

Initial Environmental Examination

May 2012

**IND: Kolkata Environmental Improvement
Investment Program (Tranche 1) – Water Supply
Subproject**

WEIGHTS AND MEASURES

cum/hr	- cubic meter per hour
cum/m ³	- cubic meter
ft	- feet
ha	- hectare
km	- kilometer
km ² or sq km	- square kilometer
lpcd	- liter per capita per day
m	- meter
m/yr	- meter per year
mg/l	- milligram per liter
MGD	- million gallon per day
MGH	- million gallon per hour
ML	- million liter
MD	- million liter per day
mm	- millimeter

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ABBREVIATIONS

ADB	- Asian Development Bank
BOD	- Biochemical Oxygen Demand
BPS	- Booster Pumping Stations
CI	- Cast Iron
COD	- Chemical Oxygen Demand
CPHEEO	- Central Public Health and Environmental Engineering Organisation
DI	- Ductile Iron
DO	- Dissolved Oxygen
DSC	- Design and Supervision Consultants
DWF	- Dry Weather Flows
KMC	- Executing Agency
EKW	- East Kolkata Wetlands
GOI	- Government of India
GRC	- Grievance Redressal Committee
HDPE	- High-Density Polyethylene
INR	- Indian National Rupee
KEIP	- Kolkata Environment Improvement Project
KMA	- Kolkata Metropolitan Area
KMC	- Kolkata Municipal Corporation
KMDA	- Kolkata Metropolitan Development Authority
KMWSA	- Kolkata Metropolitan Water and Sanitation Authority
MOUD	- Ministry of Urban Development
MS	- Mild Steel
NRW	- Non Revenue Water
O and M	- Operation and Maintenance
PMU	- Project Management Unit
PST	- Pre-Settling Tanks
PWD	- Public Works Department
SAR	- Subproject Appraisal Reports
ST	- Schedule Tribe
STP	- Sewage Treatment Plant
SWF	- Storm Water Flow
SWM	- Solid Waste Management
TDS	- Total Dissolved Solids
TFS	- Total Fixed Solids
TKN	- Total Kjeldahl Nitrogen
TOR	- Terms of Reference
TSS	- Total Suspended Solids
UFW	- Unaccounted For Water
USD	- US Dollar
WBPCB	- West Bengal Pollution Control Board
WTP	- Water Treatment Plant

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EXECUTIVE SUMMARY

1. The city of Kolkata is the seventh largest metropolis in India, and had 4.5 million residents in 2011. The city's continuous improvement in the urban environment is necessary to continuously increase the labor productivity through better health status of the urban population, especially when it has been experiencing lower population growth. There have been, however, geographical disparities in access and quality of the water supply and sewerage services, because the Kolkata Municipal Corporation (KMC), an urban local body having a mandate to provide these services under the KMC Act (1980), has an aging water supply system, and has inadequate sewer coverage in the city's peripheral areas. The Asian Development Bank (ADB) loans have assisted KMC in expansion of the sewerage coverage through the Kolkata Environmental Improvement Project (KEIP) since 2000. The Kolkata Environmental Improvement Investment Program (the investment program) will help KMC not only continue sewer network expansion at a larger scale, but also gradually improve efficiency in water supply operations which enable KMC to generate operating surplus for capital investment in water supply and sewerage.

2. The investment program is a continuation of the KEIP. It is envisaged that KMC will implement the investment program in three projects in phases. It considers that the first project under the investment program will be the second phase of KEIP. Likewise, the second and the third projects under the investment program will be the third and fourth phases of KEIP. The proposed investment activities under the investment program will include: (i) water supply including pumping and transmission system and (ii) sewerage and drainage (S&D) including dry weather flow (DWF) and storm water flow (SWF) pumping stations and sewage treatment plants (STPs).

3. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, and loans involving financial intermediaries, and private sector loans.

4. This IEE has been prepared for the Tranche 1 water supply subproject which includes (i) rehabilitation and refurbishment of the Palta water works, Garden Reach water works, and associated facilities; (ii) rehabilitation and augmentation of the transmission system; (iii) reduction of unaccounted-for water (UFW). Construction work is likely to commence in 2012 and will be completed in 48 months for the total water supply subproject. However individual components will be taken up phase-wise in an average of 18 months construction period.

5. This IEE aims to (i) provide critical facts, significant finding, and recommended actions; (ii) present the national and local legal and institutional framework within which the environmental assessment has been carried out; (iii) provide information on existing geographic, ecological, social and temporal context including associated facilities within the subproject's area of influence; (iv) assess the subproject's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the subproject's area of influence; (v) identify mitigation measures and any residual negative impacts that cannot be mitigated; (vi) describe the process undertaken during project design to engage stakeholders and the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation; (vii) describe the subproject's grievance redress mechanism for resolving complaints about environmental performance; (viii) present the set of mitigation measures to be undertaken to avoid, reduce, mitigate, or compensate for adverse environmental impacts; (ix) to describe the monitoring measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation

measures; and (x) identify who is responsible for carrying out the mitigation and monitoring measures.

6. Potential negative impacts were identified in relation to pre- , construction and operation of the improved infrastructure, but no environmental impacts were identified as being due to either the subproject design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

7. The public participation processes undertaken during project design ensure stakeholders are engaged during the preparation of the IEE. The planned information disclosure measures and process for carrying out consultation with affected people will facilitate their participation during project implementation.

8. The subproject's Grievance Redress Mechanism will provide the citizens with a platform for redress of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance.

9. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between KMC, PMU, DSC and the contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with.

