant at all times. This will include the development and implementation of a WWTP safety plans which are similar to a hazard analysis and critical control point plan (HACCP) prior to the commissioning of the WWTPs. All WWTP safety plans will need to be submitted to ADB for review and endorsement prior to plant commissioning. WWTPs will also need to employ programmable logic controllers for plant operation.

248. Hazards to public health due to overflow flooding and groundwater pollution due to failure of the sewerage system could have adverse impacts on human health and the environment. The system will have to be carefully designed and operated. The project design should include stand-by generators (the diesel generator is the second backup power). The first source is the power generated from the gasification plant. In Dhobighat WWTP, the existing solar plant of 680 kW capacity will also be used, so that the WWTP will not be operated for long hours using diesel generators. The constant source of electricity supply, if available, will also be used. An emergency response plan (ERP) that includes notification and reporting protocols will need to be developed. The ERP is important for managing wastewater systems during emergencies as pipe breaks, equipment malfunctions, power outages takes place, and leakage or spills of hazardous materials happen. Floods, earthquakes, and storms can also damage collection systems and equipment. Having emergency response procedures can save lives, prevent diseases, and minimize environmental and property damage. The ERP should be developed in coordination with all the key stakeholders, including the Executing Agency (EA), project implementation units, consultants, contractors, and other key government organizations.

249. Health and safety hazards to workers could occur from toxic gases and hazardous materials which may be contained in sewage flow and exposure to pathogens in sewage and sludge. The workers should be trained in the management of occupational health and safety hazards and provided with personal protective equipment. Inoculations should be administered on a regular basis.

250. Discharge of hazardous materials and illegal disposal of industrial waste discharges into sewers could damage the wastewater system and be dangerous to workers. It is important to ensure that the existing industries do not illegally discharge their effluents into the sewer system. Regulations should be developed and enforced by the Ministry of Environment, Science and Technology to control illegal waste discharges into the sewers. A trade waste policy, including setting discharge criteria from industries, needs to be developed.

251. Sewer cleaning staff will be at risk of communicable diseases. KUKL should ensure that the operation and maintenance staff of sewerage system are fully aware of the hazards by training them in hygiene procedures to avoid infection from wastewater, sludge handling, and health and safety procedures against exposure to hazardous gases. Workers should be inoculated against infectious diseases and kept under medical supervision. Emergency procedures need to be developed by KUKL and protective clothing to sewer cleaning workers, including safety showers at the WWTP sites, should be provided.

252. Improper operation and breakdown of the WWTP will lead to the accumulation of untreated wastewater that may cause smell and nuisance to the surrounding residential areas. To address this, the project should prepare and strictly follow standard operating procedures (SOP) and provide regular training to staff. A green buffer zone made by planting trees around the WWTP boundary should be established so that residents living next to the WWTP do not get annoyed by the foul smell and noise. Standby generators should be provided (the diesel generator is the second backup power.) The first is the power generated from the gasification plant. In Dhobighat WWTP, the existing solar plant of 680 kw capacity will also be used so that the WWTP is not operated for long hours using diesel generators. The constant source of

electricity supply, if available, will also be used. Emergency response procedures have to be developed and implemented (The plant operation will follow the Hazard Analysis and Critical Control Point Plan and programmable logic controllers).

253. Inert grit from grit chambers should be collected and dispose of at landfill sites. The char from gasification plants can be used as construction material. Kathmandu Municipality has been operating Okharpauwa sanitary landfill site situated at about 30km distance at Nuwakot district from Kathmandu. The project will deal with municipality during the time of operation for the safe disposal of inert grit.

254. Workers and operators stationed at sewers and confined spaces should be provided with safety equipment or gas detectors and awareness and safety training. Fire extinguishers should be readily available. Workers who come in contact with raw or partially treated sewage and sludge should be provided with protective wear (e.g., gum boots, gloves, visibility vest, hard hat, face masks etc.). The contractor will avoid root intrusion, create public awareness, educate the public on the types of waste to be disposed of to the sewer system, provide sufficient staff and equipment for cleaning, and establish a system for registering public complaints (grievance redress mechanism) and urgent clearance of system blockages.

Potential Environmental Enhancement Measures

255. Potential environmental measures that shall be taken by KUKL before the project commences are training and awareness programs on health, occupational health and safety measures, and community health and safety to the general public.

256. Sufficient human resources should be trained in maintaining the sewerage systems and treatment plants. The efficiency level of the treatment plants should be recorded by regularly monitoring the wastewater characteristics.

257. There are many environmental youth clubs in Kathmandu Valley. They should be mobilized to observe the sewer system in their areas and report problems like overflows to KUKL. By 2010, there were 4,321 youth services affiliated or registered with the Social Welfare Council: 697 were from Kathmandu, 43 from Bhaktapur, and 130 from Lalitpur. Out of the registered 30,284 NGOs working in the environmental protection sector, 514 were from Kathmandu, 69 from Lalitpur, and 9 from Bhaktapur. They include Batabaran Samrachahan Tatha Digo Bikasko Lagi Yuba Sakti, Bishnumati Yuba Club, Buddhanagar Yuwa Samuh, Batabaran Samrachhan Samudaya, Nepal Batabaran Club, Friends of Environment, Swacha Pani Tatha Batabaran Samuha etc.

258. All wastewater treatment plants should have a basic laboratory for the analysis of wastewater and a dedicated, trained, and qualified laboratory technician.

1. Cumulative Impacts

259. The valued components identified in the IEE are air quality, water (surface and groundwater) quality, noise, traffic management, socio-economic, cultural resources, and human health.

260. Air quality will be affected during construction. Emissions of common air contaminants and fugitive dust may increase near the construction sites but will be short term and localized. Greenhouse gas emissions may increase due to vehicle and equipment operation, disposal of excavated material, concrete production, etc. But their contribution during construction will not be very significant.

261. Noise levels near the construction sites will increase but the duration will be short. Ground vibrations due to concrete mixers, rollers, and excavators may be annoying, and

damages may occur especially to older buildings, but mitigation measures if implemented as proposed in the environment management plan (EMP), will minimize these problems.

262. Traffic management during construction will be very important. Site-specific mitigation measures will be implemented to see that disruptions are minimized and are temporary. After the project is over, the improvements made will have a long-term cumulative benefit to the people.

263. Although there will be temporary increase in the noise levels, fugitive dust, and common air emissions near the construction areas, no adverse residual effects to human health will occur because the impacts are short-term, localized, and not significant.

2. Transboundary and Cumulative Impacts

264. There will be no environmental trans-boundary and cumulative impacts with respect to air pollution and loss of habitat. However, with respect to water pollution, the Bagmati river will be less polluted than it is today when it reaches the Indian border. It can be seen that the BOD level increases from the source (Sundarijal) and keeps on rising as it traverses through the Kathmandu City and starts decreasing at Teku Dovan (where the Bagmati River meets the second biggest tributary, the Bishnumati river). As the Bagmati river leaves the Kathmandu Valley at Chovar gorge, the BOD is still above 60 mg/l. The BOD then keeps on decreasing downstream where the area is less habited and the Bagmati River gets bigger as it is fed with numerous tributaries. The WWTPs will contribute to reducing the current level of water pollution.

265. The project will help develop employment opportunities and enhance the local skills in sewer pipe laying and construction of WWTPs for future works in Nepal. Concrete sewer pipes can be manufactured locally, which can boost the local construction industries.

Table V-1:Impact Matrix

Project Stage	Project Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility
Pre-project activity (Project Design)	Incorporation of critical areas in project design	Soil erosion and slope instability	Incorporate measures and sites for handling excessive spoil materials	Design Supervision Consultant (DSC)/ Kathmandu Upatyaka Khanepani Limited (KUKL)/ Project Implementation Directorate (PID)
			Incorporate drainage plan into the final design	
			Design technical specifications to include minimum vegetation clearance and avoid areas where slope stability is a concern	
			WWTPs to incorporate sufficient drainage around infrastructure. Elevated tanks to be designed where appropriate.	
			Wastewater infrastructure to be designed as per Nepal‟s earthquake codes and standards.	
	Training preparation	Health and safety of the community and workers Operations and maintenance (O&M)	Prepare training in Nepali (or local languages) with notes and sketches on community health and safety and potential occupational health and safety. Worksite checklist and safety rule for work site (Appendix D of Health & Safety Manual by DSC)	DSC/KUKL/PID
			Prepare training in Nepali with notes and sketches, erection of signage in construction areas.	DSC/KUKL/PID/ Contractor
	Estimation of sludge volume (wastewater) and provision for their treatment	Sludge waste problem	Incorporate sludge reduction measures using gasification into the design to generate power to run the wastewater treatment plan (WWTPs)	DSC/KUKL/PID/ Contractor

	WWTP design	Odor emission	Design technical specifications to include appropriate odor control measures/ technologies including appropriate environmental buffer to be maintained (i.e. tree screening etc).	DSC/KUKL/PID/ Contractor
Preparation for construction	**Preparation of project site**			
	Consult relevant persons and submit applications to get approvals. Submit agreement and permits to DSC for official information	May result in social conflict and legal obstructions resulting in the delay of works	Obtain letters of approval and agreement for (i) temporary acquisition of land and properties, (iii) disruption of water supply and irrigation canals, (iv) get required permits (e.g. cutting trees, construction works in heritage sites and religious river ghats from the Department of Archaeology)	KVWSMBKUKL/PID
			Transfer land and treatment plant in the Kathmandu Valley Water Supply Management Board (KVWSMB)'s name. Provide detailed designs, initial environment examination (IEE), etc. to relevant authorities.	
			Sites to be demarcated and sign posted. Affected communities to be consulted and due notifications given for possible interruptions due to construction.	
	Construct temporary workforce camp	Haphazard camps resulting in social stress and degradation of the local environment	Establish temporary workers camps with sanitary amenities at designated sites only. As Nepal has no standards regarding number of ablution blocks to be constructed in temporary labor camps, follow the 1 toilet for every 15 persons (separate for men and women) based on the IFC Guidelines. In Kathmandu, most of the laborers will be local who will not stay in the camps.	Contractors/ DSC

	Make employment policy for local and affected people based on the environmental management plan	The local people may be deprived of opportunities, minors may be employed	Employ local people (not under age 16) especially the affected families and women. Settle wage rates based on the District Wage Evaluation Committee (DWEC) and provide the list of employees to DSC.	Contractors/ DSC
	Baseline photographs of project area (including buildings and temporary sites) and river water quality	False claims from people; water quality changes due to construction	Take photographs of buildings and temporary sites before construction for verification.	KUKL/DSC
	Prepare traffic plans	Traffic congestion and public annoyance	Prepare traffic plans to prevent traffic jams and annoyance by the public.	KUKL/DSC
Construction Phase	**Construction Activity**			
	Earthworks	Soil erosion and slope instability due to topsoil stripping and excavation for trenches	Separate stockpiling of topsoil for further use; spoil disposal at designated and stabilized sites; compact the excavated areas' backfill and include replacement of topsoil; adopt cut and fill approach; avoid work during the rainy season as much as possible; do mulching to stabilize exposed areas; use bioengineering techniques (e.g, re-vegetating areas promptly); provide channels and ditches for post-construction flows; line steep channels and slopes (e.g. use of jute matting); prevent off-site sediment transport using settlement ponds, silt fences. Dispose of excess materials in designated areas.	Contractors/DSC
		Surface water discharges to local drainage from trench construction	Use settling basins at reservoir sites; use straw to filter small discharges; do routine inspection and monitoring of larger discharges to water courses. Excavation dewatering to use settlement tanks.	

		Runoff from construction areas including stockpiled materials	Use temporary bunds and catchment basins. Grade soil/sand stockpiles to prevent erosion.	Contractors/DSC
		Interception and interference with localized groundwater flows due to deep excavations.	Bund local wells, springs, and irrigation canals from temporary spoil dumps; monitor local wells and spring fed spouts or kuwas particularly downhill of reservoir excavations, including temporary supply provided if flow is affected; provide permeable base and side backfill at deeply excavated reservoir sites or an alternate source of drinking water at the existing location.	Contractors/DSC
	Quarrying from river bed	Change in river hydrology and morphology	Do not allow quarrying/mining activities in river/streams to extract construction materials	Contractors/DSC
	Dumping of waste in the river	Water and land pollution	Provide designated areas with collection bins for wastes.	Contractors/DSC
			Provide toilet facilities and prohibit open defecation.	
			Prohibit washing of vehicles next to rivers and streams.	
	Construction of toilets in the camps		Ensure site is well-signed indicating the restrictions.	
	Storing of materials and dumping of excess materials in the project area		Store construction aggregates, hazardous and toxic materials, lubricating, oils and used batteries in safe areas and away from any drainage leading to water bodies; have designated bunded areas for storage. Dispose of any wastes generated by construction activities in designated areas.	
	Handling of toxic materials		Provide training to workforce on safe handling of toxic materials and occupational health and safety measures during construction. Use personal protective equipment at all times while on site.	
	Quarrying operations	Air quality deterioration	Dust suppression on roads or at open sites by sprinkling water as	Contractors/DSC

	Movement of vehicles Operation of crusher Earthworks Stockpiling of construction waste and construction materials		required at regular intervals.	
			Cover earth stockpiles using plastic sheets or cement jute bags. Use tarpaulins to cover sand and other loose materials during transport.	
			Limit vehicle speed to 10-15 km/hr; site to be signed specifying speed limits.	
			Ensure that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS.	
			Do regular maintenance of vehicles.	
			Provide ventilation in confined working areas.	
	Movement of vehicles Operation of crusher Operation of construction machineries and equipment Horn honking	Noise and vibration	Monitor noise levels regularly at site to meet the noise standards (Annex 6)	Contractors/DSC
			Fit mufflers in vehicles to control noise.	
			Limit the speed of vehicles.	
			Ban the use of power horns in vehicles. Regularly maintain the equipment.	
			Prohibit the operation of crushing plants and construction vehicles from 7 p.m. to 6 a.m. in residential areas.	
			Compensate the damages caused by vibration if caused by construction activities.	
	Construction of project structures	Vegetation clearance	Cut only trees that are marked and have been approved by the Department of Forestry. Plant and rear tree saplings at the rate of 25 saplings for each felled tree.	Contractors/DSC

	Reinstatement of damaged community services and infrastructures.	Reinstatement of community services and infrastructures	Compensate or reinstate/relocate community assets that are disturbed such as irrigation canals, electricity poles, telephone lines, drinking water pipes, roads, etc. to the satisfaction of the people. Coordinate with concerned utilities, local people, design maps of the area with utilities and emergency response plans (develop and include an emergency response plan/template that includes notification and reporting protocols)	KVWSMB/KUKL/Contractor/DSC
	Influx of outside workforce, money, and unwanted activities.	Increase in crime and community stress	Prohibit gambling and alcohol consumption in contractors' camp sites.	KVWSMB/KUKL/Contractor
			Instruct the workforce to respect the local cultures, traditions, rights, etc.	
			Provide security in contractors' camps.	
	Project activities relating to health and safety issues at work areas	Health and hygiene (unsafe working conditions, accidents, fire hazard, transmission of communicable diseases, etc.)	Provide regular health checkups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce.	Contractors/DSC/KVWSMB/KUKL
			Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AiDS using brochures, posters, and signboards.	
			Provide insurance to workers and training in occupational health and safety.	
			Give importance to community health and safety	
			Provide alternate potable water supply during maintenance works and notify the public in advance	
			Prevent pollution of air in agricultural land, vegetation, and human settlements due to dust and vehicular emissions.	

			Avoid wastewater pollution on land, humans, receiving waters, and the environment.	
			Minimize nuisance due to traffic noise and vibrations.	
			Prevent nuisance from odors and noise from wastewater treatment plants.	
			Avoid traffic accidents and traffic jams.	
			Make available first aid kits, ambulance and fire extinguishers in camp sites.	
			Make available protection gears to all construction workers and compensate for the loss of life or any type of injuries.	
		Injury to a member of the public during pipe delivery	Provide fencing and/or barricades as per site risk assessment. Apply signage and pedestrian control.	
			Devise and implement system for site inspection and security.	
			Ensure security and equipment necessary to minimize vandalism.	
		Traffic can cause personal injury to the public, contractors, and employees; and vehicle accidents.	Develop a traffic control plan and keep areas clean and clear of obstacles.	Contractors/DSC
		Slips, trips and falls, strains and sprains; manual handling of injuries such as back damage	Conduct site inspection to ensure access/space is adequate for the task activities.	Contractors/DSC
		Existing underground services can cause explosion, electrocution, and damage	Inform site in-charge before digging/excavation; check relevant authority (e.g. power, water, telephone) records for existing location of services.	Contractors/DSC
			If in doubt use the experienced service of people in the locality.	

		Excavation by plant and equipment will create noise, falling objects, damage to existing surfaces, material spillage, and injuries by moving parts.	Operations of plant by licensed personnel. Use personal protective equipment–hardhat, high visibility vest, hearing protection etc. Maintain a safety working area clear of any clutter etc. Around the moving plant.	
			Protect surfaces from plant movements. Ensure plant noise control. Maintain clean- up equipment on site.	
			Maintain (specified) spillage control equipment.	
			Employ observers where possible.	
		Falling objects during storage of materials during excavation.	No materials to be placed or stacked near the edge of any excavation.	
			No load to be placed or moved near the edge of the excavation where it is likely to cause collapse of side of work. No load handling/movement across excavation. No rollable objects stored uphill from excavation.	
		Overhead and underground power cables can cause electrocution during excavation.	Determine location of underground services. If underground power cables are located in the vicinity, exercise extreme care while excavating. Consider any restriction on kinds of tools and equipment that may be required and comply with the requirements. Liaise with relevant authority.	
		Sloping ground can cause the falling of rolling objects.	Maintain good housekeeping (remove debris, trip hazards, site tidiness).	
			Select locations to minimize potential for movement. Stack materials at level below excavation.	
			Secure/retain potential falling/rolling	
		Trench collapse and falling objects	Support / bench / batter excavation.	