10. A copy of the EMP will be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

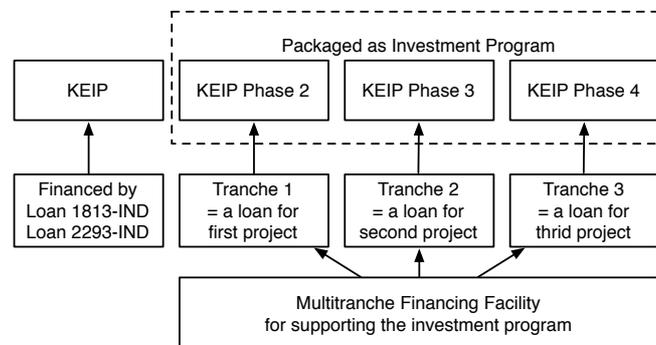
11. The subproject is unlikely to cause significant adverse impacts because: (i) most of the individual components involve straightforward construction and operation, so impacts will be mainly localized; (ii) in most cases the predicted impacts are likely to be associated with the construction process and are produced because the process is invasive, involving excavation, obstruction at specific construction locations, and earth movements; and (iii) being located mainly in the already constructed water supply facilities and built-up area will not cause direct impact on terrestrial biodiversity values. The potential adverse impacts that are 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.

12. Therefore per ADB SPS, the subproject is classified as environmental Category B and does not require further Environmental Impact Assessment.

I. INTRODUCTION

1. The city of Kolkata is the seventh largest metropolis in India, and had 4.5 million residents in 2011. It is the largest city in the state of West Bengal, and has been the biggest contributor to West Bengal's gross state domestic product, which was ranked at the sixth largest among all state in India in 2010. The city's continuous improvement in the urban environment is necessary to continuously increase the labor productivity through better health status of the urban population, especially when it has been experiencing lower population growth. There have been, however, geographical disparities in access and quality of the water supply and sewerage services, because the Kolkata Municipal Corporation (KMC), an urban local body having a mandate to provide these services under the KMC Act (1980), has an aging water supply system, and has inadequate sewer coverage in the city's peripheral areas.¹ The Asian Development Bank (ADB) loans have assisted KMC in expansion of the sewerage coverage through the Kolkata Environmental Improvement Project² (KEIP) since 2000. The Kolkata Environmental Improvement Investment Program³ will help KMC not only continue sewer network expansion at a larger scale, but also gradually improve efficiency in water supply operations which enable KMC to generate operating surplus for capital investment in water supply and sewerage.

2. The investment program is a continuation of the KEIP. It is envisaged that the Kolkata Municipal Corporation (KMC) will implement the investment program in three projects in phases. It considers that the first project under the investment program will be the second phase of KEIP. Likewise, the second and the third projects under the investment program will be the third and fourth phases of KEIP. The proposed investment activities under the investment program will include: (i) water supply including pumping and transmission system and (ii) sewerage and drainage (S&D) including dry weather flow (DWF) and storm water flow (SWF) pumping stations and sewage treatment plants (STPs).



3. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. This states that ADB requires environmental

¹ The 1899 Calcutta Municipal Act defined the administrative domain of the municipal authority as covering 25 wards and 48.5 square kilometers. Many boundary changes followed, the latest one in January 1984 when Boroughs XI, XII, XIII, XIV and XV were annexed to KMC. These boroughs are popularly known as the "added areas".

² ADB. 2000. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to India for the Calcutta Environmental Improvement Project*. Manila (Loan 1813-IND, \$250 million, approved on 15 November 2000). The project completion date is 30 June 2012.

ADB 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Supplementary Loan to India for the Kolkata Environmental Improvement Project*. Manila (Loan 2293-IND: \$80 million, approved on 20 November 2006). The project completion date is 30 June 2012.

³ ADB provided project preparatory technical assistance. ADB. 2009. *Technical Assistance to India for Preparing for Kolkata Environmental Improvement Project II*. Manila.

assessment of all project loans, program loans, sector loans, sector development program loans, and loans involving financial intermediaries, and private sector loans.

4. ADB classified the investment program as environment Category B and accordingly initial environmental examination (IEE) is required for all subprojects. This IEE has been prepared for the Tranche 1 water supply subproject which includes (i) rehabilitation and refurbishment of the Palta water works, Garden Reach water works, and associated facilities; (ii) rehabilitation and augmentation of the transmission system; (iii) reduction of unaccounted-for water (UFW). Construction work is likely to commence in 2012 and will be completed in 48 months for the total water supply subproject. However individual components will be taken up phase-wise in an average of 18 months construction period.

5. This IEE aims to (i) provide critical facts, significant finding, and recommended actions; (ii) present the national and local legal and institutional framework within which the environmental assessment has been carried out; (iii) provide information on existing geographic, ecological, social and temporal context including associated facilities within the subproject's area of influence; (iv) assess the subproject's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the subproject's area of influence; (v) identify mitigation measures and any residual negative impacts that cannot be mitigated; (vi) describe the process undertaken during project design to engage stakeholders and the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation; (vii) describe the subproject's grievance redress mechanism for resolving complaints about environmental performance; (viii) present the set of mitigation measures to be undertaken to avoid, reduce, mitigate, or compensate for adverse environmental impacts; (ix) to describe the monitoring measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures; and (x) identify who is responsible for carrying out the mitigation and monitoring measures.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

6. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, and loans involving financial intermediaries, and private sector loans.

7. **Screening and Categorization.** The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project, the sensitivity, scale, nature and magnitude of its potential impacts, and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impact and are assigned to one of the following four categories:

- (i) **Category A.** Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.
- (ii) **Category B.** Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
- (iii) **Category C.** Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.
- (iv) **Category FI.** Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all Projects will result in insignificant impacts.

8. **Environmental Management Plan.** An EMP which addresses the potential impacts and risks identified by the environmental assessment shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the Project's impact and risks.

9. **Public Disclosure.** The IEE will be put in an accessible place (e.g., local government offices, libraries, community centers, etc.), and a summary translated into Bengali/Hindi for the project affected people and other stakeholders. The following safeguard documents will be put up in ADB's website so that the affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation:

- (i) For environmental category A projects, a draft EIA report at least 120 days before Board consideration;
- (ii) Final or updated EIA and/or IEE upon receipt; and
- (iii) Environmental monitoring reports submitted by the Project Management Unit (PMU) during project implementation upon receipt.

B. National and State Laws

10. Implementation of the subprojects will be governed by the national and State of West Bengal environmental acts, rules, regulations, and standards. These regulations impose restrictions on activities to minimize/mitigate likely impacts on the environment. It is the

responsibility of the project executing and implementing agencies to ensure subprojects are consistent with the legal framework, whether national, state or municipal/local. Compliance is required in all stages of the subproject including design, construction, and operation and maintenance.

11. The following legislations are applicable to the subproject:

- (i) Environmental (Protection) Act of 1986, its rules and amendments;
- (ii) Environmental Impact Assessment (EIA) Notification of 2006 and 2009;
- (iii) Water (Prevention and Control of Pollution) Act of 1974, its Rules, and amendments;
- (iv) Air (Prevention and Control of Pollution) Act of 1981, its Rules and amendments;
- (v) Central Pollution Control Board (CPCB) Environmental Standards;
- (vi) Ancient Monuments and Archaeological Sites and Remains Rules of 1959;
- (vii) Land Acquisition Act of 1894 and as amended in 1985;
- (viii) Wetlands (Conservation and Management) Rules, 2010;
- (ix) Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules 2008
- (x) Noise Pollution (Regulation and Control) Rules of 2000 as amended up to 2011.
- (xi) National Institute of Occupational Safety and Health Criteria for a recommended standard: occupational noise exposure, NIOSH Publication No. 98-126
- (xii) Indian Standard Drinking Water – Specification, IS 10500, 1991: Bureau of Indian Standards as per revised second revision 2004 and draft revision of 2009
- (xiii) West Bengal Trees (Protection and Conservation in Non-Forest Areas) Act, 2006;
- (xiv) East Kolkata Wetlands (Conservation and Management) Act, 2006
- (xv) Manufacture, storage and import of hazardous chemical Rules, 1989

12. The summary of environmental regulations and mandatory requirements for the subproject is shown in Table 1.

Table 1: Applicable Environmental Regulations

Law	Description	Requirement
EIA Notification	The EIA Notification of 2006 and 2009 (replacing the EIA Notification of 1994), set out the requirement for environmental assessment in India. This states that Environmental Clearance is required for certain defined activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts. Category A projects require Environmental Clearance from the National Ministry of Environment and Forest (MoEF). Category B projects require Environmental Clearance from the State Environmental Impact Assessment Authority (SEIAA).	The proposed components of this water supply subproject are not listed in the EIA Notification's "Schedule of Projects Requiring Prior Environmental Clearance" and thus Environmental Clearance is not required.
Manufacture, storage and import	Storage of Chlorine (threshold quantity greater than 10 tons but	<ul style="list-style-type: none"> • Identification of major accident

Law	Description	Requirement
of hazardous chemical Rules, 1989	less than 25 tons) in Water Treatment Plants will require clearance from the competent authority as defined in the Rule	<p>hazards and steps for their prevention</p> <ul style="list-style-type: none"> • Approval and notification of the sites • Preparation of on site emergency plan • Information to persons liable to be affected • Approval of West Bengal Pollution Control Board
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	Control of water pollution is achieved through administering conditions imposed in consent issued under provision of the Water (Prevention and Control of Pollution) Act of 1974. These conditions regulate the quality and quantity of effluent, the location of discharge and the frequency of monitoring of effluents. Any component of the Project having the potential to generate sewage or trade effluent will come under the purview of this Act, its rules and amendments. Such projects have to obtain Consent to Establish (CTE) under Section 25 of the Act from West Bengal Pollution Control Board (WBPCB) before starting implementation and Consent to Operate (CTO) before commissioning. The Water Act also requires the occupier of such subprojects to take measures for abating the possible pollution of receiving water bodies.	<p>The rehabilitation and refurbishment of the water treatment plant (WTP) at Palta water works will require CTE and CTO from WBPCB⁴.</p> <p>All relevant forms, prescribed fees and procedures to obtain the CTE and CTO can be found in the WBPCB website (www.wbpcb.gov.in).</p>
Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	The subprojects having potential to emit air pollutants into the atmosphere have to obtain CTE under Section 21 of the Air (Prevention and Control of Pollution) Act of 1981 from WBPCB before starting implementation and CTO before commissioning the project. The occupier of the project/facility has the responsibility to adopt necessary air pollution control measures for abating air pollution.	<p>For the subproject, the following will require CTE and CTO from WBPCB: (i) diesel generators; and (ii) hot mix plants, wet mix plants, stone crushers, etc. if installed for construction.</p> <p>All relevant forms, prescribed fees and procedures to obtain the CTE and CTO can be found in the WBPCB website (www.wbpcb.gov.in).</p>
Environment (Protection) Act, 1986 and CPCB Environmental Standards.	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards notified.	Appendix 1 provides applicable standards for ambient air, air emission, effluents, receiving water bodies, and drinking water at the consumer end.
Noise Pollution (Regulation and Control) Rules, 2002 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	Appendix 2 provides applicable noise standards.
National Institute of Occupational Safety and Health (NIOSH) Publication No. 98-	NIOSH has laid down criteria for a recommended standard: occupational noise exposure. The standard is a combination of noise	Appendix 3 provides applicable NIOSH occupational noise standards.