			Keep safe distance from edge of trench (at least 0.6 m away from sides of trench depending on soil type and conditions to be decided by DSC during detailed design and to be barricade/fenced to debar the public). Materials not to be placed or stacked near the edge of trench.	
			No load to be placed or moved near the edge of trench where it is likely to cause collapse of the trench.	
			All trenches to have safety barricades when left open for a period of time.	
			Provide submersible pump to dewater trenches where ground is water-charged.	
			Use personal protective equipment. No load/personnel movement across trench.	
		Falling into trenches	Install a shoring system. Where possible backfill trenches.	
			Erect 1.8 metre (min) security fence if open excavation is to be left unattended, or cover open excavation with steel plating if left unattended.	
			No personnel movement across	
		Other risks associated with confined spaces such as gases etc.	Where trench/conduit is considered to be confined space, use experienced trained personnel.	
			No smoking and use of mobile phone use, and avoid sparking.	
		Trip hazard; dust–eye injury; environmental damage due to storage of fill.	Provide necessary environmental protection measures:	
			Secure fill stockpile. Provide a dedicated area for fill.	
			Watering of material.	
			Provide necessary personal protective equipment to workers.	

			Covers fill when unattended or unable to be watered.	
		Manual handling (shoveling) can cause strains and sprains, injuries such as back damage, injuries due to lifting pipes and swinging loads	Correct manual handling techniques.	
			Provide adequate rest periods, allowed job rotation, minimize repetitious twisting and shoveling.	
			Use mechanical aids where possible. Maintain control of loads when lifting and moving.	
			Carry pipes close to ground while moving if mechanical aid is used.	
		Contaminated soil can cause impact on health of persons.	Use protective clothes/shoes/gloves.	
		Defective materials can cause injuries	Visual inspection of materials by experienced persons.	
		Storage of hazardous materials can cause injuries and illnesses.	Handling and storage to be done carefully under guidance.	
		Earth mounds can cause engulfment and dust can cause eye injuries.	Control operation of mobile plant by competent person.	
			Watering of material. Control slopes.	
			Delineate earth mounds. Put up warning signage.	
			Cover earth mounds when unattended or unable to be watered.	
		Personal injury due to working plant and equipment	Maintain a safe distance from working plant.	
			Wear personal protective equipment (PPE) including high visibility clothing and hard hat, etc.	
			Put up perimeter fencing place trained personnel on the look-out. Have a first aid kit at the site.	

		Public hazards due to inadequate compaction, construction refuse, and inadequate re-surfacing during site restoration	Compaction to specified international standard (backfill shall be compacted to a dry density of not less than 90% of the maximum dry density); clear site of debris and refuse; re-surface without leaving gaps or uneven surfaces and erect fence around hazardous areas until they are safe and restored.	
		Inadequate training, consultation, planning and improvisation can cause task-specific injuries due to inexperience, inadequate consultation or failure to provide required equipment	All personnel on - site should be trained and kept aware and should be suitably qualified. Provide competent supervision to be on site.	
		Weather conditions (e.g. Hot, cold, wet, flooding/inundation, high winds) can cause dehydration	Supply adequate drinking water in the work	
		Slippery surfaces can cause slips and falls	Wear non-slip safety footwear in all work sites. Ensure extreme care when working in wet and slippery areas. Personnel should never run on worksite.	
		Untidy site can cause slips and falls.	Keep worksite clean and tidy at all times, free from clutter and rubbish. Store materials in designated areas as specified in site plans	
		Materials stored may be dislodged and fall onto people or property particularly when site is unattended.	Store materials safely by barricading or fencing the area.	

		Public safety make be at risk due to pipes or drums accidentally rolling onto the roadway causing an accident or may be rolled by unauthorized persons particularly when site is unattended causing injury to persons.	All materials to be secured by blocks or wedges, sandbags or other means. All pipes not laid during the course of a day are to be returned to the stockpile and secured.	
		Public safety may be at risk due to improper storage of plant.	Store/park plant and equipment off site and in a secure area.	
		Nuisance due to excavated soil. Deterioration of air quality due to dust.	Provide for safe disposal and re-use of excavated soil. Remove waste soil as soon as it is excavated. Sprinkle water to avoid dust.	
		Soil erosion, silt runoff, and settling of street surfaces. Water could get polluted; land values degraded and be a nuisance to pedestrians. Street surfaces would settle, bringing about ponding of water.	Precautionary measures should be taken during construction such as backfilling of excavated trenches. Construction activities should be, as far as possible and avoided during the rainy season. Provide temporary diversions and sign boards for pedestrians.	
		Workers and the public are at risk from accidents on site	Prepare and implement a site health and safety plan that includes these measures:	
			exclude the public from all construction sites	
			ensure that workers use protective equipment	
			provide health and safety training for personnel	
			follow documented procedures for site activities	
			keep accident reports and records As far as possible, the local people (who know the local conditions) should be hired.	

		Local residents and sites of social/cultural importance may be disturbed by noise, dust and impede access	Carry out the work as quickly as possible to minimize disturbances. Consult residents; inform them of work in advance. Erect “work to commence” and “work in progress” signage.	
	Traffic management at construction sites	Traffic congestion (temporary disruption to local access due to open trenches, excavation across roads, or road closures due to construction).	Develop a traffic plan to minimize traffic flow interference from construction activities.	Contractors/DSC
			Provide advance local public notification of construction activities, schedule, routing and affected areas including road closures.	
			Erect alternative routing signage in Nepali and English languages.	
			Use steel plates or other temporary materials across trench facilities in key areas such as pedestrian access, sidewalks and parking areas.	
			Arrange for night-time construction for activities in congested/ heavy day-time traffic areas.	
			Arrange for onsite “grievance handling” through the use of liaison officers.	
			Undertake trench closure and facilitate surface rehabilitation or paving as quickly as feasible.	
Operational Phase				

	Release of inadequately treated wastewater to river	Downstream pollution, health and environmental risks.	; regularly monitor (using online meters hooked up to the SCADA network) the quality of the treated wastewater and that of the receiving water upstream and downstream from the outfall. Develop and implement a WWTP safety plans (similar to HACCP plans).	KUKL/KVWSMB
	Overflow flooding	Hazards to public health and the environment due to overflow flooding and groundwater pollution	Ensure careful design and operation of wastewater system to meet peak wastewater loads of 3 times the dry weather flow; provide stand-by generators form pumping stations.	KUKL/KVWSMB
			Train operators for regular inspection cleaning, and maintenance of plant and sewers.	
	Discharge of industrial wastes	Hazards to public health and the environment due to overflow flooding and groundwater pollution	Train workers in OHS hazards and provide PPE; monitor illegal discharge of industrial wastes to the system through regular audits/spot inspections of the industries in the catchment area; monitoring of DO and electrical conductivity at the inlet of the WWTPs and enforce strict regulations in coordination with the Ministry of Environment, Science and Technology. Storage of treatment chemicals in designated areas that are bonded.	KUKL/MOEST
		Improper operation and breakdown will lead to accumulation of untreated	Prepare a WWTP safety plan for the WWTPs that will include standard operating operation of the WWTPs (automatic shutdown procedures etc).	KUKL
		wastewater that may cause smell and nuisance to the surrounding residential areas	Provide regular training to the staff.	
		Spill and contamination from fuel and lubricants	Provide a green buffer zone by planting trees around the WWTP boundary (appropriate buffer to be determined following air quality dispersion modeling at the design stage).	

	WWTP operation		Provide standby generators (the diesel generator is the second backup power.	
			Recover used oil and lubricants, and reuse or remove them from the sites. Storage areas for fuels and lubricants should be away from any drainage leading to water bodies. All fuel use areas e.g. generator, must have drip basins installed to prevent any leakages and must be recycled. All fuelling, repair, and maintenance work should be done on a concrete surface provided with a catch tank that can be cleaned and all spilled fuel recovered and recycled.	
	Grit (from WWTP) and char (from gasification plant) collection and disposal	Grit can reduce the efficiency of the WWTP	Collect inert grit from grit chambers and dispose of at landfill sites Char from gasification plants can be used as construction material.	KUKL

DSC = Design and Supervision Consultant, DWEC = District Wage Evaluation Committee, IEE = initial environment examination, KUKL = Kathmandu Upatyaka Khanepani Limited, KVWSMB = Kathmandu Valley Water Supply Management Board, PID = Project Implementation Directorate, WWTP = wastewater treatment plant.

VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

200. As part of the feasibility studies, an extensive consultation program with key stakeholders was carried out, in line with the requirements pertaining to environment and social considerations of ADB. The tools used for consultations were stakeholder workshops and meetings, interviews, structured questionnaires, and focus group discussions (FGD). These consultations provided inputs for identification of the felt needs of the communities, and the relevant stakeholders.

201. During the business survey, business/shops of different core areas of cities were informed about the project activities such as replacement, rehabilitation, cleaning of sewer, separation of storm water drain and sewer, new laying of sewer etc. in the main road and inner roads of the cities. They were informed about the possible impacts such as disruption to the local inhabitants, and pedestrians during construction. During the business survey, the business owners and the shop keepers were informed about the possibility of disruption to the business and the survey was a preliminary activity to determine possible profit losses if full closure of the road was required during construction. They were informed that future public consultations and disclosures would be held regarding possible disruption to businesses and issues of compensation modality would be discussed. They were also informed that they will get more information about the project activities during topographical survey.

202. Dhobighat WWTP as recently there have been a number of strikes and bandhs from the local people opposing the rehabilitation of squatters that were evicted from the Bagmati River banks and tensions prevailed. Series of formal and informal meetings and discussions at local lever were carried out.

203. A Focus Group Discussion for the proposed rehabilitation, laying of new sewer pipelines was also held in Khasi Bazaar, Ward no 5, Kirtipur Municipality. The main complaint was overflow of sewage from the small sized sewer due to clogging of solid waste and people wanted a larger sized sewer and separation of storm water from sewage so that the storm water could be used for irrigation.

204. People of Ta Dhoka, Lalitpur, Maru Dhoka, Kathmandu and Panga, Kirtipur had similiar comments that they wanted public participation in project implementation, a donor agency for the project, an implementation agency and better improved services. People from Purano Jagati, Bhaktapur (with poor households) and Jagritinagar want livelihood training programs for women and employment in projects (Appendix 7).

266. The Project Affected People of Kathmandu Valley have been informed about the rehabilitation/modernization of existing and new construction of WWTPs and laying of new interceptors and collectors; rehabilitation and cleaning of existing interceptors/collectors and replacing existing brick sewers. Discussions were held with the participants in a closed circle and the details of the dates, number of participants are given in Table *VI-1* and in Appendix 7.

Table VI-1: Meetings, workshops, consultations and focus group discussions held

SNo.	Date	Topic	No. of participants	Institutions
1	26 March 2012	Scope and objectives of PPTA -7936 and PPTA-43448; ongoing activities of HPCIDBC; BAP implementation	6	Project Manager and Deputy Project Manager HPCIDBC; PPTA Team

SNo.	Date	Topic	No. of participants	Institutions
2	19 April 2012	Scope and objectives of PPTA - 7936; ongoing activities and problematic areas of Lalitpur Municipality	4	Environment Section Chief and Drainage Section Chief Lalitpur Municipality; PPTA Team
3	19 April 2012	Scope and objectives of PPTA - 7936; ongoing activities and FGD on problematic areas of Kathmandu Metropolitan City	4	Division Chiefs, PPTA Team
4	20 April 2012	Scope and objectives of PPTA - 7936; ongoing activities and FGD on problematic areas of Bhaktapur Municipality; vision on wastewater management	5	Ex-Mayor and Engineers, PPTA Team
5	20 April 2012	Scope and objectives of PPTA - 7936; ongoing activities and FGD on problematic areas of Madhyapur Thimi Municipality	4	Engineer and Community Development Officer of Municipality, PPTA Team
6	24 April 2012	Scope and objectives of PPTA - 7936; ongoing activities and FGD on problematic areas of Kirtipur Municipality	3	Municipality Engineer, PPTA Team
7	26 April 2012	FGD on identification of project intervention areas	17	Kirtipur Municipality, Lalitpur Sub-Metropolitan City, Bhaktapur Municipality, Madhyapur Thimi Municipality, KVWSMB, KUKL, PID, PPTA Team
8	31 May 2012	Ongoing activities of CBP Team, status of sewer networks, GIS activities in KUKL	6	CBP Team Leader, GIS expert, PPTA Team
9	22 June 2012	Meeting on coordination on the wastewater sector	13	MoUD, HPCIDBC, PID, KUKL, Kathmandu Metropolitan City, KVWSMB, PPTA
10	28 June 2012	FGD in Sallaghari WWTP	14	Local people
11	29 June 2012	FGD in Kodku WWTP	8	Local people (refused to sign their presence)
12	29 June 2012	Ongoing activities of DSC under HPCIDBC,	15	PID, KUKL, BDA, Stakeholders
13	9 July 2012	FGD in Ta Dhoka Purnchandi, Lalitpur	12	Local people
14	10 July 2012	FGD in Maru Dhoka, Kathmandu	12	Local people
15	13 July 2012	FGD in Khasi Bazaar, Kirtipur	11	Local people
16	16 July 2012	FGD in Jagritinagar	20	Local people
17	16 July 2012	FGD in Panga, Lachi, Kirtipur	11	Local people
18	17 July 2012	FGD in Gokarna VDC Ward 6 on WTP	15	Local people
19	18 July 2012	FGD in Shantinagar Baneshwor	10	Local people
19	19 July 2012	FGD in Thola Byasi, Bhaktapur	20	Local people
20	20 July 2012	FGD in Purano Jagati Bhaktapur	14	Local people
21	14 August 2012	Consultative Stakeholders Workshop on Interim Report	53	PID, ADB, MOUD, KUKL, HPCIDBC, PPTA Team, Municipalities

205. In addition, the Resettlement Team undertook a random survey of 90 households (vendors, hawkers businesses and shops to obtain information on the loss of income due to temporary disruption of business during laying/rehabilitation/cleaning of sewerage pipeline in different problematic areas of the Municipalities. Results of the survey are included in the Resettlement Plan.

206. PID will make copies of the IEE report and any other project reports available to interested people in the Nepali language (if required) to ensure that stakeholders understand the objectives, policy, principles and procedures. These reports will be made available at public places, including the offices of PID, KUKL main office and branch offices, and the Kathmandu Metropolitan city, Lalitpur Sub-Metropolitan city and Madhyapur Thimi, Bhaktapur, and Kirtipur Municipalities Offices.

207. The PID will extend and expand the consultation and disclosure process during the detailed design stage and construction period of the project. A community awareness firm will be recruited to ensure ongoing consultations and public awareness during project implementation. The firm will continue the consultations with the affected communities through distribution of leaflets, about the project activities and entitlement matrix and the project contact persons for outreach and queries. Intensive consultations will be made on those WWTP areas where people have different opinion for the construction of WWTP.

208. The community awareness consultant will coordinate with the PID, design and DSC, and contractors to ensure that communities are made fully aware of project activities in all stages of construction. A community awareness and participation plan were also prepared for the project, and will be implemented by the recruited firm in coordination with the PID and DSC safeguards staff. Community groups such as tole committees and vendor associations will be consulted and made aware of the civil works and project activities prior to construction.

VII. GRIEVANCE REDRESS MECHANISM

209. A grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns. The GRM for the project is outlined below, and consists of four levels with time-bound schedules and specific persons to address grievances.

210. **First level of GRM.** The first level and most accessible and immediate contact for the fastest resolution of grievances are the contractors and supervision consultants on site. Prior to construction of any works, the community awareness consultants, DSC, and contractors are to hold local community meetings to notify the local residents and businesses of the temporary disturbance, and to inform them of the project. If a local area committee (LAC) exists, they should also be informed. If any complaints arise, the contractors, DSC, and PID can immediately resolve the complaints on site. The PID branch offices can also be involved in grievance redress at this stage. The KUKL hotline and PID office phone numbers will be posted in public areas within the project area and construction sites. Any person with a grievance related to the project can contact the project to file a complaint. The PID branch offices are staffed with a consumer relations officer to field and resolve complaints. The consumer relations officer or branch manager will document the complaint, and immediately address and resolve the issue with the contractor within 1-2 days, if the complaint remains unresolved at the field level. The branch manager may seek the assistance of the DSC safeguards specialists (the environmental specialist or social safeguards specialist) to help resolve the issue. The consumer relations officer or branch manager will notify the PID safeguards unit that a complaint was received, and whether it was resolved. The branch manager will fully document the following information: (i) name of the person, (ii) date complaint was received, (iii) nature of complaint, (iv) location, and (v) how the complaint was resolved.

211. **Second level of GRM.** Should the grievance remained unresolved, the branch manager will forward the complaint to the PID safeguards unit. The person filing the grievance will be notified by the consumer relations officer or Branch Manager that the grievance was forwarded to the PID safeguards unit. For resettlement issues, the resettlement officer will address the grievance; for environmental issues, it will be the environmental officer. Grievances will be resolved through continuous interactions with affected persons, and the PID will answer queries and resolve grievances regarding various issues, including environmental, social, or livelihood impacts. Corrective measures will be undertaken at the field level by the PID safeguards staff within 7 days. The relevant safeguards unit staff will fully document the following information: (i) name of the person, (ii) date complaint was received, (iii) nature of complaint, (iv) location, and (v) how the complaint was resolved.