⁴ WBPCB has a common CTE and CTO form (Form L) for Local Authorities covering all aspects of municipal constructional and operation activities. All proposed interventions under the WS subproject will be covered under one CTE and CTO

Law	Description	Requirement
126	exposure levels and duration that no worker exposure shall equal or exceed.	
Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008.	According to the Rules, hazardous wastes are wastes having constituents specified in Schedule II of the Rules if their concentration is equal to or more than the limit indicated in the said schedule (Appendix 4).	If during excavation works, the excavated material is analyzed to be hazardous, they are to be stored and disposed of only in such facilities as may be authorized by the WBPCB for the purpose
Forest (Conservation) Act, 1980 and Forest Conservation Rules, 2003 as amended	As per Rule 6, every user agency, who wants to use any forest land for non-forest purposes shall seek approval of the Central Government.	No notified forest land within the subproject area.
Wetlands (Conservation and Management) Rules, 2010	The Rules specify activities which are harmful and prohibited in the wetlands such as industrialization, construction, dumping of untreated waste and effluents, and reclamation. The Central Government may permit any of the prohibited activities on the recommendation of Central Wetlands Regulatory Authority.	The subproject is not within the East Kolkata Wetlands thus no permission from the Central Government is required.
Ancient Monuments and Archaeological Sites and Remains Rules of 1959	The Rules designate areas within a radius of 100 meters (m) and 300 m from the "protected property" as "protected area" and "controlled area" respectively. No development activity (including mining operations and construction) is permitted in the "protected area" and all development activities likely to damage the protected property are not permitted in the "controlled area" without prior permission of the Archaeological Survey of India (ASI). Protected property includes the site, remains, and monuments protected by ASI or the State Department of Archaeology.	There are no protected properties in Kolkata. However, in case of chance finds, the contractors will be required to follow a protocol as defined in the Environmental Management Plan (EMP).
Land Acquisition Act of 1894	Private land acquisition is guided by the provisions and procedures in this Act. The District Collector or any other officer designated will function as the Land Acquisition Officer on behalf of the Government. There is a provision for consent award to reduce the time for processing if the land owners are willing to agree on the price fixed by the Land Acquisition Officer.	For the subproject, there will be no land acquisition. Temporary resettlement of shops and establishment will be involved during pipe laying work. A Resettlement Plan has been prepared in accordance with the ADB SPS, 2009.
West Bengal Trees (Protection and Conservation in Non-Forest Areas) Act, 2006	The Act states that those who want to fell trees will have to obtain permission from the Forest Directorate, Government of West Bengal. Violators (means whoever fells or causes to be felled any tree or cuts, uproots or otherwise disposes of any fallen tree or contravenes the permission granted) shall be punished with imprisonment up to one year or with fine of Rs.5000/- or both. Also, until plantation of requisite number of trees is undertaken, the violators will	Permission from the Divisional Forest Officer (Utilisation Division), Forest Directorate, Government of West Bengal____ will be required if trees, particularly those looked upon as sacred groves, identifies as belonging to an endangered species, or given the status of heritage, will be cut/felled. Promoters/developers will have to submit a 'Tree Plantation Plan' while they seek approval for a residential/ commercial/ industrial project.

Law	Description	Requirement
	be fined for each day of default of Rs.50/-. In case the development agency or entrepreneur fails to implement the plantation plan, the defaulter might have to face an imprisonment up to two years or fine that may extend to Rs.10,000/- or with both.	
East Kolkata Wetlands (Conservation and Management) Act, 2006	In August 2002, 12,500 hectares (ha) of the East Kolkata Wetland area was included in the 'Ramsar List' making it a 'wetland of International Importance'. The Ramsar convention is playing a vital role by providing certain basic guidelines to draw up suitable plans for the maintenance and sustenance of the wetlands. Among these, the three most important guiding principles are: (i) maintenance of the special characteristics of the ecosystem; (ii) wise use of its resources with an eye towards sustainability; and (iii) economic development for the wetland community. The East Kolkata Wetlands Management Authority (EKWMA) has the power to enforce land use control in the substantially waterbody-oriented areas and other areas in the East Kolkata wetlands.	The subproject is not within the East Kolkata Wetlands thus no permission from the Central Government is required.
The Child Labour (Prohibition and Regulation) Act, 1986	No child below 14 years of age will be employed or permitted to work in any of the occupations set forth in the Act's Part A of the Schedule or in any workshop wherein any of the processes set forth in Part B of the Schedule.	No children between the age of 14 to 18 years will be engaged in hazardous working conditions.
Information required for Irrigation & Waterways Department, Govt. of West Bengal for examining the availability of Surface Water for the Industrial Project:	<ol style="list-style-type: none"> 1. The application to with required details for drawl of river water for industrial purpose is to be recommended by WBIDCL 2. In case of perennial flow viz. Bhagirathi/ Hooghly river system, prior No Objection Certificate of Kolkata Port Trust is required before permission is accorded by Irrigation & Waterway Department, West Bengal Government. 3. Additional Information is to be furnished to as per prescribed proforma 	Since the requirement of seeking permission from Irrigation and Waterways Department, West Bengal Government is for industrial projects, Water Supply Subproject of Tranche 1 does not attract the provisions of this requirement. However, construction of any new/additional facility of withdrawal of raw water from Hooghly river and/or construction of any additional/new structure on the Hooghly river will require prior approval of Kolkata Port Trust

III. DESCRIPTION OF THE SUBPROJECT

A. Existing Situation

13. KMC has two existing water works for drinking water supply: Palta and Garden Reach. Present average per capita supply is 134 litres per capita per day (lpcd), which is below the desired supply of 150 lpcd (for metropolitan cities). The supply is very uneven, ranging from 310 lpcd to 40 lpcd. Unaccounted for water (UFW) is 40%. Average supply period is 8 hours a day. Residual pressure is very low. The average terminal pressure at consumer end is around 2.5 m of water head. In some areas it ranges around 0.5 to 1.0 m of water head. Coverage by piped water supply is 92% which is nearing 100%. But the remaining 8% is far from the treatment plants and far from surface water sources. Hence the service is below the desired level.

14. Due to lack of KMC service level, inhabitants in some areas depend on personally owned tube wells to supplement shortfall, often up to an extent required for the livelihood and survival. However, ground water contaminated by arsenic has been found in number of places within KMC area, therefore KMC is now discouraging abstraction of ground water with intent to replace it with surface water supply.

15. Insufficiency of the water supply system in KMC area also gives rise to other adverse effects like i) water borne diseases, ii) unhygienic conditions and iii) increased allocation of time and expense in sourcing water which lead to a greater burden on women.

16. Based on the 2011 service level, the demand-supply gap is summarized below (Table 2):

Table 2: Demand Supply Analysis of Water Supply In Kolkata

Sl. No.	Parameter	Demand ⁵	Supply	Gap to achieve the target	Remarks/Target
1	Surface water source quality after treatment	As per Central Public Health and Environmental Engineering Organisation (CPHEEO) permissible limits	As per CPHEEO permissible limits	-	From treated water quality point of view there is no gap
2	Ground water source quality	As per CPHEEO permissible limits	Arsenic concentration is more than permissible limit	Arsenic to be removed or replace ground water by surface water	Replace ground water by surface water
3	Surface water source quantity (river flow)	With 15% System loss = 1,255 MLD With 30 % System loss = 1,524 MLD	98,000 MLD	-	There is no shortage of surface water.
4	Ground water source quantity	-	114 MLD	-	Ground water source is to be discarded.
5	UFW	15%	40%	25%	
6	System Leakage	15%	30%	15%	
7	Water production	With 15 % System loss = 1,130 MLD	From surface water = 1,072.4 MLD	No gap with system loss of 15%	Further analysis on discrete service zone in given in relevant

⁵ 'Demand' figures are based on the theoretical demand target as per service level indicator of national standard. Services to other municipalities are not considered in this analysis.

Sl. No.	Parameter	Demand ^o	Supply	Gap to achieve the target	Remarks/Target
		With 30 % System loss = 1,372 MLD	From ground water = 114 MLD Total = 1,186.4 MLD	185.6 MLD with system loss of 30%	section elsewhere in the report.
8	Delivery	960 MLD	731.2 MLD	228.8 MLD	System loss to be minimized.
9	Per capita demand	150 lpd (litres per day)	134 lpd		System loss to be minimized.
10	Supply hours	24 hours	8 hours (average)	16 hours	
11	Coverage (by surface water)	100%	92%		Surface water supply to be increased with additional lines.
12	Distribution lines	6,182 km	5,687 km		
13	Reservoir capacity	With 15 % System loss = 392 ML (million litre) With 30 % System loss = 475 ML	225 ML	245 ML	
14	Power availability	24 hours	24 hours	No gap	
15	Residual Pressure	12 m minimum. Cause for rejection below 7m	2.5 m water head (In some area it is 0.5 to 1.0m)	9.5 m water head	System network to be analyzed with proper districting.
16	Extent of metering	90%	0.1%	89.9%	
17	Efficiency of redressal of complaints	80%	91%	-	
18	Efficiency of collection of user charges	90%	93%	-	

17. **Palta water works.** A schematic diagram of water sourcing, treatment, and supply in the Palta water works is given in Figure 2. Palta water works is located 23 kilometer (km) north of Kolkata in North Barrackpur municipality in N 24 Parganas district (Latitude 22° 47' N, Longitude 88°20' E). The water works have 3 WTPs with a total capacity of 1,182 MLD. Raw water is presently drawn from Hooghly river through 3 pumping stations. The raw water is then treated through a series of clarifiers, settling tanks, filter beds, and chlorinators. Sludge generated from 2 WTPs (1 and 3) are discharged back to the pre-settling tank of WTP 1 for dewatering. Ludge generated from WTP 2 is directly discharged to river. Water content of sludge is allowed to evaporate and the dewatered sludge are re-used as raw material in manufacturing bricks contracted out by the government to a private company. Supernatant from sludge pond is discharged to nearby drainage.

18. **Garden Reach water works** - It is located on the western boundary of Kolkata in Borough XV of KMC and Mahestala Municipality. Total capacity of the Garden Reach WTP is 545.5 MLD. There are two treatment process trains, 272.8 MLD each.

19. Garden Reach Treatment Plant was installed for production of 272.8 MLD of filtered water in 1982. The source of raw water was the Hooghly River. Later in late 90's another new treatment plant of 272.8 MLD was constructed. Total capacity of Garden Reach Water treatment plant is 545.5 MLD.