212. Third level of GRM. Should the grievance remain unresolved, the PID's Project Director will activate the third level of the GRM by referring the issue (with written documentation) to the local Grievance Redress Committee (GRC) of KUKL, who will, based on review of the grievances, address them in consultation with the PID safeguards unit, Project Director, and affected persons. The local GRC will consist of members of PID, affected persons, and local area committee, among others determined to provide impartial, balanced views on any issues. The GRC should consist of around 5 persons. A hearing will be called with GRC, if necessary, where the affected person can present his or her concern/issues. The process will promote

conflict resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 days. The functions of the local GRC are as follows: (i) to provide support to affected persons on problems arising from environmental or social disruption, asset acquisition (if necessary), and eligibility for entitlements, compensation, and assistance; (ii) to record grievances of affected persons, categorize and prioritize them, and provide solutions within 15 days; and (iii) to report to the aggrieved parties developments regarding their grievances and decisions of GRC. The PID safeguards officers will be responsible for processing and placing all papers before the GRC, recording decisions, issuing minutes of the meetings, and taking follow-up action to see that formal orders are issued and the decisions carried out.

213. Fourth level of GRM. In the event that a grievance is not addressed by the contractor, DSC, branch office, PID, or GRC, the affected person can seek legal redress of the grievance in the appropriate courts, the fourth level of the GRM, which is the formal legal court system. The grievance redress mechanism and procedure are depicted in Figure VIII-1.

214. GRC Composition. Below is the GRC members composition under the project:

(i) GRC Chairman - PID Director
(ii) GRC Members:
(iii) Concerned municipality representative
(iv) Tole Community representative as AP's representative
(v) Appointed NGO representatives as independent party
KUKL/ KVWSMB/DSC (as relevant)

215. ADB Accountability Mechanism. In the event when the established GRM is not in a position to resolve the issue, Affected Person also can use the ADB Accountability Mechanism (AM) through directly contact (in writing) to the Complaint Receiving Officer (CRO) at ADB headquarters or to ADB Nepal Resident Mission (NRM). The complaint can be submitted in any of the official languages of ADB's DMCs. The ADB Accountability Mechanism information will available in the PID to distribute to the affected communities, as part of the project GRM.

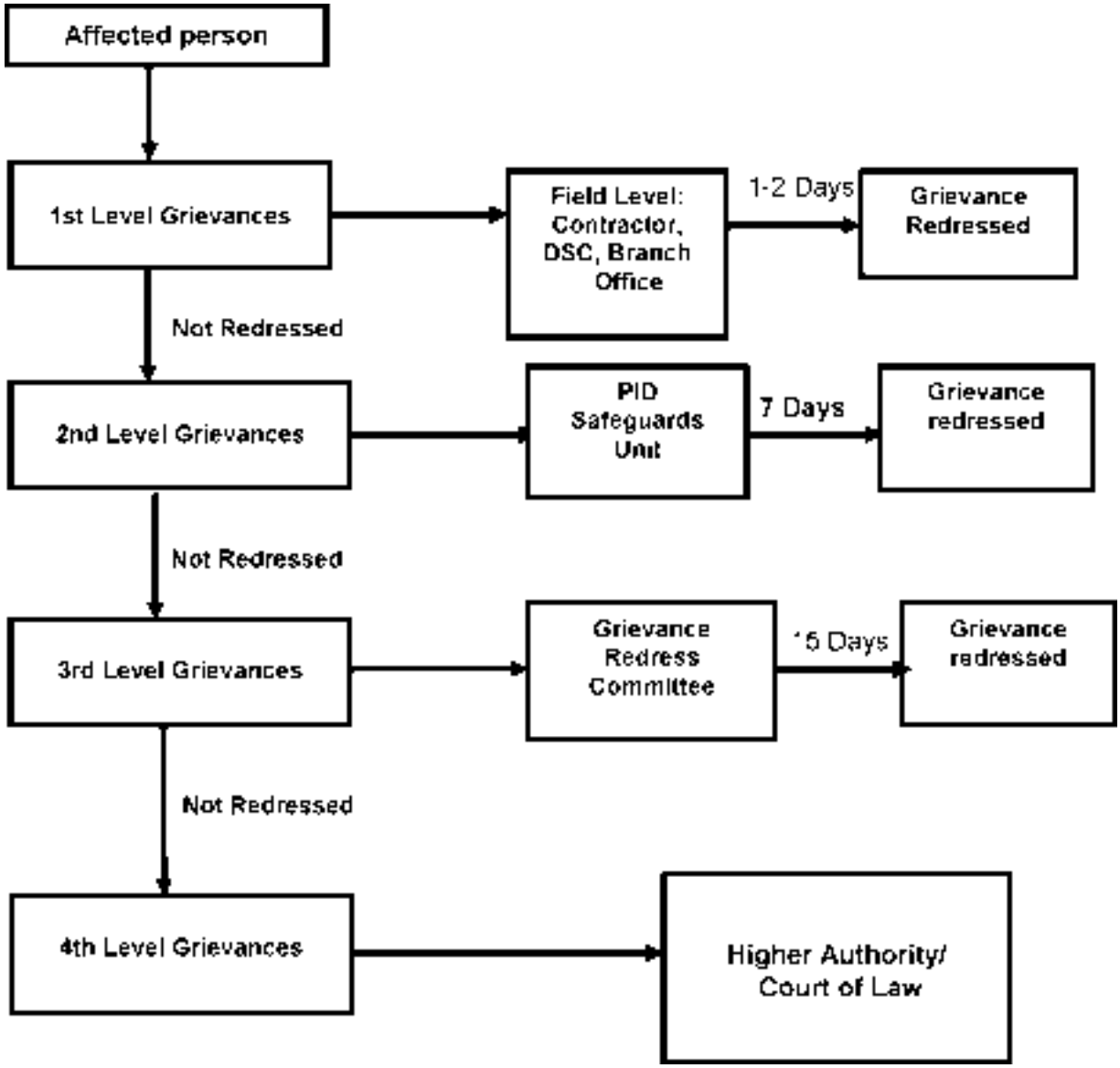


Figure VII-1: Grievance Redress Mechanism (GRM)

DSC= design and supervision consultant, PID=project implementation directorate.

VIII. ENVIRONMENTAL MANAGEMENT AND MONITORING

A. Institutional Arrangement

216. This Environmental Management Plan (EMP) has been prepared to ensure that all mitigation measures and monitoring requirements will actually be carried out at different stages of project implementation and operation - preconstruction, construction and operation and maintenance. The EMP has established the roles and responsibilities of all parties involved in the project's environmental management describing mitigation measures that shall be implemented to avoid or mitigate adverse environmental impacts and maximizing the positive ones; ensuring the environment and its surrounding areas are protected and developed to meet the needs of the local people and stakeholders. Role and responsibilities of different institutions during different phase of the project are presented in the following table.

Table VIII-1:Institutional Arrangements

SN	Phase	Activity	Responsible Institution	Unit
1.	Pre-construction	Preparation of IEE, Detail Design, cost estimate, Tender and Bidding document	KUKL-PID, Design and construction supervision consultant	PID and DSC
2.	Construction	• Daily monitoring of underground water supply pipelines and utilities along the excavated trenches Coordination and supervision of pipe laying works and support	KUKL-PID, Design and construction supervision consultant	
3.	Construction	• Monitoring and supervision for Sallaghari WWTP during the time of excavation and construction	Bhaktapur Municipality/ Ward 2 office	
4.	Construction	• Monitoring and supervision for Kodku WWTP during the time of excavation and construction	LMC and LMC ward 9 office	
5.	Construction	• Monitoring and supervision for Dhobighat WWTP during the time of excavation and construction	LMC and LMC ward 4 office	
6.	Operation	Daily monitoring and supervision	KUKL-PID	
7.	Operation	Safe operation of plants; regular monitoring and maintenance	Construction contractor	
8.	Operation	Cooperation and coordination with stakeholders while required for combine maintenance work.	Community Awareness and Safeguard Support Consultant (CASSC)	
9.	Operation	Cooperation and coordination with PID and other stakeholders while required for combine maintenance work.	Bhaktapur Municipality/ Ward 2 office	
10.	Operation	Cooperation and coordination with PID and other stakeholders while required for combine maintenance work.	LMC and LMC ward 9 office	
11.	Operation	Cooperation and coordination with PID and other stakeholders while required for combine maintenance work.	LMC and LMC ward 4 office	

B. Environmental Management and Mitigation Measures

217. Anticipated environmental impacts and mitigation measures have been dealt in detail in

Section D and (*Table VIII-2*).

218. A detailed self-explanatory environmental management and monitoring program is presented. The Table lists the environmental impact, its mitigating measures; the parameters to be monitored (including measurement and responsible agency) and the cost. The program will evaluate: (i) the extent and severity of the adverse environmental impacts as compared to what was predicted, (ii) how effective the mitigating measures were and compliance with the regulations and the (iii) overall effectiveness of the EMP.

C. Environmental Monitoring Program

219. The environmental monitoring of the Wastewater System includes field supervision and reporting of project activities prior to and during the project construction and operation in order to ensure that the works are being carried out in accordance to the approved design and that the environmental mitigation measures are fully implemented in accordance with the EMP.

Table VIII-2: Environmental Management and Monitoring Plan of TP-02

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
CONTRACTORS DESIGN PHASE						
stoppage of existing WWTP	Minimum stoppage planned	Work plan should be properly prepared				
Soil erosion and slope instability	Incorporate drainage system in final design	Review if detailed drainage systems with plans have been designed				Contractor
Sludge disposal	Incorporation of optimum sludge reduction using anaerobic digestion in design for power generation.	Review if designs for sludge management have been made				Contractor
Health and safety of community and workers	Prepare training manuals in Nepali (or local languages) with notes and sketches on Community Health and Safety and Potential Occupational Health and Safety	Review information for errors and quality				Contractor
Treatment plant inefficiency	Develop and Implement HACCP plans as part of the O&M manuals and provide in Nepali with sketches and regular training to the staff	Operation of plant as per HACCP Plan and O&M Manual. Operational reports (including incidence reports)	Audit of HACCP Plans and O&M manuals (Audit reports) Submission of operational reports			Contractor
PRE-CONSTRUCTION ACTIVITIES						
Permits and Approval	Obtain required permits and approval for disruption of existing wastewater treatment plant during construction	Ensure work plan such that no disruptions to WWTP are planned				Contractor
Lack of public consultations and awareness programs	Develop and implement a project communications plan to make the stakeholders feel they are part of the project and it belongs to them.	Implementation of communications plan throughout the project.	Audit of communications plan (Audit reports) Number of meetings, awareness programs held	Project sites	Bi-annually for the first 2 years of the project then annually in	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
		Arrange meetings, workshops and group discussions to disseminate project final designs, plans and activities			O & M period	
Workforce camps	Establish temporary workforce camps with sanitary amenities at designated sites only	Ensure temporary workforce camps are established within designed area with sanitary facilities and first aid facilities	Visual inspections of wastewater disposal, solid waste management, noise and air pollution, health of workforce, potable drinking water, kerosene availability	Project site	Monthly	Contractor
CONSTRUCTION PHASE						
Job opportunity	Employ local people (not under age 16). Settle wage rate based on DWEC and provide the list of employees to DSC	Number of local persons employed, number of under-aged people employed. Whether the wage rate is at par with DWEC	List of employees , nationality, age of employees, wages	Project site	During construction every month	Contractor
Change in hydrology and morphology of streams and rivers	Quarrying/mining activities in river/streams for extraction of construction materials shall not be done so as to change the river cross sections and longitudinal profiles.	Cross sections of river before construction and during construction upstream (at the quarry site, upstream and downstream) and river discharge	Cross-section of river; Visual inspection, discussion with locals, discharge measurements and photographs before and during construction	Quarrying/mining Sites in river course	During construction every month	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Soil erosion and slope stabilization	Separate stockpiling of topsoil for further use; spoil disposal at designated and stabilized sites; excavated areas' backfill to be compacted and include replacement of topsoil; avoid work during the rainy season as much as possible; mulching to stabilize exposed areas; use bioengineering techniques (e.g. re-vegetating areas promptly); provide channels and ditches for post-construction flows; lining of steep channels and slopes (e.g. use of jute matting); prevent off-site sediment transport using settlement ponds, silt fences Use of settling basins at reservoir sites; use of straw for filtering of small discharges; routine inspection and monitoring of larger discharges to water courses. Use of temporary bunds; use of catchment basins below steep reservoir sites. Construction to be done in the dry season only; use of river diversions with *bundings*. Local wells and springs to be bunded from temporary spoil dumps; local wells and spring fed spouts or kuwas to be monitored particularly downhill of excavations plus temporary supply provided if flow is affected; permeable base and side backfill required at deeply excavated sites or an alternate source of drinking water provided at the existing location.	Drainages systems Stockpiling of top soil for its re-use Bio-engineering measures Management of excessive spoil materials	Site drawings showing drainage system in project sites. Visual inspections, photographs and the local people's views if excavation and other site works have caused soil erosion; stockpiling of excavated soils have been done or not (logbook on transportation of excess spoil materials from the site); whether spoils have been disposed in approved areas or not and whether the contractor has taken mitigation measures or not (site plan showing areas for disposal Number of trees or saplings planted Site operations log book (to determine if construction works is being carried out in the wet or dry season). Log book of water delivery to people being served.	Project Site	During construction (Weekly)	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Water pollution	Avoid camping facilities within clear water supply rivers Provide designated areas with collection bins for wastes. Provide safe toilets and septics tanks in site Prohibit open defecation in open areas. Storage of construction aggregates, hazardous, and toxic materials in safe areas and disposal of chemical containers, packaging materials, plastic bags etc. Prohibit washing of vehicles next to rivers and streams. Provide training to workforce on safe handling of toxic materials and OHS measures during construction. Recover used oil and lubricants and reuse or remove from the sites. Storage areas for fuels and lubricants should be away from any drainage leading to water bodies. All fuel use areas e.g. generator must have drip basins installed to prevent any leakages and recycled. All fuelling, repairing and maintenance work should be done on a concrete surface provided with a catch tank that can be cleaned and all spilled fuel recovered and recycled.	Water quality and health status of workers before and during construction. Site plan of camp facilities showing nearby receptors, toilet facilities/ablution blocks. Site plan showing designated storage areas, list of chemicals on site; prohibition/restrictive signage at the construction sites. OHS training plan and material safety data sheets (MSDS) on site at all times Oil and lubricant spill prevention measures	Baseline water quality of receiving water (complete physical, chemical and bacteriological tests). Inspection of site plans, distance of camping facility from drainage areas (at least 100m); number of toilets/ablution blocks provided; audit of training plan, inspection of signage and MSDS, health/clinic reports of workers. Observation of fuelling and generator areas	Streams and rivers, Project sites and camps	Once in a month	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Air Quality	Dust suppression on roads or at open sites by sprinkling water as required at regular intervals. Cover earth stockpiles using plastic sheets or cement jute bags. Limit vehicle speed. See that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS. Regular maintenance of vehicles. Provide ventilation in confined working areas.	Operation of dust suppression tanks, sprinklers on site Stockpiles covered with appropriate sheeting. Vehicle maintenance records; renewal of "green stickers". Ventilators in confined spaces	Visual inspection if water is sprinkled or not; logbook of operation of dust suppression trucks. Photographs of stockpiles, visual inspection reports Check maintenance records and "green stickers". Inspection reports of site plans and no of ventilators (meets international standards).Site drawings showing location of ventilators, no of ventilators	Project location	During construction/ every week	Contractor
Noise level and vibration	Monitoring of noise levels regularly at site. Fit mufflers in vehicles to control noise. Limit the speed s of vehicles. Ban the use of power horns in vehicles. Regular maintenance of equipment. Prohibit the operation of crushing plants and construction vehicles between 7 PM to 6 AM. Compensate the damages caused by vibrations.	Baseline noise level Adoption of noise level control measures as specified; vehicles with mufflers installed or not; speed limit signage erected; maintenance schedule of equipment; operation log of crushing plants. Nearby structures/buildings in construction areas.	Sound level (DBA); feedback/complaints from nearby residents; number of vehicles installed with mufflers; number of vehicles with/without power horns; number of speed limit signage at the project site; inspection reports/photographs of nearby buildings/structures for cracks before/during construction	Project Site	Every week	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
Waste management	Store all materials, toxic, non-toxic and hazardous materials in safe place (warehouse). Collect, segregate and dispose waste at designated areas	Waste management plan Log of collection and disposal of waste from the site	Check amount of solid waste generated and if solid waste management is carried out efficiently. Audit of waste management plans; inspection of disposal areas/site plan drawings, photographs etc.	Project site	During the construction period	Contractor
Vegetation Clearance	Provide LPG/kerosene to workforce. Stockpile the felled trees and take permission from concerned authority for its use Plant and rear tree saplings at the rate of 25 saplings for each felled tree.	Cutting of only the specified and marked trees; use of timber and wood; availability of LPG/kerosene; plantation @ 25 tree saplings per cut tree Permits for tree felling and its use	Check records of trees cut and planted; whether LPG/kerosene is available in camp sites. Photographs, expiry date of permits and number of permits etc.	Project Site	Regularly	Contractor
Damaged infrastructures and services	Reinstate/relocate community assets that are disturbed such as irrigation canals, electricity poles, telephone lines, drinking water pipes, sewerage lines, roads, etc. to the a standard as before and/ or better.	Reinstatement of structurally damaged infrastructures like temples, bridges, irrigation channels, electricity poles, telephone lines, drinking water pipes, sewers, access roads, cracks in buildings etc.	Field observation to visually assess if disturbed community assets are reinstated. Design drawings and technical specifications showing areas for potential reinstatement, photographs before and after construction in sensitive areas etc.; emergency response plans	Project Site	Once construction in the area is over.	Contractor
Crime and community	Prohibit gambling and alcohol consumption in camp sites.	Situation of social disharmony	Crime records and causes; camp issues;	Project Location	Once a month	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
stress	Instruct the outside workforce to respect the local cultures, traditions, rights etc. Provide security in camps	Awareness program. Workers/ Staff conduct policy	enforcement of remedies; security situation in camps. Audit of staff/ workers conduct policy		Once a month	
Health and hygiene	Provide regular health check-ups, sanitation and hygiene, training in community health and safety, OHS measures, health care, and control of epidemic diseases to the workforce. Launch awareness programs concerning human trafficking and the possibility of spread of STDs and HIV/AIDS using brochures, posters, and signboards. Make available first aid kits, ambulance and fire extinguishers in camp sites.	The use of safety equipment by workforce The provision of health measures and training Awareness program Signs and posters Compensation for health	Health records; records of outbreak of diseases; maintenance of health clinic; health complaints; number of awareness programs launched; number of persons trained.	Project Site	Every week	Contractor
Archaeological and cultural heritage sites	Protect archaeological and cultural heritage sites: In case of relocation consult the local community Inform the Chief District Officer (in case of chance finds) who has to report the findings in writing to the Department of Archaeology within 35 days, according to the Ancient Monuments Protection Act, 1956 and Rules, 1989. Use manual labour for digging trenches and avoid heavy equipment and pneumatic drills.	Surveys and discussion with local residents and community Notification to CDC and Department of Archaeology before works are to begin Availability of workers and equipment to undertake the works	Field observation of archaeological and cultural sites and number of chance finds to authorities. No. of notifications sent and meeting minutes/ letters of correspondence Design and technical specification documents specifying requirements. No of workers available etc.	Project site	Every month	Contractor
Traffic Management	Develop a traffic plan to minimize traffic flow interference from construction activities. Advance local public notification of	Working schedules and traffic plans. Information about	Visual observation of traffic; complaints from travellers and locals;	Project site	Every week	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
	construction activities, schedule, routing, and affected areas including road closures. Erect signage in Nepali and English languages. Use of steel plates or other temporary across trench facilities in key areas such as foot trails or livestock routes; arrange for pedestrian access and sidewalks and parking areas. Arrange for night-time construction for activities in congested/ heavy day-time traffic areas. Undertake trench closure and facilitate rehabilitation as quickly as feasible.	construction schedule to the local people	existence of signage and effectiveness of speed control and diversion measures.			
Operation Phase						
Discharge of industrial wastes to WW treatment System	Train workers in OHS hazards and provide PPE; monitor illegal discharge of industrial wastes to the system and enforce strict regulations in coordination with the Ministry of Environment, Science and Technology	Observation; implementation of training plans, OHS policy, implementation of trade waste policy. Monitoring at the inlet of WWTPs for electrical conductivity and DO using online instrumentation.	Visual observation, audit of training plan OHS policy and trade waste policy. EC (for electrical conductivity), mg/L (for DO)	Nearby Industries	Once a month	Contractor
Wastewater release	Treat wastewater to meet the effluent standards before releasing it to natural surface sources; regular monitoring the quality of the	Quality of treated wastewater that will be released to river	Influent BOD/COD, pH, TSS T, heavy metals; effluent BOD/COD, pH,	At the WWTP outlet and downstream of	Regularly during operation	Contractor