20. The Garden Reach water supply scheme comprises of:

- (i) Raw water pumping station (RWPS)
- (ii) Treatment plant comprising of flash mixer, clariflocculators, rapid sand filters
- (iii) Clear water reservoir
- (iv) Clear water pumping station
- (v) Chlorination arrangement

21. Proposed Tranche 1 work is limited within the old treatment plant.

22. Old Raw Water Intake & Pumping Station: The raw water pumping station (RWPS) comprises of:

- (i) Intake Jetty of mild steel structure .
- (ii) Suction Pipe: One 1550 mm diameter mild steel welded pipe 120 m long with bell mouth below low water level
- (iii) Three Horizontal centrifugal pumps with motors
- (iv) One Raw water Rising Main 1575 mm diameter mild steel welded pipe 3700 m long

23. The raw water pumps are not compatible to tidal fluctuation, as a result the pumping system cannot deliver its rated output. With the present condition of the equipment and accessories, the RWPS is pumping about 441.9 MLD of raw water for processing against its installed capacity of 545.5 MLD. The RWPS building was constructed in 1982 and condition is good.

24. Water Treatment: The treatment process is a conventional Rapid Sand Filtration system. It consists of a Raw Water Channel (RWC), Chemical House (CH) with coagulant dosing units, Flash Mixer (FM), Clariflocculators (CF), Rapid Sand Filters (RSF), and Clear Water Reservoir (CWR) and chlorination arrangement. All civil structures are made of RCC and mechanical units like Clariflocculator bridge, paddles, etc. are of mild steel.

25. The raw water from intake station flows to the CF through the RWC after being dosed with alum solution from the CH and mixed in the FM. The clarified water from the CF flows to the RSF and after filtration the clear water is stored in the CWR and pumped to the service areas. Pre-chlorination and post-chlorination are done at RWC and CWR respectively. The general conditions of all the units are in order. However control devices for monitoring unit wise production are absent.

26. Transmission of Filtered Water: Filtered water from the CWR is pumped to different reservoir in GR Service area.

27. Disposal: Sludge mud is dumped into the sludge pond. Three sludge ponds are there. Sludge is taken manually through private agency from each pond in alternate year. Supernatant from sludge pond is discharged to near by drainage system.

B. Components of the Subproject

28. The rehabilitation and refurbishment activities will be located in the following three discrete areas: (i) Palta water works; (ii) Garden Reach water works; and (iii) along 4.0 kilometer stretch of the Taratala - Garden Reach road in ward 80 of Borough IX of KMC for the transmission lines.

29. The specific work components that have direct bearing on environment are summarized in Table 3.

Table 3. Details of Work Components under Water Supply Subproject

Works	Salient Features	Remarks
A. Palta Water Works		
Renovation and Refurbishment of WTP - Construction of 81.8 MLD rapid gravity filter unit for old 454.6 MLD WTP - Renovation and repair of 1 unit clarifloculator (75.7 MLD) of old 454.6 MLD WTP	Rapid gravity filter plant Capacity – 81.8 MLD Under drainage system – False floor type Clarifloculator – 1 unit Repair work – Structural part (bridge) and minor civil works. Mechanical parts replacement	Construction job No land acquisition as civil works are within existing facilities owned by KMC
Rehabilitation of intake jetty (272.8 MLD)	Structure - MS (Mild steel) (coated with anti-corrosive paint) Length 30m in water from Low Water Level (LWL) brim line. Pile foundation Existing suction pipe diameter – 1500 millimeter (mm)	Construction job No land acquisition as civil works are within existing facilities owned by KMC
Cleaning of Pre-settling Tanks (PSTs) - Preparation of dumping yard for sludge from PSTs - Construction of infrastructure for sludge disposal - Cleaning of PSTs - Rehabilitation of the drain for sludge supernatant disposal system	PST1 – sludge cleaning 230,000 m ³ Holding site development – 1 no. (53,000 square meter [sq. m]) Boundary wall as infrastructure strengthening Road development as sludge cake disposal Rehabilitation of existing drain - 1.1 km length will be rehabilitated out of 1.7 km	Construction job No land acquisition as civil works are within existing facilities owned by KMC
Supply and Installation of pumps and motors at Tallah Palta system - Replacement of worn out pumping unit		Construction job No land acquisition as civil works are within existing facilities owned by KMC
B. Garden Reach Water Works		
Rehabilitation of existing jetty at Garden Reach WTP intake system and sludge pond A) - Rehabilitation of old raw water intake jetty (273 MLD) - Laying of 1500mm dia MS pipe from intake to raw water Pumping Station (PS) - Cleaning of existing raw water mains	Structure - MS steel (coated with anticorrosive paint) Length 65m in water from LWL brim line. Pile foundation Existing suction pipe cleaning – 1500mm x 2 units Laying of 170 m new 1500 mm dia pipe.	Construction job No land acquisition as civil works are within existing facilities owned by KMC
B) Redevelopment of sludge ponds, monitoring, and quality control of effluent Redevelopment of sludge pond, monitoring and quality control system of supernatant Construction of drainage disposal system of supernatant from sludge pond.	Total pond area – 62, 000 sq. m No. of ponds – 3 Length of drain for supernatant – 300 m	Construction job
Supply and Installation of pumps and motors	Details given in Annex F of technical report	Construction job No land acquisition as civil works are within existing facilities owned by KMC
Rehabilitation and augmentation of existing clear water transmission main system for Garden Reach	Length – 4.0 km Diameter – 1500mm Method of laying – Microtunneling	Construction job No land acquisition as civil works