Impacts / Project Activities	Management Plan					
Impacts due to	Mitigating Measures	Parameters to be monitored	Measurements	Location	Frequency	Responsibility
	treated wastewater and that of the receiving water.	(TSS, BOD_5, and heavy metals in mg/l; pH, T (°C) as mentioned in Annex 3)	TSS and heavy metals; stream water quality (TSS, T, BOD/COD, pH)	wastewater release	(fortnightly)	
Overflow flooding	Careful operation of wastewater system according to the Operation Manual and HACCPP; provide stand-by generators for pumping stations. To ensure O&M, training of operators to be provided for regular inspection, cleaning and maintenance of plant and sewers.	Standby generators in operating conditions with sufficient fuel (the diesel generator is the second backup power. The first is the power generated from the digestion plant. The constant source of electricity supply, if available will also be used). Emergency response procedures have to be developed and implemented. . Operation and maintenance schedules Trainings conducted	Visual observation Audit of O&M manual, schedules, HACCP plans. No of incident reports	Treatment plants	Once a month	Contractor
Health and safety	Provide trainings to workers on OHS	Number of trainings given	Quizzes and interviews, audit of OHS policy, number of workers participated etc.	Plant sites	Once a month	Contractor

D. Environmental management and monitoring cost

1. Environmental Procedures and Institutions

220. The Ministry of Water Supply (MoWS) has the overall responsibility for environmental monitoring of all water supply and sewerage projects. In case of an Initial Environmental Examination (IEE), the final approval lies with MoWS.

221. The MoWS will be the executing agency responsible for overall strategic planning, guidance, and management of the project, and for ensuring compliance with loan covenants. As part of institutional reforms under the ongoing loans, three water and wastewater organizations were created - Kathmandu Valley Water Supply Management Board (KVWSMB), the asset owner; KUKL, the asset operator and service provider. KVWSMB will continue to discharge its responsibilities as asset owner of water supply and wastewater systems and monitoring of performance of KUKL as provided in the lease and license agreement between KVWSMB and KUKL. KUKL will be the implementing agency, and the existing PID in KUKL will be responsible for (i) project planning, implementation, monitoring, and supervision; (ii) reporting to KUKL Board of Directors, MoWS, and ADB; and (iii) coordination of all activities. All the cost of monitoring during the time of construction will be under Design and Supervision Consultant.

222. Table VIII-3 defines the roles of different organisations and groups in environmental monitoring:

Table VIII-3: Institutional/organizational responsibilities in environmental monitoring

SNo.	Organization	Roles and Responsibilities		
		Pre- construction phase	Construction phase	Operation phase
2	Ministry of Water Supply (MoWS)	• Review IEE document and submit to donors; approve IEE report, • review design and tender documents in order to examine whether or not mitigation prescriptions are included and instruct KUKL.	• review EMP Report (i) to ensure EMP implementation (ii) effectiveness of the implementation measures and (iii) compliance	• review bi-annual monitoring reports, and • annual site inspection.
3	Kathmandu Valley Water Supply Management Board (KVWSMB)/ Kathmandu Upatyaka Khanepani Limited (KUKL) and Projection Implementation Directorate (PID)	• review final design and tender documents and forward them to MoWS, • instruct PID to update RAP and get it approved, • establish 'Safeguard Unit/Utility Management Coordination Subcommittee /appoint Design and Supervision Consultant (DSC) • obtain all necessary permissions and permits, notify, carry out land acquisition (if required), and crop compensation evaluation • select contractor, award and	conduct frontline monitoring on mitigation implementation (i) effectiveness (ii) enhancement programs (iii) appoint monitoring team (iv) ensure public participation (v) RAP implementation (vi) environmental compliance and (vii) prepare quality monitoring report to submit to MoWS.	• ensure smooth operation of water supply and sewerage systems

4	Design and Supervision Consultant (DSC)	• incorporate all provisions of EMP in the final design, • incorporate all mitigation measures in the tender documents, • assist in site inspection during land intake, and • Baseline monitoring of air and receiving water quality, noise level and vibrations and overall environmental status of the project area.	approval of construction works • monitoring of the contractor's performance on EMP implementation/ mitigation effectiveness / impact monitoring • labour employment as per regulations • instruct contractor for corrective actions • impose fine/or null payment in case of noncompliance and • prepare monthly monitoring report/ participate in inspection • periodic monitoring of air quality, receiving water quality and noise and vibration levels at the project area • monitoring of impacts on physical, biological and	
5	Construction Contractor	• prepare EMEP for contracts, • select temporary land use sites, and • assist the supervising engineer in joint site inspection of KVWSMB/ KUKL for approval.	• get permission to start work from DSC • ensure that all prescriptions of EMP are included in the work activities • ensure employment opportunities for the locals and maintain records of employment, and submit to the Supervising Engineer • carry out corrective measures as recommended by DSC • participate in monitoring and inspection • prepare an operational manual to submit to DSC • provide training to the monitoring personnel, and • submit monthly reports on EMP compliance to DSC.	

E. Monitoring and Reporting Procedures

223. The Construction Contractor should develop a construction environmental management plan (CEMP) based on the EMP. The CEMP should be approved by PID/KUKL and DSC. Contractors are to submit monthly CEMP implementation status reports to DSC. DSC should submit quarterly reports to PID which should be reviewed by the Safeguard Unit of PID. PID should submit semi-annual monitoring reports to ADB in a similar format provided in the following section. The reporting system should be based on site supervision to see whether mitigation measures are carried out according to the Monitoring Plan. DSC is responsible for checking the monthly progress reports submitted by the Contractor and field verified whether or not the Contractor has complied with the approved conditions as stated in the CEMP.

224. DSC should then prepare a quarterly environmental monitoring report based on the monthly report submitted by the Contractor and submit to PID/KUKL for review. The report is developed based on field inspection, investigation, consultation and information given in the monitoring report. 10 copies of the reports should be submitted to PID/KUKL every month, which should be distributed to the responsible agencies for review. The Environmental Specialist of DSC should then review the comments and suggestions from the various authorities and act accordingly.

225. Monthly progress reports, including bi-annual and annual reports on the implementation of EMP should be produced on a regular basis. The monthly progress report should contain information on the works carried out and the results of all monitoring and investigation works performed during that particular month. The report should also include cases of compliance and non-compliance and the corresponding further mitigation measures to be adopted to correct the non-compliances and also include the outcome of the monitoring, important issues identified and the measures to be undertaken to ameliorate them. Format sample for the reporting documents are presented as follows.

Monthly Progress Report format

1. Introduction
2. Major issues raised during construction
3. Status of construction activities
4. Status of labour camps
5. Material storage yard
6. Safety status
7. Waste disposal status
8. Mitigation measures mentioned in the EMP implemented
9. Photographs

Sample Semi-Annual Environmental Monitoring Report Template

This template must be included as an appendix in the EIA/IEE that will be prepared for the project. It can be adapted to the specific project as necessary.

1. Introduction
- Overall project description and objectives
- Description of sub-projects
- Environmental category of the sub-projects
- Details of site personnel and/or consultants responsible for environmental monitoring
- Overall project and sub-project progress and status

No.	Sub-Project Name	Status of Sub-Project				List of Works	Progress of Works
		Design	Pre Construction	Construction	Operational Phase		
		□	□	□	□		
		□	□	□	□		
		□	□	□	□		

2. Compliance status with National/ State/ Local statutory environmental **requirements**

No.	Sub-Project Name	Statutory Environmental Requirements	Status of Compliance	Action Required

3. Compliance status with environmental loan covenants

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

Compliance status with the environmental management and monitoring plan

- Provide the monitoring results as per the parameters outlined in the EMP. Append supporting documents where applicable, including Environmental Site Inspection Reports.
- There should be reporting on the following items which can be incorporated in the checklist of routine Environmental Site Inspection Report followed with a summary in the semi-annual report send to ADB. Visual assessment and review of relevant site documentation during routine site inspection needs to note and record the following:
- What are the dust suppression techniques followed for site and if any dust was noted to escape the site boundaries;
- If muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads;
- Adequacy of type of erosion and sediment control measures installed on site, condition of erosion and sediment control measures including if these were intact following heavy rain;
- Are their designated areas for concrete works, and refuelling;
- Are their spill kits on site and if there are site procedure for handling emergencies;
- Is there any chemical stored on site and what is the storage condition?
- Is there any dewatering activities if yes, where is the water being discharged;

- How are the stockpiles being managed;
- How is solid and liquid waste being handled on site;
- Review of the complaint management system;
- Checking if there are any activities being under taken out of working hours and how that is being managed.

Summary for Monitoring Table

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

Overall Compliance with CEMP/ EMP

No.	Sub-Project Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

Approach and methodology for environmental monitoring of the project

- Brief description on the approach and methodology used for environmental monitoring of each sub-project

Monitoring of Environmental Impacts on Project Surroundings (ambient air, water quality and noise levels)

- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 pg/m3	SO2 pg/m3	NO2 pg/m3

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters >		Government Standards)			
			pH	Conductivity pS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Summary of Key Issues and Remedial Actions

- Summary of follow up time-bound actions to be taken within a set timeframe.

Appendices

- Photos

Noise Quality Results

Site No.	Date of Testing	Site Location	LAea (dBA) (Government Standard)	
			Day Time	Night Time

- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- Other

SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name Contract Number

NAME: _____ DATE: _
TITLE: _____ DMA: _
LOCATION: _____ GROUP:

WEATHER CONDITION:

INITIAL SITE CONDITION: _____

CONCLUDING SITE CONDITION:

Satisfactory ___ Unsatisfactory___ Incident ____ Resolved ___ Unresolved

INCIDENT:
Nature of incident:

Intervention Steps:

Incident Issues

Resolution

Signatu

Project Activity Stage	**Survey**	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Emissions	Waste Minimization
Air Quality	Reuse and Recycling
Noise pollution	Dust and Litter Control
Hazardous Substances	Trees and Vegetation

Site Restored to Original Condition Yes No

re

Sign off

Name
Position

Regular Monitoring checklist

Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited

Monitoring Checklist for Lalitpur Core area sewer						
Name of Work:						
Name of Contractor:						
Contract No:		Monitoring Date:				
		Time:				
Place:						
SN	**Activities**	**Yes**	**No**	**Full Score**	**Achieved Score**	**Remarks**
1	Available Sign Board with the Name of Project & Contractor including start and completion date			6		
2	Available Visible Sign Board for Traffic Alternative Route/ Safety sign boards			5		
3	Available of authorized representative of contractor at work site (Engineer/Supervisor)			5		
4	Regular visit of work area for supervision by contractor's Safety supervisor			5		
5	Is the safety barricade placed around is adequate (1 m height of green net that must be tightened either to a bamboo pole or to iron poles which shall be installed at least 1.5m distance from the edge of the excavation or as local conditions required)			10		
6	Toolbox talk completed?			5		
7	Is there any emergency plan for the construction site/Emergency contact numbers provided to workers?			6		
8	No entry of Non-Authorized Person inside the area of Safety Barriers.			3		
9	Does the contractor check his machinery regularly and is it in good condition (Excavator etc.)?			5		
10	Use of Personnel Protective Equipments (PPEs) by Workers i.e. hard helmets, PPE vest, Gloves, Boots, etc			5		
11	Is the First Aid box on site and in good condition with all the items intact /First Aider?			9		
12	Are all the laborers above age 16 working on site?			7		
13	Has potable water been provided to all the laborers?			3		
14	Help Desk: Table, Chair and First Aid with Grievance Register Available visible by Public			3		

15	Is the ground of working site clear and secure against any possible injury?			4		
16	Is the excavated material piled safely without earth falling into the trench again?			5		
17	Are all the excavated trenches > 1.5m depth (Trench Shoared)			10		
18	There is no any spillage of chemicals around the working site.			4		
				100		
The acceptable score is 80 and above						

If any item is answered with a “No”, explain below:

DSC04/CASSC	**On behalf of contractor**
Name:	Name:
Signature:	Signature:
Date:	Date:

205. The EMP has been incorporated into the bidding and contract documents and the contractors were made available a budget for all such environmental mitigation measures.

206. A domestic Community Awareness and Safeguard Support Consultant (CASSC) firm will facilitate community awareness and participation programs over the 5-year period. The cost for the public awareness specialist, support team, and IEC (Information, Education and Communication) materials has been estimated as $600,000.

207. The Contractors and their supervisory staff should be made aware on the importance of meeting environmental safeguard standards in the contracts, and the importance of preparing, submitting and getting the Environmental Mitigation Execution Plan (EMEP) (to be prepared for each subproject, according to the EMP) approved before construction starts. A one-day orientation programs will be provided to construction contractor as and when required. The orientation program will consist of (i) environmental issues in WWTP construction and operation, (ii) implementation of mitigation measures, (iii) monitoring of implementation and (iv) preparation of the

Environmental Mitigation Execution Plan.

208. Costs for the operation and maintenance phase trainings of KUKL staff, including monthly monitoring.

However, the indicative costs of EMP implementation are shown in Table VIII-4;

Table VIII-4: EMP cost

S.n.	Particulars	Stages	Unit	Quantity	Rate	Cost
					(US$)	(US$)
	Training and capacity development					
1	On job training	Construction		LS		32,765.12
2	Inland training	Construction		LS		32,765.12
3	Overseas training	Construction		LS		54,680.38
	Total Trainings					**120,210.62**
	Safety Equipment (Fire Extinguisher etc.)	Construction		LS		**7,961.70**
1	**Sallaghari**	Construction	Number			
	Land scape	Construction	No	5	3,280.82	
	· Pergola	Construction	No	500	37.36	18,680.00
	· Trees plantation	Construction	m2	1500	15.81	23,715.00
	· Grass	Construction	m	486	47.42	23,046.12
	· Seating wall	Construction	m2	2067	30.90	63,870.30
	· Paving	Construction	m	100	27.30	2,730.00
	· Planter					**148,445.52**
	Total					
1	**Kodku**	Construction				
	Land scape	Construction	No	5	3,280.82	16,404.10
	Pergola	Construction	No	3000	37.36	112,080.00
	Trees plantation	Construction	m2	8000	15.81	126,480.00
	Grass	Construction	m	760	47.42	36,039.20
	Seating wall	Construction	m2	3400	30.90	105,060.00

S.n.	Particulars	Stages	Unit	Quantity	Rate	Cost
	Paving	Construction	m	100	27.30	2,730.00
	Planter					**398,793.30**
	Total					
1	**Dhobighat**	Construction				
	Land scape	Construction	No	10	3,280.82	32,808.20
	Pergola	Construction	No	10000	37.36	373,600.00
	Trees plantation	Construction	m2	40000	15.81	632,400.00
	Grass	Construction	m	1374	47.42	65,155.08
	Seating wall	Construction	m2	6940	30.90	214,446.00
	Paving	Construction	m	200	27.30	5,460.00
	Planter					**1,323,869.28**
	Total					
	All Total					**1,999,280.42**

IX. CONCLUSIONS AND RECOMMENDATIONS

209. Overall the impacts of the Project will be very positive, benefitting the environment and the people. Some impacts are anticipated during implementation but in specific areas and for short duration (dust, noise, traffic problems, erosion, sedimentation etc.). It is expected that the adverse environmental impacts of the planned project for will in general not be significant and can be reduced and/ or prevented through mitigation measures and regular monitoring during the design, construction and operation phases.

210. This IEE is updated for wastewater treatment plant facilities that will be upgraded and extended under TP-02, whereas new waste water treatment plants will be established at Sallaghari, Kodku and Dhobighat under TP-02. The project will contribute significantly to the improvement of the health and quality of life of the people due to the wastewater improvements in Kathmandu Valley.

211. The project is unlikely to cause significant adverse impacts. The potential adverse impacts associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures as detailed in the EMP.

212. Based on the findings of the IEE, the classification of the project as category - B is confirmed, and no further special study or detailed EIA needs to be undertaken to comply with ADB SPS (2009).

Appendix 1: Rapid Environmental Assessment (REA) Checklist Kathmandu Valley

Wastewater Management Project

1. The Kathmandu Valley Wastewater Management Project (KVWMP) will support the ongoing efforts of the Government of Nepal toward improving the wastewater services in Kathmandu Valley.

2. The proposed infrastructure components of this project include (i) rehabilitation and expansion of sewerage network including property connections; (ii) rehabilitation and construction of WWTP; (iii) rehabilitation and construction of 5 wastewater treatment plants of 90.5 MLD capacity; and (iv) energy generation of approximately 910 KW through sludge digestion and gasification, etc.

3. **Categorization (Environment)** - Category B. No significant impacts. Potential impacts are site specific, few if any of them are irreversible, and in most cases mitigation measures can be designed readily. An IEE with EMP was prepared.

Screening Questions	Yes	No	Remarks
B. Project Siting Is the project area...			
a) Densely populated?	x		Rehabilitation of sewerage network will be in urban areas. Extension of interceptors will be in non-populated areas. WWTPs will be rehabilitated/ constructed in existing sites owned by the Government.
b) Heavy with development activities?		x	In established residential areas
c) Adjacent to or within any environmentally sensitive areas?			
Cultural heritage site	x		Sewer will be laid on the streets of the Heritage sites. Prior to construction approval will be sought from Department of Archaeology in accordance to The Ancient Monuments Preservation Rules 2046 (1989) Section 4.1.1
• Protected Area		x	
• Wetland		x	
• Mangrove		x	
• Estuarine		x	
• Buffer zone of protected area		x	
• Special area for protecting biodiversity		x	
• Bay		x	
Potential Environmental Impacts Will the Project cause.			
■ impairment of historical/cultural monuments/areas and loss/damage to these sites?	x		If there are any chance finds, work will be stopped immediately, the Chief District Officer contacted immediately, and the findings reported in writing to the Department of Archaeology within 35 days, according to the Ancient Monuments Protection Act, 1956 and Rules, 1989.

Screening Questions	Yes	No	Remarks
■ interference with other utilities and blocking of access to buildings?	x		Detailed surveys will be conducted of all services and as constructed drawings obtained where possible to locate existing services and to prevent disruption during construction. Budget for restoration/replacement of damaged utilities will be made available and a contingency plan in case of disruption prepared and implemented.
■ nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?		x	Not anticipated.
■ dislocation or involuntary resettlement of people?		x	No displacement of communities required in this project.
■ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		x	Not applicable.
■ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		x	Project involves construction of WWTPs designed to allow for expansion as wastewater flows increase in the future. WWTPs to be operated using WWTP safety plans that use a risk-based approach to operation.
■ overflows and flooding of neighbouring properties with raw sewage?		x	Sewers will be designed to meet peak flow to ensure no overflows of raw sewage. provide stand-by generators for pumping stations. Train operators for regular inspection, cleaning, and maintenance of plant and sewers.
■ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		x	Sludge will be treated and managed to produce energy at 4 WWTPs via gasification, anaerobic digestion etc.
■ noise and vibration due to blasting and other civil works?	x		No blasting activities. Restrictions on operational hours of crushing plants and construction vehicles etc will be applied.
■ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?		x	Use of PPE at all sites will be applied strictly. The EMP ensures occupational health and safety measures are included. No hazardous chemicals will be used during construction and operation.
■ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?		x	Not anticipated. Sewerage to be collected from residential areas. Some commercial connections are anticipated. Waste from these industries discharged to the sewer network will be restricted through the implementation of appropriate discharge standards and monitoring through regular audits conducted by health
■ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?		x	Establishment and maintenance of environmental buffer zones in WWTP along with secure fencing. Design of pumping stations will include appropriate housing for pumps for noise proofing and protection of the facility.
■ road blocking and temporary flooding due to land excavation during the rainy season?		x	Not anticipated. Construction activities to be conducted during non-rainy season.

Screening Questions	Yes	No	Remarks
■ noise and dust from construction activities?	x		Anticipated during construction activities. However impacts are temporary and short in duration. The EMP ensures measures are included to mitigate the impacts.
■ traffic disturbances due to construction material transport and wastes?	x		Anticipated during construction activities. However impacts are temporary and short in duration. A traffic management plan will be developed and implemented by the contractor. Contractors will also coordinate with the local traffic police.
■ temporary silt runoff due to construction?	x		Run-off during construction is anticipated. However impacts are temporary and short in duration. The EMP ensures measures are included to mitigate the impacts. Spoil disposal will be immediate and any stockpiling will be away from drain channels etc.
■ hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		x	Not anticipated. Sewer system to be designed to accept future flows and peak flows. Design to also include stand-by generators for pumping stations.
■ deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		x	Not anticipated. The EMP ensures measures are included to manage the sludge. Design of plants include management of sludge for energy generation. Design to include plant to accept future flows. Water safety plans for the plants will be developed and implemented to ensure effluent complies with government standards and minimize operational failure.
■ contamination of surface and ground waters due to sludge disposal on land?		x	Not anticipated. Sludge to be managed and used for energy generation.
■ health and safety hazards to workers from toxic gases and hazardous materials which maybe contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge?		x	Not anticipated. The EMP ensures measures are included to mitigate the impacts. Occupational, health and safety training provided to all personnel. PPE to be worn at all times. Emergency response plans to be developed and implemented. Personnel will also be provided with relevant inoculations.
■ large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		x	Priority in employment will be given to local residents. Contractors will provide workers camps with sanitary amenities that meet the IFC 2009 guidelines.
■ social conflicts between construction workers from other areas and community workers?		x	Priority in employment will be given to local residents.
■ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		x	Not anticipated. Construction will not use explosives and chemicals. The EMP ensures measures are included to manage storage, use and disposal of fuel for construction equipment. Storage will be **in designated areas away from water bodies. Fuel use areas to have drip basins/ catch tank (for fuelling) to prevent leakage and catch spills. Fuel to be recycled where possible or disposed in designated areas.**

Screening Questions	Yes	No	Remarks
■ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		x	Operation area will be clearly demarcated and restrict public access.

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	Yes	No	Remarks
■ Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Appendix I)?	x		Kathmandu Valley is located in a seismic zone.
■ Could changes in precipitation, temperature, salinity, or extreme events over the Project lifespan affect its sustainability or cost?		x	Not applicable.
■ Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		x	The project will improve the socioeconomic conditions of both, the poor and non-poor populations of Kathmandu valley.
■ Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., increasing traffic or housing in areas that will be more prone to flooding, by encouraging settlement in earthquake zones)?		x	Improved wastewater services could potentially attract migrants to the area.

Appendix 2: Bagmati River pollution

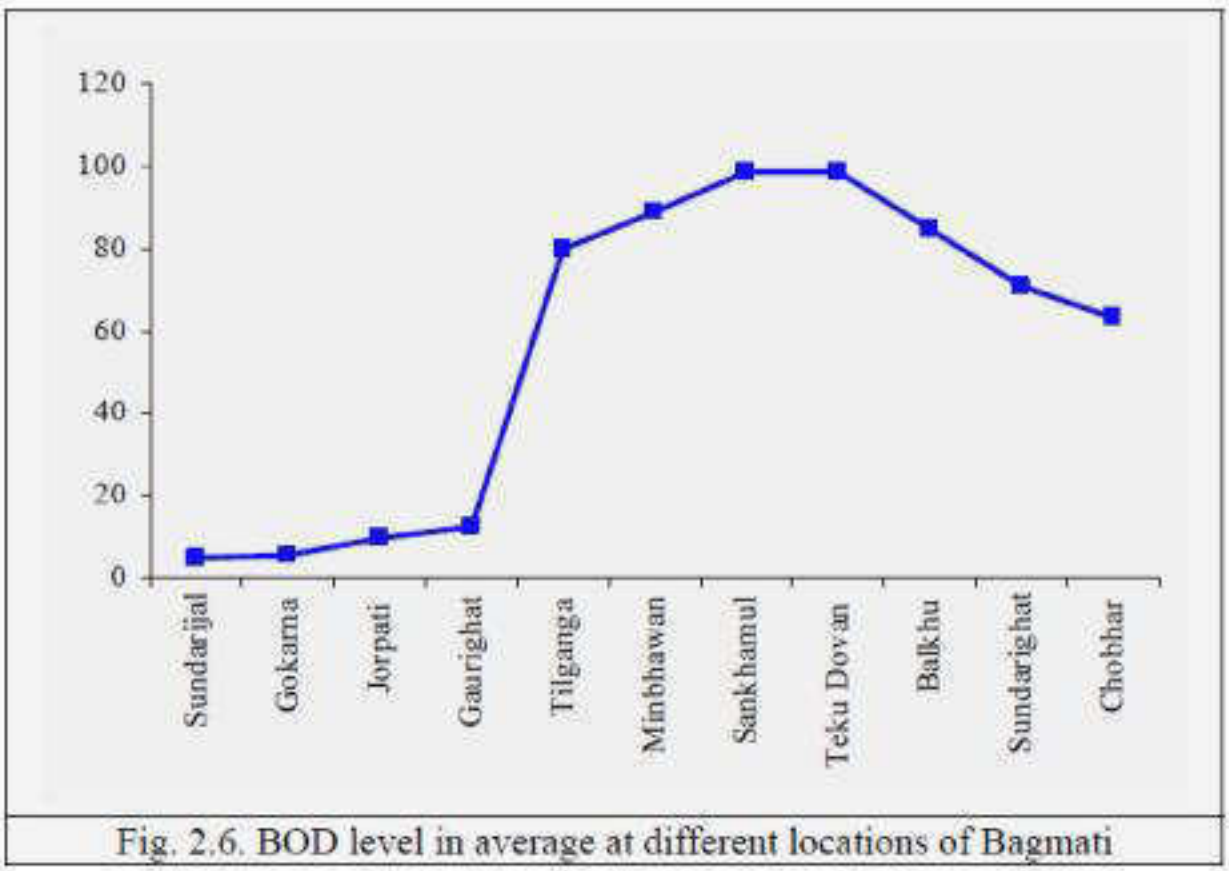


Fig. 2.6. BOD level in average at different locations of Bagmati

Y- Axis: BOD (mg/l); X-Axis: Locations in Kathmandu Valley

Table 3.1. Waiter quality parameters

Parameters	Sundarijal	Khokana
TSS mg/1	5	70
Chloride mg/1	1	24
Ammonia mg/1	0.03	11
BOD mg/1	1.3	65
Coliforai counts per 100 ml	1000	1.000.000
DO mg/1	S.9	1.7

Source: MWSP (2000)

Source: BAGMATI ACTION PLAN (2009-2014), DRAFT REPORT, March 31, 2008
Submitted to: National Trust for Nature Conservation
Submitted by Joint Venture of Astra Development Network Pvt. Ltd, GeoSpatial Systems Pvt. Ltd, Innovative Solution Pvt. Ltd

Appendix 3: Tolerance limits for wastewater to be discharged into inland surface waters from combined wastewater treatment plant (generic standards)

Characteristics	Tolerance Limit
Total Suspended solids, mg/L, Max	50
Particle size of total suspended particles	Shall pass 850-micron Sieve.
pH	5.5 to 9.0
Temperature	Shall not exceed 40 degree C in any section of the stream within 15 meters down-stream from the effluent outlet.
Biochemical oxygen demand (BOD) for 5 days at 20 degree C, mg/L, Max	50
Oils and grease, mg/L, Max	10
Phenolic compounds, mg/L, Max	1
Cyanides (as CN), mg/L, Max	0.2
Sulphides (as S), mg/L, Max	2
Radioactive materials:	
a. Alpha emitters, c/ml, Max	7-Oct
b. Beta emitters, c/ml, Max	8-Oct
Insecticides	Absent
Total residual chlorine, mg/L	1
Fluorides (as F), mg/L, Max	2
Arsenic (as As), mg/L, Max	0.2
Cadmium (as, Cd), mg/L, Max	2
Hexavalent chromium (as Cr), mg/L, Max	0.1
Copper (as Cu), mg/L, Max	3
Lead (as Pb), mg/L, Max	0.1
Mercury (as Hg), mg/L, Max	0.01
Nickel (as Ni), mg/L, Max	3
Selenium (as Se), mg/L, Max	0.05
Zinc (as Zn), mg/L, Max	5
Ammonia nitrogen, mg/L, Max	50
Chemical Oxygen Demand, mg/L, Max	250
Silver, mg/L, Max	0.1

Source: Urban Environment Management Framework 2068 (2011), GON

Note:
This generic standard applies to discharge of wastewater into inland surface waters from combined wastewater treatment plants. The municipal wastewater treatment plants in the proposed project will collect and treat only domestic wastewater from Kathmandu Valley. Therefore, in the absence of generic standards for domestic wastewater to be discharged into inland surface water from municipal wastewater treatment plants, this standard will only be applied as a guide. The project will assist in the development and implementation of domestic sewage discharge standards.

Appendix 4: National Ambient Air Quality Standard, 2012 for Nepal

Parameters	Units	Averaging Time	Concentration in Ambient Air, maximum	Test Methods
TSP (Total Suspended Particulates)	µg/m^3	Annual	-	
		24-hours*	230	High Volume Sampling
PM10	µg/m^3	Annual	-	
		24-hours*	120	Low Volume Sampling
Sulphur Dioxide	µg/m^3	Annual	50	Diffusive sampling based on weekly averages
		24-hours**	70	To be determined before 2005.
Nitrogen Dioxide	µg/m^3	Annual	40	Diffusive sampling based on weekly averages
		24-hours**	80	To be determined before 2005.
Carbon Monoxide	µg/m^3	8 hours**	10,000	To be determined before 2005.
		15 minute	100,000	Indicative samplers ***
Lead	µg/m^3	Annual	0.5	Atomic Absorption Spectrometry, analysis of PM_{10} samples****
		24-hours	-	
Benzene	µg/m^3	Annual	20	Diffusive sampling based on weekly averages
		24-hours	-	
PM10	µg/m^3	24-hours	40	
Ozone	µg/m^3	8-hours	157	

***Note:** 24 hourly values shall be met 95% of the time in a year. 18 days per calendar year the standard may be exceeded but not on two consecutive days

****Note:** 24 hourly standards for NO_2 and SO_2 and 8 hours standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before 2005

*****Note:** Control by spot sampling at roadside locations: Minimum one sample per week taken over 15 minutes during peak traffic hours, i.e. in the period 8am - 10am or 3pm - 6pm on a workday. This test method will be re-evaluated by 2005

******Note:** If representativeness can be proven, yearly averages can be calculated from PM10 samples from selected weekdays from each month of the year.

Appendix 5: Recommended noise exposure limits for the work environment (adopted from Occupational Safety and Health Administration (OSHA)

S.No	Noise Exposure (dBA)	Permissible exposure (Hours and Minutes)
1.	85	16 hrs.
2.	87	12 hrs. -18 min.
3.	90	8 hrs.
4.	93	5 hrs - 18 min.
5.	96	3 hrs.-30 min.
6.	99	2 hrs. - 18 min.
7.	102	1 hr. - 30 min.
8.	105	1 hr.
9.	108	40 min.
10.	111	26 min.
11.	114	17 min.
12.	115	15 min.
13.	118	10 min.
14.	121	6.6 min.
15.	124	4 min.
16.	127	3 min.
17.	130	1 min.

Source: Marsh, 1991

Recommended Average Equivalent Sound Levels for Protecting the Public Health and Welfare

S.No	Land Use	Measure	To Protect Against Activity Interference and Hearing Loss Effects (dBA)
1.	Residential including farm residences	Leq (24)	55
2.	Commercial	Leq (24)	70
3.	Hospitals	Leq (24)	55
4.	Industrial	Leq (24)	70
5.	Educational	Leq (24)	55
6.	Recreational Areas	Leq (24)	70
7.	Farmland and general unpopulated land	Leq (24)	70

Source: U.S Environmental Protection Agency, 1974
Note: Leq (24) = Equivalent Sound Level in decibels for 24 hours.

Appendix 6: Recommended Standards for Vibration from Construction Sites

Type of Restriction	Area Classified	
Standard Value	I & II	85 dBA
Work Prohibited Time	I	7.00 P.M. - 7.00 A.M.
	II	10.00 P.M. - 6.00 A.M.
Maximum Working Duration	I	10.00 hrs. per Day
	II	14 hrs. per Day
Maximum Consecutive Working Days	I & II	6 Days
Working Prohibited Days	I & II	Saturdays & Holidays

Source: Vibration Regulation Law 64 of 1976, Japan

Notes: 1. Area I, stands for areas to which one of the following descriptions applies:

- Areas where maintenance of quiet is particularly needed to preserve the residential environment.
- Areas which require maintenance of quiet since they are need for residential purposes.
- Areas need for commercial and industrial as well as residential propose which are in need of measures to prevent vibration pollution since a considerable number of houses are located.
- The neighbourhood of schools, hospitals and the like.
- Area II stands for areas where there is a need to preserve the living environment of in habitants and other than Area I.