Works	Salient Features	Remarks
service zone. - Laying of clear water transmission main between Garden Reach WTP to Taratala	(major part) + Open cut Maximum cushion – 5m (approx.)	are within existing facilities owned by KMC
C. Reduction of UFW		
Geographical Information System (GIS) Mapping - Mapping of the city's water supply distribution system	Through out KMC area	Study/Design job
NRW program in pilot wards in Garden Reach service zone - Rezoning of the distribution system of Garden Reach service zone - Identification of District metered area (DMA) - Baseline study on system loss in a pilot DMA - Monitoring of system loss by introducing water meters - Reduction of system loss by replacement of distribution pipes.	Replacement of Distribution pipe lines 400 mm 100 mm dia (approximately 22.7 km) Domestic water meter – 1842 nos DMA meter – 2 nos Public Stand Post (PSP)s flow assessment - 113 nos	Pilot study with monitoring equipment/arrangements at strategic points No land acquisition as civil works are within existing right of ways

30. Table 4 summarizes the “with subproject” and “no-subproject scenarios.

Table 4: Water Supply “With Subproject” and “No-Subproject” Scenarios

	Parameter	'With-Project' Scenario	'No-Project' scenario
	Services		
1	Water source	Mostly from surface water (Hooghly river) and minor quantity from ground water (by tube well)	Major part from surface water (Hooghly river) and partly from ground water (by tube well)
2	Water treatment	More efficient treatment	Impaired treatment affecting quantity of supply
3	Per capita supply	150 lpcd	134 lpcd
4	Water quality	Potable as per CPHEEO	Potable as per CPHEEO
5	Duration of supply	24 hours	8 hours
6	UFW	15%	40%
	Environment		
7	Effect on aquatic ecology	No effect	No effect
8	Effect on terrestrial ecology - Tree cutting	Minor (maximum 10 trees)	No issue
9	Effect on ground water	Ground water abstraction minimized; Improvement of ground water status	Deterioration of ground water status with abstraction of ground water
10	Sludge (waste) and effluent treatment before disposal	Solid waste management with re-use of waste; prevention of water pollution	Continued pollution
	Social		
11	Inconveniences to people	During construction phase only	No issue
12	Effect on business	Both positive and negative. - Positive (during construction phase – activities in the area and businesses will increase) - Negative (during construction phase - access to some shops and establishments along the transmission mains alignment will be impeded)	No issue
13	Quality of life	Improve with availability of more treated water	Negative with increase of population
	Economic		

	Parameter	'With-Project' Scenario	'No-Project' scenario
	Services		
14	Economic development	Increased investment due to improved infrastructure and services	Slow development
15	Business	Attract more business due to improved infrastructure and services	No change

C. Implementation Schedule

31. Construction work is likely to commence in 2012 and will be completed in 48 months for the total water supply subproject. However individual components will be taken up phase-wise in an average of 18 months construction period.

IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE DATA)

A. Physical Resources

32. **Topography, drainage, and natural hazards.** Regionally KMC area is mostly flat and sloping in general from north to south and from west to east. The subproject area within Boroughs IX (transmission main) and XV (Garden Reach Water works) of KMC are low lying. The Palta waterwork area in North Barrackpur Municipality is on the broad levee of Hooghly river and is in higher grounds. The broad topographical features of the subproject area are given in Table 5.

Table 5: Topographical information of Boroughs XI-XV, KMC

Borough/Municipality	Ground level	General slope
XI	Varying from about 5 m to 2.5 m	Generally in north to south direction
XV	Varying from 5.50 m to 1.50m	Generally in north to south and west to east direction
North Barrackpur		Generally from west to east

33. The primary surface water resource for Kolkata is the Hooghly River. In addition, the city has a large number of water bodies and canals that are heavily used for everything from water supply, bathing, washing, aquaculture, and recreation to waste disposal. Hooghly river forms the western boundary of the KMC area. Bidyadhari and Kulti rivers meander along the eastern boundaries of KMC and discharge directly in to the Bay of Bengal. These rivers, along with an elaborate network of canal systems connected to these rivers are the recipients of entire drainage from KMC and its adjacent areas. Drainage of KMC area is generally divided in to the following drainage basins according to the topography and land use: Kolkata Basin; Bagjola Basin; Tollys Nullah Basin; Manicktala Basin; Tollygunge – Panchanagram (T-P) Basin; Keorapukur Basin; Monikhali Basin; and Churial Basin

34. The KMC area, with its generally flat terrain condition, receives more than 1,582 mm of rainfall yearly mainly spread over a 4 months period and comprised of mainly medium density – high frequency long duration storms. Due to the absence of an efficient drainage system to cater such an adverse condition, large areas of KMC suffer from prolonged inundation during monsoon causing severe health and economic hazards to the inhabitants.

35. The waste and storm water of the KMC area is carried by a system of natural and man-made canal system as follows:

- (i) Bagjola Canal system – flowing in easterly direction
- (ii) Kestopur Canal system – flowing in southerly direction
- (iii) Beliaghata (Circular) Canal system

- (iv) Storm water Flow (SWF) – Dry Weather Flow (DWF) canal system – flowing in easterly direction towards East Kolkata Wetlands carrying the pumped storm and sewage water of Kolkata
- (v) Tolly’s nallah system
- (vi) Tollygaj-Panchannagram (T-P) system
- (vii) Monikhali system
- (viii) Churial system

36. Natural hazards in southern part of Kolkata (project influence area in general) include water logging and flooding during monsoon months. . In areas like Behala, Tollygunge and Garden Reach even a small shower causes water logging in many localities which takes considerable period to evacuate. Some pockets remain inundated for even 3 to 4 months in a year. All these result due to poor and inadequate drainage facility in the areas. However, with the completion of KEIP I S & D subprojects situations have improved to a great extent. The Palta area is relatively free from water logging.