2. Vibration level shall be measured at the boundary line of the specified construction work site.

Recommended Limits for Road Traffic Vibration

Area	Day time	Night time	Applicable areas
I	65 dB	60 dB	Areas where maintenance of quiet is particularly needed to preserve a good living environment and where quiet is called for us as they are used for residential purpose.
II	70 dB	65 dB	Areas need for commercial and industrial as well as residential purposes where there is a need to preserve the living environment of local inhabitants and areas mainly serving industrial proposes which are in need of measures to prevent the living environment of local residents from deteriorating.

Source: Vibration Regulation Law 64 of 1976, Japan
Note: Vibration level shall be measured at the boundary line of the road.

Appendix 7: Focus Group Discussions, Stakeholders Consultations/Workshops and Meetings

Consultations/ Focus Group Discussion with the stakeholders of proposed Gokarna wastewater treatment plant

Venue of discussion: Private house, Gokarneshowr VDC, ward no. 6 **No. of participants:** 12 **Issues raised**

- At present more than 90 % of the HHs discharge wastewater into the Bagmati river.
- The coverage of the present reed bed treatment plant is very low (only for HHs of ward no. 1.
- Focus should be given to other wards also-1,2,3,4,5,6,and 8.
- Sewage disposal is the main problem in different wards.
- The proposed land for wastewater treatment is not sufficient. There should be a provision of roads on both sides of the bank of the river as it has been proposed in other wards also. The people of ward no 6 should have access to the river bank.
- There are more than 3 drinking water pipes and cables under the existing road. There will be no space for laying sewers in the existing road unless the road is widened further.
- The population growth is very high in this VDC. More than 500 houses will be constructed during the next five years. Land has been fragmented in very small pieces. So the population will reach more than 9,000 by 2020.
- The community is going to form a committee in the near future to look into the basic needs of the community like roads, sewage treatment, water supply, and drainage etc..

Basically, the stakeholders agreed on the following agenda:

1. Wastewater treatment should be done using the Vetiver system and should be community based.
2. Another option of treatment of sewage is to divert the sewage to the existing Guheshowri WWTP.
3. Due to lack of space, a large WWTP is not feasible.
4. Active participation of the local community is a must for the management of the wastewater treatment system.

Consultation/ Focus Group Discussion for the Proposed Rehabilitation, laying of new sewer pipeline in Khasi Bazaar, Ward no 5, Kirtipur Municipality

Venue: Community building, Khasi bazaar, ward no 5, near police post
No. of participants:.....
Issues/ discussion

- The main sewer passes through this area. Due to the small size of the sewer, waste water always overflows in this area due to clogging of solid wastes.
- About 400 meter of a larger diameter sewer is required to be laid so as to solve the overflow problem.
- People are paying 50% tariff for sewerage, on the total drinking water tariff to KUKL.
- People are ready to pay more if the sewerage system is improved.

- The local people have objected to the connection of a small diameter sewer in the upper side of *Toga! Tote.*
- The existing road should be as rehabilitated to its original state after the replacement of bigger sewer.
- People are now using the old septic tanks because of the frequent overflow of wastewater from the sewer which was constructed in 2054 BS (1997).
- Stormwater pipes and sewers should be separated.
- If stormwater pipes are separated, the stormwater could be used for irrigation purposes by collecting it in the 3 existing ponds in this area which are now almost empty.
- There is also lack of space for solid waste disposal. People dispose their households waste into the streets or in the open places of the municipality though most of the people have compost bins (only for organics). The non-organic waste is disposed on the streets.

Consultation/ Focus Group Discussion for the Proposed Rehabilitation, laying of new sewerage pipeline in Sikucha, Panga, Ward no 10, Kirtipur Municipality

Venue: Sikucha, Panga, ward no 10, Kirtipur Municipality
No. of participants: 10
Date: 16 July 2012
Issues/ discussion

- Panga covers ward no 9, 10 , 11, 12 wards of the Municipality
- Almost all the ethnic /caste are Newars except Chetrri in Karki gaun.
- Kirtipur has one Municipality consisting of 19 wards and 8 VDCs
- There is no problem of sewerage pipe but the problem of outlet. At the moment all the discharge have been collected in 2 septic tanks constructed by PLAN International (INGO) about 15 years ago. The sewerage pipeline come from Bhatkepati. Na gau has been also connected from that pipeline.
- The sewerage pipeline can be connected to Sundarighat for treatment
- East belt of Panga area is most problematic, severe problem of clogging and overflow of waste water found in that areas.
- Community would fully support the project if implemented. If any grievances/ issues rose during the construction, the community will solve it.
- Regarding the tariff, each households is spending about Rs. 12, 000 per year for the management of wastewater. If the tariff increased by the government, people will accept it and ready to pay if constructed properly and covered all problematic areas.
- There should be separate storm water drainage and sewerage pipeline. This will solve the problem clogging and overflow from the sewerage pipeline.
- The sewerage problematic areas identified by the project does not cover all the areas so it should be update. Some problem areas are missing.
- There is already formation of one joint committee of 4 political party to look different problems of the area and to solve them. So there will be no problem of coordination in this area.

Consultation with the stakeholders at Shantinagar (New settlement)

Venue: Dirghayu Tole,
Shantinagar No. of participants: 10
Date: 18 July 2012 Issues/
discussion:

- Formed a *Tole Sudhar Samittee* (Community Improvement Committee) for the development of community. Dirghayu Tole is a new settlement
- They have initiated to construct the sewerage pipeline.
- The settlement adjoin the squatters area which is located in the west bank of Bagmati River
- All the squatters are settled here almost 10 years ago and discharge their residential waste directly into the river
- The Dirghayu Tole (settlement) has about 680 households including squatters in the area
- Bagmati High Powered Committee (project) has constructed sewerage pipeline of about 36 " diameter in the west side of Bagmati River recently (about 4 months ago) but has not functioned yet.
- The existing sewerage pipeline is very small. It could not cope with the increased population.
- The committee strongly demanded that the government should look these new areas and manage the sewerage and drainage system immediately.

FGD in Panga, Kirtipur
Minutes of Focus Group Discussion on identification of project intervention areas

A Focus Group Discussion (FGD) was held with an objective of involving key stakeholders and receiving their input in identification and prioritization of the project intervention areas in relation to the sewerage network improvement.

Date: 26th April 2012 (Thursday)

Time: 11:00 - 14:00

Venue: Falcha/SAP Nepal, Babarmahal,

Kathmandu Presence:

S.N.	Name	Designation	Institution
1	Krishna Bhola Maharjan	Engineer	Kirtipur Municipality
2	Rudra Prasad Adhikari	Civil Engineer	Lalitpur SubMetropolitan City
3	Prabin Shrestha	Arch. Infrastructure Planner/PWD	”
4	Narayan Kumar B.C.	Sr. Finance Officer	KVWSMB
5	Shree Krishna Nyaichyai	Civil Engineer	Bhaktapur Municipality
6	Satya Narayan Sah	Sr. Engineer	Madhyapur Thimi Municipality
7	Sudan Raj Panthee	Deputy Project Director	KUKL/PID
8	Richard H. Pope	Vice General Manager	KUKL
9	Shekhar Adhikari	Deputy Manager	KUKL
10	Noor Kumar Tamrakar	DTL	PPTA
11	Himesh A. Vaidya	Sr. Engineer	PID/KUKL
12	Carlo Pandolfi	GIS Expert	PPTA
13	Darryl Jackson	Wastewater Engineer	PPTA
14	Raja Ram Pote Shrestha	Wastewater Engineer	”
15	Susheela Chand	Office Manager	”
16	Abadh Kishor Mishra	Project Director	PID/KUKL
17	Chandra Lal Nakarmi	Manager	KUKL

Deputy Project Director of KUKL/PID Mr. Sudan Raj Panthee opened the FGD with brief introduction of the programme. It was followed by brief introduction of all the participants. Wastewater Engineer (Int.) Mr. Darryl Jackson made a power point presentation and briefed on the background and scope of PPTA and the selection criteria for identification of project intervention areas. Wastewater Engineer (Nat.) Mr. Raja Ram Pote Shrestha recalled the meeting with all five municipalities in respective municipality before the FGD and requested to make a presentation on problematic areas based on maps and tables provided to them by PPTA team earlier. He informed that the identified areas from this FGD will be considered for further detail analysis and will be screened through technical and other criteria for inclusion in project development. He also facilitated the FGD.

A. Bhaktapur Municipality:

Er. Shree Krishna Nyaichyai briefed about the existing sewerage system in Bhaktapur Municipality. He informed that the municipality has two different

problems in core area and in new developed urban areas. GTZ developed sewerage system with combined system in core area, which has been running till date. The major problem in core area is related with overflow of pipes during rainy season due to clogging of pipe in some places. The north collector is a gravity run system and has been running to some extent but south collector which consisted of pumping system is out of order due to problems in pumping system.

The new settlements have been developed in north and both sides of Arniko Highway in south. Although the municipality prohibits disposal of sewage into Hanumante river, they have been discharging on their own. The sewage discharge from these areas and surrounding VDCs causes pollution of Hanumante and Khasyang Khusung river.

The major problematic areas in the municipality are Kamal Vinayak (Ward No. 4) and other 3 newly developed land pooling areas.

The municipality is planning to implement land pooling project with 75 Ha, which will include sewerage network as well.

The major areas of concern/priority for the municipality is to rehabilitate/relay north collector to make it operable without pumping system and rehabilitate existing south collector and sewer lines in core area, lay interceptor sewers along Hanumante and Khasyangkhusung river to intercept sewer from newly developed areas and treatment of wastewater at Sallaghari WWTP.

B. Lalitpur Municipality:

Mr. Prabin Shrestha and Mr. Rudra Prasad Adhikari joined the discussion with elaboration on geographical structure of municipality. The city has been surrounded by Kodku Khola (east), Bagmati (north) and Nakhu (west). They informed that the municipality can be divided into several catchment areas and wastewater management plan has to be prepared for each of the catchment considering decentralization of wastewater disposal. The municipality has three type of sewer lines, one constructed during Rana period, second constructed by IDA project (Bhandari Builders) in 1988 and the last constructed by the municipality and NWSC/KUKL after the year 2000. All these sewers have been converted into combined sewer although some of them (IDA sewers) have been designed as sanitary sewer and old sewers have been designed as storm water sewer. They informed that old Rana period sewers and new sewers constructed after year 2000 are still functional but sewers constructed under IDA project are mostly clogged and non-functional. The overflow of sewage is common in many places in core area after a spell of heavy rain. The main problematic flooding areas are Kumaripati, Mahapal, Kusunti and near Patan Campus..The main cause of flooding is due to inadequate size of main collector sewer but in some cases the inlet and outlet sewers are of appropriate size but the intermediate sewer are of inadequate size. . Some existing sewers are under the houses e.g. in Kumbheshwar area making it difficult to rehabilitate or to maintain. Mr Prabin Shrestha suggested that diversion of some sewage coming to core area of town (Mahapal area) to west side of town would relieve the load on existing sewer at Mahapal and municipality is working towards making such diversion.

The major problematic areas are as follows:

S.N.	Area	Ward No.
Flooding Area		
1	Mahapal	18, 22
2	Patan Campus	21, 10
3	Kumaripati	5, 19
4	Kusunti Dole	13
5	Satdobato - Gwarko	
6	Bakungol - Kopundol	1
7	ICIMOD - Hattiban	15
Clogging Area		
1	Na Tole - Gabahal	
2	Mangal Bazar - Sankhmul	

C. Madhyapur Municipality:

Er. Satya Narayan Sah informed that the municipality consists of 4 valleys. Although urbanization process has accelerated along Arniko Highway in recent years, the large portion of the municipality still remains unorganized. Considering this, on site sanitation system has been practiced in these areas. Although the septic tank is mandatory for new house construction, many people tend to avoid this. The Natural Resources Committee of the Parliament has suggested to construct community septic tank in the municipality, which is also being considered. Municipality feels that there is a need to construct four interceptor sewers.

The most problematic areas are Lokanthali and Garkhu. In Garkhu, the Rajkulo has been converted into a drain but the problem of flooding is still recurring each year. The municipality has been laying main sewer lines of 1200 mm. to 1500 mm diameter. These sewers have been designed as combined sewer.

As the Supreme Court prohibited discharge of wastewater into rivers, the municipality does not allow discharge of sewage into river. It is also considering laying Interceptor along left bank of Manohara to protect the river. The municipality has also discussed about laying Interceptor along Hanumante river.

The local community has been successfully operating Sunga WWTP designed for 200 HHs. Such type of DEWATS is feasible and easily manageable. Considering topography of the municipality, at least 4 DEWATS can be constructed in the municipality.

Since the municipality is newly developed, the possibility of separation of sanitary sewer and storm water line is still possible in the Madhyapur Thimi municipality. Similarly, the wastewater can be managed through DEWATS in this area.

D. KUKL:

Er.Shekhar Adhikari, Chief of Sewerage Operation Department (SOD)/KUKL highlighted the role played by SOD in managing wastewater in the valley. He raised the necessity of south collector in Bhaktapur and informed that other problematic areas in the Bhaktapur are Byasi to Kamal Vinayak and Bhaktapur

Industrial Area.

He informed that KUKL has not constructed any sewer line in Madhyapur and have received no complaints so far. But there is a high demand of Jetting machine in Kirtipur because of frequent clogging. The major problematic areas are Baghbhairav, Nayabazar, Khasibazar etc.

The problematic areas in Lalitpur are Kumaripati and Mangalbazar, where Jetting machine has to be used every week because of clogging and small size pipes. The other areas are Lagankhel to Batukbhairav and Jawalakhel to Ekantakuna. The sewer lines in this area are clogged with fatty materials because of haphazard disposal by restaurants.

He briefed that there are several problematic area in Kathmandu. The most problematic areas are Jamal area, Kamalpokhari-Putalisadak and Tripureshwor. The SOD has been managing these areas through diversion of wastewater into nearby other sewer lines. The Thamel area is suffering from clogging due to small pipe size and fatty materials.

Mr. Richard Pope, Vice GM of KUKL appreciated the PPTA efforts and informed that improvement in wastewater sector is very necessary. He stressed on the synchronization of works between water supply and wastewater works especially in DNI areas. He also emphasized to give due attention to rehabilitate sewer lines in narrow lanes.

Mr. Carlo Pandolfi briefed the meeting about asset condition assessment survey and the preparation of GIS of sewerage network which the PPTA is preparing to carry out. He informed that the survey work will start by the end of May 2012 and requested for the cooperation of municipalities and KUKL in conducting this survey.

Mr. Darryl Jackson concluded the FGD and informed that the suggestions will be considered to identify and prioritize areas for intervention. He thanked all the participants for positive feedback and informed that similar interaction will be conducted in future to finalise the areas.

Minutes of Meeting on Coordination on Wastewater Sector

A meeting was organized with an objective of coordinating activities of different stakeholders working on wastewater management sector in Kathmandu Valley.

Date: 22nd June 2012 (Friday)

Time: 15:00 - 16:00

Venue: Meeting Hall, Ministry of Urban Development (MoUD), Singh Durbar,

Kathmandu Presence:

S.N.	Name	Designation	Institution
1	Mr. Tana Gautam	Secretary	MoUD
2	Mr. Gajendra Thakur	Project Manager	HPCIDBC
3	Mr. Abadh Kishore Mishra	Project Director	PID
4	Mr. Anil Bhadra Khanal	Deputy Project Director	,,
5	Mr. Sanjeev Bikram Rana	,,	,,
6	Mr. Himesh A. Vaidya	Eng. Section Chief	,,
7	Mr. Prayag Lal Joshi	Chairman	KUKL
8	Mr. Kiran Amatya	General Manager	,,
9	Mr. Narayan B. Bhattarai	Division Chief	Kathmandu Metropolitan City
10	Mr. Narayan Kumar B.C.	Sr. Finance Officer	KVWSMB
11	Mr. Hannu Pelkonen	Team Leader	PPTA Team
12	Mr. Noor Kumar Tamrakar	DTL	,,
13	Mr. Raja Ram Pote Shrestha	Wastewater Engineer	,,

Mr. Tana Gautam, Secretary of MoUD chaired meeting and initiated it briefing on the objective of organizing this coordination meeting. He requested an active participation to make the meeting success. Thereafter, Mr. Abadh Kishore Mishra, PID Director elaborated the agendas of the meeting.

Mr. Noor Kumar Tamrakar made a power point presentation and briefed on the background and scope of the PPTA. He also informed the expected outputs of the project and requested the participants to express their opinion on the several coordination issues like scope of work, design parameters, ongoing & planned programmes of different stakeholders, coordination mechanism etc. The presentation was then followed by discussion.

Major Issues Discussed:

1. Several agencies like KUKL/PID, High Powered Committee for Integrated Development of Bagmati Civilization (HPCIDBC), Municipalities are working on wastewater sector in Kathmandu valley. There are some other stakeholders like Kathmandu Valley Development Authority (KVDA), Department of Roads (DoR), Department of Survey, Town Development Fund (TDF) and some other agencies working in this sector and their activities should be coordinated to have better results.
2. Kathmandu Municipalities has gradually decreased laying of sewer lines. In recent years, it has been supplying hume pipes to some limited local users committees.
3. The design parameters used by various agencies are different and there must be common understanding to apply uniform design guidelines to sewer network improvement work.
4. HPCIDBC intends to be river basin management organization. It is not interested to operate Guhyeswari WWTP and if KVWSMB comes with suitable proposal, it is ready to handover. The issue of wastewater tariff collection in Guhyeswari WWTP area has also been discussed.
5. The HPCIDBC is planning to lay Interceptors along banks of all nine rivers in the valley. It is expected that the contract will awarded to lay Interceptor upto Balkhu

within three months. The necessity of coordination of these activities with PPTA team was discussed.

6. There are several sewer network problems in the valley and KUKL alone cannot improve the whole situation. The proposed ADB project is an opportunity, which will not come again and again. Considering this, the fund should be utilized not only for WWTP and Interceptor construction but also for neighborhood network improvement. But before that, asset condition survey should be carried out to propose improvement projects. Implementation should be realistic and not very ambitious.

Decisions:

1. It was agreed to form two committees on coordination issues. One Coordination Committee will be formed to oversee all coordination issues, which will be headed by MoUD. Another will be technical coordination committee, where KUKL/PID, HPCIDBC, KVDA, Municipalities and both ADB PPTA will represent. The meeting will be conducted at least once in a month.
2. There will be uniform design guidelines on sewerage works carried out by various agencies, which will be proposed by technical committee.

The Chairperson of the meeting thanked all the participants for fruitful discussion and informed that the suggestions will be considered to improve the working modalities of different agencies.

Summary of Proceedings

Consultative Stakeholders Workshop on Interim Report

Background:
The consulting team (FCG in association with TMC and ERMC) is working under PPTA 7936 funded by Japanese Fund for Poverty Reduction and executed by the Asian Development Bank to prepare a project for wastewater service improvement in Kathmandu Valley for a project grant from Asian Development Bank and other development partners.

The proposed wastewater service improvement investment has focussed on: a) neighbourhood sewer rehabilitation, improvement and expansion; b) construction of new interceptor and collector sewers to convey sewage from neighbourhood network to WWTPs; c) Modernisation, expansion and construction of new WWTPs to treat sewage before discharge into river system and d) institutional development and capacity-building programs for efficient and effective management of wastewater sector. The consultants have prepared an interim report on the project feasibility study and Project Implementation Directorate (PID)/KUKL has organised a consultative stakeholder"s workshop.

Objectives:
The objectives of the meeting are to discus and obtain a broad consensus on the range of necessary improvement works on wastewater management of Kathmandu Valley and to develop investment programs for ADB financial assistance for a period of 2013-18.

Time: 09:00am – 16:25 pm
Date: 14th August 2012 (Tuesday)
Venue: Hotel Everest, New Baneshwor, Kathmandu, Nepal

PROGRAMME
9:00 - 9:30 AM : Registration and Tea
9:30 – 9:45AM : Informal Opening Session
9:30 AM : Call on Dignitaries to Dais by the MC/Moderator
: Welcome Remarks Mr. Abadh Kishore Mishra, Project Director, PID
: Opening Remarks Mr. Kenichi Yokoyama, Country Director, ADB

: Opening Remarks Mr. Tana Gautam, Secretary MoUD
9:45 – 10:05 AM : Presentation on Project Overview, components and implementation by Mr. Hannu Pelkonen, Team Leader, PPTA
10:05 – 10.25 AM : Presentation on Existing Wastewater Management in KV Mr. Tirtha Raj Poudel Manager, Sewerage Operation Department, KUKL
10:25 – 10:40 AM : Discussion
10:40 – 11:05 AM : Refreshment (Light)
11:05 – 11:35 AM : Presentation on Sewer Network by Mr. Raja Ram Pote Shrestha, Wastewater Expert, PPTA, including: issues related to combined/separate sewers operation and maintenance of sewerage network issue of synchronization and/or double excavation of water pipeline networks and sewerage networks;
11:30 – 11:45 PM : Discussion Session11:45 – 12:15 AM : Presentation on Wastewater Treatment Plants and related Issues, Sludge Management and Energy Generation by Mr. Ari Niemela, Wastewater Treatment
Plant Expert, PPTA, including: comparative analysis of various wastewater treatment technologies and the
Recommendations applicability of and recommendations for decentralized wastewater treatment systems (DEWATS) in KV.

12:15 – 12:30 PM : Discussion Session
12:30 – 12:45 PM : Institutional and Capacity Building Issues, by Mr. Rajendra Giri, Institutional Expert, including: suggestions for proper institutional structure and capacity building of institutions responsible for O&M of wastewater systems in KV; demarcation of role and responsibilities among various institutions involved in wastewater management in KV
12: 45 – 1:00 PM : Discussion
1:00 – 2:00 PM : Lunch
2:00 – 2:25 PM : GIS Development on Sewerage and Water Supply Infrastructure in KUKL, by Mr. Carlo Pandolfi, GIS Expert, including recommendations to develop sewerage GIS and the action plan by the CBP team to develop such GIS;
2:25 – 2:40 PM : Discussion
2:40 – 3:00 PM : Resettlement, Gender and Social issues, by Ms. Gita Adhikari, Social Development Specialist, including important concerns and recommendations to make the project more inclusive focusing on social and gender aspects and ensuring community participation

3:00 – 4:00 PM : Main Discussion Session, opening by Mr. Noor Tamrakar, DTL, including O&M and sustainability of wastewater management with special emphasis on availability of personnel, uninterrupted power and O&M budget – key issues
4:00 – 4:10 PM : Conclude/Remarks on Discussion, by Mr. Noor Tamrakar, DTL
4:10 – 4:25 PM : Closing Remark by Mr. Prayag Lal Joshi, Chairperson, KUKL

Meeting Proceedings:
The Workshop was conducted in two sessions namely Opening Session and Technical Session.

A. Opening Session:
Mr. Abadh Kishore Mishra, Project Director of Project Implementation Directorate (PID) made first welcome remarks. He welcomed all the participants and briefed about the background of KVWMP. He informed the activities carried out by PPTA and the objectives of the present workshop. He emphasized on the improvement of waste water network, upgrading of existing wastewater treatment plants and construction of new plants. He expressed his view that the water supply and sewerage system will be more effective in the Valley after the completion of Melamchi Water Supply Project by the end of 2015. He requested all invitees to actively participate in the discussion.

Mr. Kenichi Yokoyama, Country Director of Asian Development Bank (ADB) highlighted the role of this PPTA to improve urban environment of Kathmandu Valley and asked to coordinatewith other similar projects especially with another ADB funded Bagmati River Basin Improvement Project. He emphasized two key issues which should be considered seriously by the government. There is a need to

enhance project readiness for smooth implementation of the project. The disbursement rate is less than 9 % out of 25% targeted in most of the on-going ADBs projects. So it needs to expedite and implement the projects without any delay. Second issue is related with operation and maintenance of wastewater management system including sewerage network and WWTP. He asked to consider an uninterrupted power supply as a key challenge in implementing the proposed project. He asked to complete PPTA works resolving all pending issues by taking advanced actions in coordination with KUKL, HPCIDBC, PID, DSC and other agencies. He also requested the strong commitment of the government for successful completion of this project.

Mr. Tana Gautam, Secretary, Ministry of Urban Development (MoUD) informed that the Government of Nepal has considered this project very seriously. He informed that the KVWMP is the priority project for Kathmandu Valley and expected that the project will contribute to government policy of providing sanitation to all by 2017. He highlighted the present status of waste water and emphasized the need to treat the waste water before discharging into the river. He lauded the role of ADB in implementation of projects on water and sanitation. He concluded his remarks asking all participants to contribute from their sides to make the project a successful.

Speaking from the Chair, **Mr. Prayag Lal Joshi, Chairman, KUKL** mentioned that the sewerage and drainage are the complicated issues in the valley. He requested to consider some critical issues like land availability for WWTP, social problems and synchronization of sewerage works with DNI activities. There are multiple actors involved in this sector which had made the system more complicated. There is no coordination between and among them and the work has been done haphazardly. He closed the opening session requesting all for active participation and contribution in the discussion.

B. Technical Session: Interim Report Findings Presentation

Mr. Hannu Pelkonen, **Team Leader of PPTA** made first presentation and elaborated on the overall Project overview, components, scope and magnitude of the project and implementation. He also introduced the objective and the development of the interim report, prepared by the PPTA and submitted to MoUD, KUKL, PID and ADB.

Thereafter, **Mr. Tirtha Raj Poudel, Manager of Sewerage Operation Department, KUKL** made presentation on Existing Wastewater Management in Kathmandu Valley. He briefed about the existing wastewater management system of Kathmandu and role of KUKL in managing it. He informed that KUKL activity at the moment is limited to cleaning and repairing some sewer lines due to limited budget, human resources and other technical constraints.

Mr. Raja Ram Pote Shrestha, Wastewater Expert of PPTA presented on Sewer Network, Interceptors and Related Issues. He briefed the existing condition on network informing that the actual condition is not known. He highlighted some key issues in managing sewer network like issues related to combined/separate system, O & M of sewerage network and issue of synchronization and/or double excavation of water pipeline networks and sewerage networks. He then presented proposed projects on network and interceptors with justification and limitation. He raised some major coordination issues which are very important for successful implementation of the proposed project.

Mr. Ari Niemela, Wastewater Treatment Plant Expert of PPTA made presentation on Wastewater Treatment Plants and related Issues, Sludge Management and Energy Generation. He briefed on the existing wastewater treatment system in the valley and informed the operational condition of existing WWTPs. He elaborated the proposed WWTP projects with comparative analysis of various wastewater treatment technologies and the recommendations. He also discussed on applicability of and recommendations for decentralized wastewater treatment systems (DEWATS) in KV.

Mr. Rajendra Giri, Institutional Development Expert of PPTA presented on Institutional and Capacity Building Issues. He elaborated on existing institutional issues in KUKL on wastewater sector and roles played by various agencies in this sector. He suggested a list of manpower and capacity building activities required to implement and sustain this project.

Mr. Carlo Pandolfi, GIS Expert of PPTA made presentation on GIS Development on Sewerage and

Water Supply Infrastructure in KUKL. He briefed the current situation and ongoing activities of KUKL in relation to GIS. He presented on proposed structure and recommendations of the PPTA team to develop sewerage GIS and action plan to be taken by CBP team to develop such GIS.

Mr. Sushil Babu Aryal, Social Safeguard Specialist of PPTA presented on Resettlement Issues. He briefed about the potential resettlement issues in project implementation and proposed some mitigation measures.

Ms. Gita Adhikari, Social Development Specialist of PPTA made presentation on Gender and Social Issues. She informed the findings of the FGD and other consultation meetings with the community people. She highlighted some important concerns and recommendations to make the project more inclusive focusing on social and gender aspects to ensure community participation.

Mr. Noor Tamrakar, Deputy Team Leader of PPTA presented on Operation and Maintenance of Sewerage System. He elaborated on the existing O & M issues in this sector in KUKL with due consideration of financial issues. He highlighted key issues on O&M and sustainability of wastewater management with special emphasis on availability of personnel, uninterrupted power and O&M budget.

c. Discussion:

The presentation has been followed by floor discussion, where the following remarks/issues were raised.

Mr. Prayag Lal Joshi, Chairman, KUKL

He commented on the involvement of multiple agencies in the construction of sewerage and drainage system without proper design. This has created a serious problem in the functioning of the system. Such haphazard system of construction should be discouraged.

Ms. Laxmi Sharma, Project Officer, ADB/NRM

She raised the issue on the involvement of different organization in the construction of drainage and sewerage system. Since, KUKL has been given the mandate for the management of sewerage, why permission is given to different organizations to connect the storm water into sewerage system. She also raised the issues of quality work and insufficient manpower for the project implementation. She requested to have better coordination with the Department of Urban Development and Building for implementation of provision of construction of septic tank while issuing building permit for new house construction.

Mr. Gajendra K. Thakur, Project Manager, HPCIDBC

Mr. Thakur mentioned the deterioration of water quality in the river due to the approval of new house plan/construction by the Municipality without mandatory construction of Septic Tank. Prior to 2050 BS (1993), one could not construct a new house without constructing Septic Tank. After 1993, the Municipality did not administer strict rule of compulsory construction of Septic Tank. People started to discharge wastewater from their house directly into the river. He also requested to mention expenditure done by HOCIDBC in managing wastewater system, which is about NRs. 30 million per year.

Mr. Ganesh Thapalia, Kathmandu Metropolitan City

Mr. Thapalia defended the existence of the policy of compulsory construction of Septic tank when one seeks approval of housing plan from Kathmandu Metro. He argued that there is a problem in the upstream of river. The river is being polluted from the upstream. Further, he mentioned the problem of sludge management in Kathmandu Metro. He asked the audience where to dispose the sludge which comes from the Septic tank. The present coordination problems with different organization involved in waste water sector has made the wastewater management in the valley more difficult. He requested that Kathmandu Metro should be informed about the project activities and the assistance required from the Metro to solve the problem. He also requested all to cooperate in the awareness programs launched by Kathmandu Metro for cleaning the rivers of Kathmandu Valley.

Mr. Satya Narayan Shah, Engineer, Madhyapur Thimi Municipality

Mr. Shah opined that the centralized system of wastewater treatment will not be practical in Nepal. He gave the example of the failure of Bhaktapur Wastewater Treatment Project constructed in 1970s. He

recommended decentralized wastewater management system through local community based small treatment plant. He informed that the Municipality used to have only on-site sanitation system in the past, which later on polluted dug wells. As a result they now emphasized on sewerage system.

He suggested the need of good relationship between KUKL and Municipality in solving the problem. He also raised the issue of tariff on the sewerage. The Municipality does not have any taxation system on the sewerage management. For the effectiveness of Septic tank, sufficient water should be available which we do not have.

Mr. Mahesh Bdr. Basnet, Chairman, HPCIDBC

Mr. Basnet opined that the pollution of river increased dramatically after the starting of PPP model program for laying of sewer by Municipalities which discharged raw sewage directly into the river. If small WWTP had been constructed, the present problem would not have come. He attributed deteriorating river water quality on not following the rule and regulations of the government. He requested the concerned organization/authority to implement the restriction or prohibition of discharging waste water into the river. He also commented on the recent amendment of reducing right of way in Dhobikhola bank corridor from 12 meter to 9 meter. He pointed out that the PPP model started by Municipality encouraged people to lay sewer and drain lines haphazardly.

Mr. Tirtha Raj Poudel, Manager, KUKL

Mr. Poudel opined that there may a need to dig the same road many times unless proper coordination of DNI works and Sewerage network construction is done. He asked for synchronization of DNI activities and proposed network improvement works. He commented on proposed laying of interceptor sewers on both side of the *Tukucha* River since there is no space to construct. Mr. Poudel also stressed on the importance of land acquisition for the proposed Wastewater Treatment Plant at Khokana. He urged implementation of different rules and regulations to manage wastewater system in the valley.

Mr. Richard Popes, Vice General Manager, KUKL

Mr. Popes expressed the view that since there is not much space for locating WWTPs and not much expertise in design and management of wastewater treatment plant and so Kathmandu should have centralized system of WWTP and not isolated many treatment plants. Every treatment plant will be different based on quality of raw sewage and has to be designed differently. So having centralized WWTP simplifies both the design and the operation and maintenance of the plant. He emphasized that the interceptor sewers should be designed at right level and proper technology should be adopted for laying it.

Mr. Rammani Bhattarai, Executive Officer, Bhaktapur Municipality

Mr. Bhattarai requested the workshop organizer to conduct such workshop on government holidays, so that everybody can participate whole day in the workshop.

The Workshop was concluded with closing remarks by **Mr. Prayag Lal Joshi, Chairman of KUKL.** He summed up the discussion and presented his views on the proposed project. Mr. Joshi opined that the project has covered everything but left out some policy aspects in planning, formulation of laws, regulations, organizations responsibility, and enforcement mechanism for separate system (i.e. storm water and sewerage). He suggested the consultant to look on the decentralized wastewater treatment system in the valley. He requested the consultant to recommend some specific training programs to the KUKL staff. He further requested to recommend scientific tariff structures and collection procedure for the sewerage.

At the end, he thanked all the experts for presenting different technical papers and the participants in actively participating in the discussions and providing very useful inputs.

Appendix 8: IFC/EBRD | Guidance on Workers' Accommodation Sanitary and toilet facilities

It is essential to allow workers to maintain a good standard of personal hygiene but also to prevent contamination and the spread of diseases which result from inadequate sanitary facilities. Sanitary and toilet facilities will always include all of the following: toilets, urinals, washbasins and showers. Sanitary and toilet facilities should be kept in a clean and fully working condition. Facilities should also be constructed of materials that are easily cleanable and ensure privacy. Sanitary and toilet facilities are never shared between male and female residents, except in family accommodation. Where necessary, specific additional sanitary facilities are provided for women.

Benchmarks

1. Sanitary and toilet facilities are constructed of materials that are easily cleanable.
2. Sanitary and toilet facilities are cleaned frequently and kept in working condition.
3. Sanitary and toilet facilities are designed to provide workers with adequate privacy, including ceiling to floor partitions and lockable doors.
4. Sanitary and toilet facilities are not shared between men and women, except in family acommodation.

Toilet facilities

Toilet arrangements are essential to avoid any contamination and prevent the spread of infectious disease.

Benchmarks

1. An adequate number of toilets is provided to workers. Standards range from 1 unit to 15 persons to 1 unit per 6 persons. For urinals, usual standards are 1 unit to 15 persons.
2. Toilet facilities are conveniently located and easily accessible. Standards range from 30 to 60 metres from rooms/dormitories. Toilet rooms shall be located so as to be accessible without any individual passing through any sleeping room. In addition, all toilet rooms should be well-lit, have good ventilation or external windows, have sufficient hand wash basins and be conveniently located. Toilets and other sanitary facilities should be ("must be" in cold climates) in the same building as rooms and dormitories.

Showers/bathrooms and other sanitary facilities

Hand wash basins and showers should be provided in conjunction with rooms/dormitories. These facilities must be kept in good working condition and cleaned frequently. The flooring for shower facilities should be of hard washable materials, damp-proof and properly drained. Adequate space must be provided for hanging, drying and airing clothes. Suitable light, ventilation and soap should be provided. Lastly, hand washing, shower and other sanitary facilities should be located within a reasonable distance from other facilities and from sleeping facilities in particular.

Benchmarks

1. Shower/bathroom flooring is made of anti-slip hard washable materials.
2. An adequate number of handwash facilities is provided to workers. Standards range from 1 unit to each 15 persons to 1 unit per 6 workers. Handwash facilities should consist of a tap and a basin, soap and hygienic means of drying hands.
3. An adequate number of shower/bathroom facilities is provided to workers. Standards range from 1 unit to 15 persons to 1 unit per 6 persons.
4. Showers/bathrooms are conveniently located.
5. Shower/bathroom facilities are provided with an adequate supply of cold and hot running water.

Source:
http://www1.ifc.org/wps/wcm/connect/9839db00488557d1bdfcff6a6515bb18/workers accomodation.pdf?MOD=AJPERES

Appendix 9: Traffic Management Planning (TMP)

A. Principles for TMP around the Sewer Construction Sites

1. One of the prime objectives of this TMP is to ensure the safety of all the road users along the work zone, and to address the following issues:

- **(i) the safety of pedestrians, bicyclists, and motorists travelling through the construction zone;**
- **(ii) protection of work crews from hazards associated with moving traffic;**
- **(iii) mitigation of the adverse impact on road capacity and delays to the road users;**
- **(iv) maintenance of access to adjoining properties; and**
- **(v) addressing issues that may delay the project.**

B. Operating Policies for TMP

2. Figure A12.1 illustrates the operating policy for TMP of the sewer works.

C. Analyse the impact due to street closure

3. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:

- **(i) approval from the ward office or community to use the local streets as detours;**
- **(ii) consultation with businesses, community members, traffic police, Department of Roads, etc, regarding the mitigation measures necessary at the detours where the road is diverted during the construction;**
- **(iii) determining of the maximum number of days allowed for road closure, and incorporation of such provisions into the contract documents;**
- **(iv) determining if additional traffic control or temporary improvements are needed along the detour route;**
- **(v) considering how access will be provided to the worksite;**
- **(vi) contacting emergency service, school officials, and transit authorities to determine if there are impacts to their operations; and**
- **(vii) developing a notification program to the public so that the closure is not a surprise. As part of this program, the public should be advised of alternate routes that commuters can take or will have to take as result of the traffic diversion.**

4. If full road-closure of certain streets within the area is not feasible due to inadequate capacity of the detour street or public opposition, the full closure can be restricted to weekends with the construction commencing on Friday night and ending on Sunday morning prior to the morning peak period.

D. Public awareness and notifications

5. As per discussions in the previous sections, there will be travel delays during the constructions, as is the case with most construction projects, albeit on a reduced scale if utilities and traffic management are properly coordinated. There are additional grounds for travel delays in the area, as most of the streets lack sufficient capacity to accommodate additional traffic from diverted traffic as a result of street closures to accommodate the works.

Figure A12.2: Policy Steps for the TMP

Steps	**Review**	**Review** construction schedule and methods
1.	Traffic Re-Circulation	Identify initial traffic recirculation and control policy

2.	Traffic Diversion	Identify routes for traffic diversions.
3.	Full Road Closures	Begin community consultation for consensus.
4.	Temporary Parking	Identify temporary parking (on and off-street)- Discuss with ward, owner, community for use
5.	Police Coordination	Coordinate with the Traffic Police to enforce traffic and diversions
6.	Install Control Devices	Install traffic control device (traffic cones, signs, lightings, etc).
7.	UMC Sub-committee	Coordinate with the UMC sub-committee to reconcile with the future plans of utility agencies
8.	Awareness	Conduct campaigns, publicity, and notify public about street closure
9.	Public Redness	Develop a mechanism to address public grievances disruptions (traffic, utilities, and diversions.

7. The awareness campaign and the prior notification for the public will be a continuous activity which the project will carry out to compensate for the above delays and minimize public claims as result of these problems. These activities will take place sufficiently in advance of the time when the roadblocks or traffic diversions take place at the particular streets. The reason for this is to allow sufficient time for the public and residents to understand the changes to their travel plans. The project will notify the public about the roadblocks and traffic diversion through print, TV, and radio media. In addition, the project, in collaboration with the utility management coordinator, will also seek the assistance of the ward office, local clubs, and others to post the public notice regarding street closure and traffic diversions in the future.

8. The utility management coordinator will also conduct an awareness campaign to educate the public about the following issues:

(i) traffic control devices in place at the work zones (signs, traffic cones, barriers, etc.);
(ii) defensive driving behaviour along the work zones; and
(iii) reduced speeds enforced at the work zones and traffic diversions.

9. It may be necessary to employ a road safety education specialist to design an appropriate program for road safety, and to conduct the awareness programs.

10. The campaign will cater to all types of target groups i.e. children, adults, and drivers.

11. Therefore, these campaigns will be conducted in schools, civic centres and community centres. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the area and will also be available at the KUKL Project Directorate, Office of both the contractor and consultant, and the contractor's site office. The text of the brochure should be concise to be effective, with a lot of graphics. It will serve the following purpose:

(i) explain why the brochure was prepared, along with a brief description of the project;
(ii) advise the public to expect the unexpected;
(iii) educate the public about the various traffic control devices and safety measures adopted at the work zones;
(iv) educate the public about the safe road user behaviour to emulate at the work zones;
(v) tell the public how to stay informed or where to inquire about road safety issues at the work zones (website, name, telephone, mobile number of the contact person; and SMS service or traffic information on FM radio, e.g. Ujyalo FM Station); and
(vi) indicate the office hours of relevant offices.

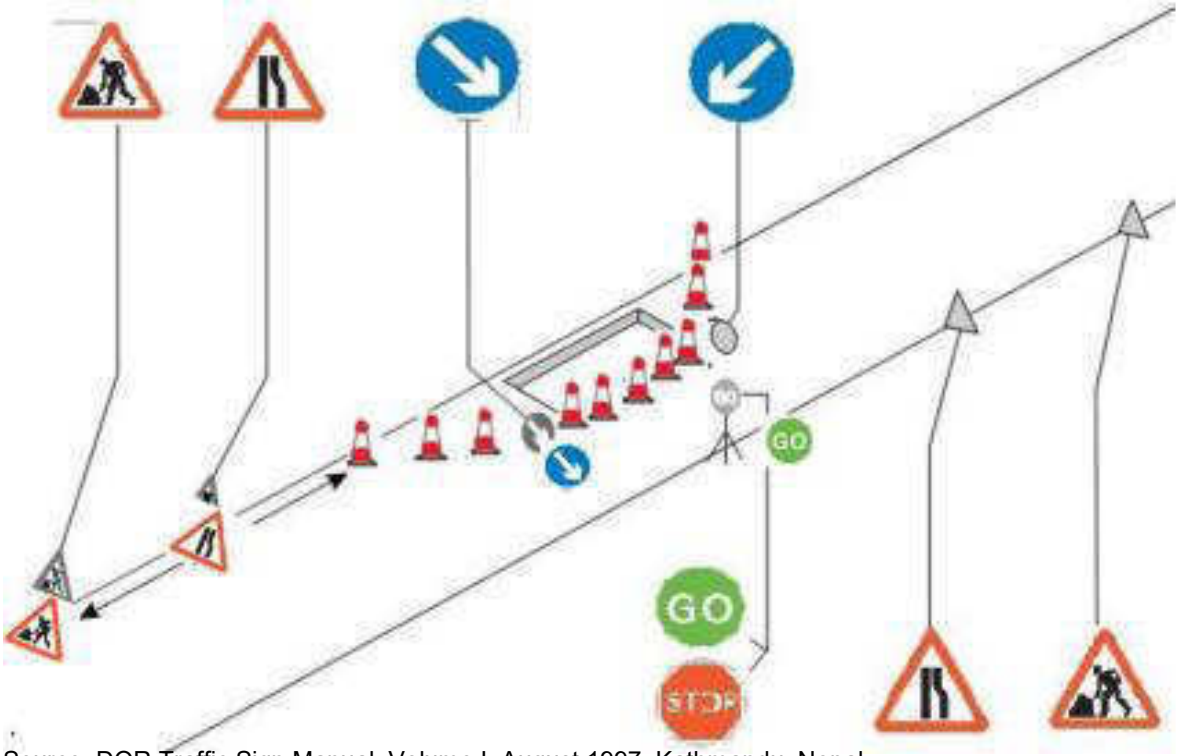
E. Install traffic control devices at the work zones and traffic diversion routes

12. The purpose of installing traffic control devices at the work zones is to delineate these areas to warn, inform, and direct the road users about a hazard ahead, and to protect them as well as the workers. As proper delineation is a key to achieve the above objective, it is important to install good traffic signs at the work zones.

13. Procedures for installing traffic control devices at any work zone vary, depending on road configuration, location of the work, construction activity, duration, traffic speed and volume, and pedestrian traffic. Work will take place both at both minor streets and major streets. As such, the traffic volume and road geometry vary, with the latter requiring more elaborate settings. However, regardless of where the construction takes place, all the work zones should be cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary "STOP" and "GO"). The work will closely follow the guidelines outlined in the DOR Traffic Sign Manual 1997 (which includes DOR 1996 document "Safety at Roadwork") and other literature available in this respect.

14. Figure A12.3 illustrates a typical set-up for installing traffic control devices at the work zone of the area.

Figure A12.3: Basic Layout for Delineation of a Work Zone (small area)



Source: DOR Traffic Sign Manual; Volume I; August 1997; Kathmandu, Nepal.

15. The work zone should take into consideration the space required for a buffer zone between the workers and the traffic (lateral and longitudinal) and the transition space required for delineation, as applicable. For the works, a 30-cm clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 cm is necessary to install the temporary traffic signs and cones. Figure 5 clarifies that the "ROAD NARROWS" warning-sign is only necessary at the works zones where high traffic speeds are likely during the off-peak hours and at night. All the temporary traffic signs should be reflectorized, especially for the works to be conducted during nighttimes, as per the DOR Traffic Sign Manual 1997.

16. All the traffic diversions should be properly delineated through proper "DIVERSION

AHEAD" and "ROADWORK AHEAD" signs as indicated in Figure A12.4. In addition, the "B46" temporary warning sign for sharp bends used at the temporary diversion should be in place after the start of the taper of the traffic cones. Flashing beacons should be installed at the entry to the work zone and traffic diversion for night construction, or if backfilling of the sewer trench does not take place after the completion of a day shift.

Figure A12.4: Basic Layout for Delineation of a Work Zone (small area)

Source: DOR Traffic Sign Manual; Volume I; August 1997; Kathmandu, Nepal.

17. Traffic police should regulate traffic away from the work zone and enforce the traffic diversion result from full street closure in certain areas during construction. One person is necessary at each entry to the diversion from both directions. These personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type) for regulating the traffic during night time.

18. In addition to the delineation devices, all the construction workers should wear fluorescent safety vests and helmets in order to be visible to the motorists at all times. There should be provision for lighting beacons and illumination for night constructions. In light of the ongoing load-shedding problem in Nepal, it is practical to use solar-powered LED lights, which are energy efficient, wherever feasible.

SOUTH ASIA REGIONAL DEPARTMENT
SAFEGUARDS INFORMATION LOG FOR SAUW PROJECTS

Project:	NEP: Kathmandu Valley Wastewater Management Project (Dhobighat / TP-02) of L-3000		
Loan No.:	3000	**Package No.:** KUKL/WW/TP-02	WWTP – TP-02
Components:	This IEE is updated for Dhobighat waste water treatment plant facility that will be established at Dhobighat near the Bagmati River with modernized technology for treatment of wastewater collected from various parts of Kathmandu Valley.		
Contract Type:	NCB		
Date of IEE:	Updated August 2018		

Draft IEE	Updated/Revised IEE	Others
		A draft IEE has been prepared based on preliminary design. The draft IEE is disclosed on ADB website (https://www.adb.org/sites/default/files/linked-documents/43524-014-nep-ieeab.pdf) which included WWTPs. The civil works contract is on-going. The revised/updated IEE has been submitted to ADB for review and clearance.

	Section	Status		Comments/Remarks (include date accomplished or obtained, if applicable)	Action taken
1.	Environmental assessment report (EIA/IEE/env. due diligence) has been prepared?	**Yes**	**No**		
		X			Baseline data updated as available. Section IV. KVWMP Cat B project. IEE is required. Draft IEE was prepared during project preparation. Environmental assessment for this updated/revised IEE is based on detailed design including description on the different components and

	Section	Status		Comments/Remarks (include date accomplished or obtained, if applicable)	Action taken
					environmental conditions. Identification and assessment of potential impacts based on site-specific conditions and description of different components provided in the detailed design documents.
2.	EIA/IEE/env. due diligence based on project components and detailed engineering design?	**Yes**	**No**		
		X			Information based on detailed engineering design provided. This include WWTP component, layout drawing, confirmation that no vegetation to be cleared, no utilities to be shifted, materials storage within the project compound, no disposal required, buffer area provided. Section III
3.	Statutory Requirements		Forest Clearance		No statutory clearance required; as the proposed locations are within the land own by the project.
			No Objection Certificate		
			Site Location Clearance		
			Environmental Compliance		

	Section	Status		Comments/Remarks (include date accomplished or obtained, if applicable)	Action taken
			Certificate		
			Permit to Construct (or equivalent)		
			Permit to Operate (or equivalent)		
			Others		
5.	Policy, legal, and administrative framework	Adequate	Not Adequate		The proposed project is under one package (TP-02) and relevant information provided.
		X			
		EIA/IEE/envi due diligence included discussion on:			
			National regulation/law on EIA		
			Environmental agency		
			Relevant international environmental agreements		Not applicable
			Environmental standards (IFC's EHS Guidelines)		ADB SPS requirements highlighted and discussed. Section II. A. Further, the EMP mentioned in the BOQ has been attached in updated IEE.
6.	Anticipated environmental impacts and mitigation measures	EIA/IEE/env. due diligence satisfactorily discussed impacts and risks on:		IEE.	DSC has instructed contractor to prepare site specific EMP and draft EMP has been submitted.
				No	
			Biodiversity conservation	.	No presence of any endangered species or habitat in the subproject

	Section	Status		Comments/Remarks (include date accomplished or obtained, if applicable)			Action taken
							area.
			Pollution prevention and abatement				Section V A and B provides required information. Information on design and pre-construction activities provided. Environmental impacts were avoided thru design and contractor's pre-construction activities comply with ADB SPS requirements.
			Health and safety				EMP attached in BOQ. Site specific EMP will include health and safety measures being implemented on-site.
			Physical cultural resources (PCR)				Proposed project area does not comprise of any PCR as illustrated in Section IV, F8
			Cumulative impacts				Cumulative impacts due to WWTP expansion, other activities proposed in the urban area included as mentioned in Section V

	Section	Status		Comments/Remarks (include date accomplished or obtained, if applicable)		Action taken
			Transboundary impacts		Not applicable	
7.	Impacts from Associated Facilities	Addressed	Not Addressed	Not applicable		No associated facilities. Sewer lines and interceptors from which wastewater will be brought in to the WWTP and treated are part of L3000.
				X		
8.	Analysis of Alternatives	**Yes**	**No**			Not required for Cat B.
9.	EMP budget included	**Yes**	**No**			
		X				The environmental cost related to public awareness campaign and IEC and contractors training is included (Annual cost USD 34000). Table VIII-3
10.	EMP implementation integrated in PAM, and in bid and contract documents	**Yes**	**No**			
		X				Confirmed that EMP included in BOQ.
11.	Consultation and Participation	**Yes**	**No**			
		X				Section VI Table VI-1 provides that consultations conducted meet ADB SPS requirements for “meaningful consultations”.
12.	Grievance	**Yes**	**No**			

	Section	Status		Comments/Remarks (include date accomplished or obtained, if applicable)		Action taken
	Redress Mechanism	X				GRM mechanism included in IEE. List of consultation details are mentioned in Section VII. Contractors not yet oriented.
		Description of GRM				Included in IEE (main text)
		Identification of GRC members				Done.
13.	Disclosure		Endorsement to disclose on ADB website			IEE may be disclosed on ADB website
			Disclosed on project website			IEE may be disclosed on project website
			Relevant information available to stakeholders and affected people in language and form they understand			Relevant information provided to stakeholders in local language.
14.	Mobilized PID Environment Officer	**Yes**		**No**		
		X				Safeguard Unit chief appointed.
15.	Mobilized PIU Environment Specialist	**Yes**		**No**		
						Not applicable. NO PIU in L3000
16.	Mobilized DSC Environment Specialist	**Yes**		**No**		
		X				DSC Environment Specialist available and has incorporated all the comments provided as far as applicable.
17.	Confirm bid and contract	**Yes**		**No**		
		X				EMP included in

	Section	Status	Comments/Remarks (include date accomplished or obtained, if applicable)		Action taken
	documents and/or EMP include requirement for the contractor to appoint EHS supervisor and/or nodal person for environmental safeguards				bidding document. Contractor has appointed EHS officer.
18.	If contract awarded already, confirm contractor's appointment of EHS supervisor and/or nodal person for environmental safeguards	Yes	No		
		X			Contract awarded; EHS supervisor not appointed yet
19.	Awareness training on compliance to safeguard requirements	**Yes**	**No**		
		X			CASSC is providing awareness programmes
20.	Monitoring and Reporting	**Yes**	**No**		
		X			updated