37. Duration of flooding varies from hours to days, depending on the facility available, nature of topography and outfall conditions in and around different localities. However, July is the worst month, followed by June and August.

38. In revised seismic zones map of India (IS 1893; Part 1, 2002) eastern part of Kolkata falls in Zone IV while the area to the west falls in Zone III. No seismic micro-zonation map has yet been prepared for the KMC area.

39. **Geology and Mineral Resources.** The subproject area is underlain by Quaternary sediments consisting of clay, silt, and various grades of sand, gravel, and pebbles. Lithological logs show the presence of a clay bed at the top, with a thickness of 10 to 40m. There is a further clay bed 250 to 650 m below ground level. There is a group of granular aquifers between these layers, and these are being tapped as a ground water resource. Regional subsoil data covering a large area in subproject area reveal six levels of strata up to a depth of about 50 m below ground level. Near surface stratigraphy of Kolkata Region is given in Table 6.

Table 6 : Near Surface Stratigraphy of Kolkata Region

Horizon I	Stratum I	Brownish grey/ light brown, silty clay/ clayey silt/ sandy silt with occasional lenses of silty fine sand; encountered from the top ground surface to a depth of about 3 to 4 m; occasionally only fill material of widely varying characteristics (about 4 m).
	Stratum II	Grey/ dark gray silty clay with semi-decomposed timber pieces, having lenses of silt and peaty clay; encountered between depths 3-4m and approximately 15m below ground level (about 10m).
Horizon II	Stratum III	Bluish grey and mottled brown/ grey, silty clay with kankar nodules and minute pockets of silt and sand (about 5.5m).
	Stratum IV	Brown/ yellowish brown, sandy silt/ silty fine sand/ clayey silt with lenses and pockets of brown/ grey silty clay (about 6m).
	Stratum V	Mottled brown/ grey, grey silty clay and brown silty clay frequently showing laminar character (about 18m).
	Stratum VI	Brown/ light brown, silty fine to medium sand (9m +).

40. The Horizon I comprising Strata I and II represents generally soft sediments. The second horizon comprising Strata III to VI have two clay layers (Stratum III and V) separated by a predominantly cohesionless layer (Stratum IV). Stratum VI is definitely water bearing and shallow tube wells in Kolkata region draw water from this stratum. The sediments of the second horizon are oxidized and are consolidated. The sequence is intercepted at several locations by deposits of the recent river system, parts of which are now dry.

41. There no mineral occurrence in the area.

42. **Soil.** The Kolkata area may be divided into two groups based on the soil types : Entisols and Alfisols. The Entisols are present at the western part of the area and the other part is represented by Alfisols. These soils are typically deltaic alluvial soils. The agro-climatic zone characterization of the area is Gangetic alluvium group of soils rich in calcium. Free calcium carbonate occurs in surface soils and the soil profile shows low to medium levels of organic matter and medium levels of available phosphate and potash. Kolkata and the neighboring areas are represented predominantly by clayey soils. Table 7 lists the physical and chemical characteristics of soil sampled and analyzed from the five Boroughs of KMC within the study area. The data will be applicable to soils of Borough IX also.

Table 7 : Soil Quality in Five Boroughs of Kolkata Municipal Corporation

Sl.No.	Parameters	Sample (S1)	Sample (S2)	Sample (S3)	Sample (S4)	Sample (S5)
1	Sand (%)	14.0	15	20	22.0	24.0
2	Silt (%)	32.0	30	40	44.0	30.0
3	Clay (%)	54.0	65.0	60.0	34.0	46.0
4	pH	8.5	9.3	6.9	9.7	9.47
5	Available nitrogen (mg/kg)	1250	1428.0	1071.0	2356.2	904.4
6	Available phosphorus (mg./kg)	180	230	190	280	210
7	Available potassium (mg./kg)	58	80	62.5	90	52.0
8	Iron (mg/kg)	326.0	266.9	250.0	5433.57	3125.87
9	Zinc (mg/kg)	29.1	25.0	28.5	31.1	31.48
10	Copper (mg/kg)	5.81	7.69	8.5	21.94	<0.4
11	Hexavalent chromium (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
12	Trivalent chromium (mg/kg)	11.67	8.33	5	28.33	25.0
13	Nickel (mg/kg)	10.0	13.2	8	14.8	14.0
14	Arsenic (mg/kg)	<0.1	<0.1	<0.1	<0.1	<0.1
15	Lead (mg./kg)	12.35	12.8	8.5	25.19	13.33
16	Cadmium (mg./kg)	<0.4	<0.4	<0.4	<0.4	<0.4

Notes: S1 - HL Sarkar Road, Borough XI, Ward 113; S2 - Near Chowbagha, Borough XII, Ward 108; S3 - Motilal Gupta Road, Borough XIII, Ward 122; S4 - Near Kalitala Market, Borough XIV, Ward 125; and S5 - Near Badartala, Borough XV, Ward 141

43. **Climate.** The climate is hot and humid from March to October. It is somewhat cool from November to February. Rains are received principally from June to September with frequent pre-monsoon showers and *nor'westers*⁶ during April and May. The winter season begins in November and continues to February, followed by the summer season which continues until mid-June. The monsoon starts in mid-June and goes up to mid-September, sometimes extending up to October.

44. April and May are the hottest months with monthly mean maximum temperature above 35 degree Celcius (deg C). Mean maximum temperature is above 30 deg C from March to October. Relatively low monthly mean minimum temperatures occur during December (15.2 deg C), January (14.1 deg C) and February (18.1 deg C). Mean monthly minimum temperature is relatively high and is between 26 deg C and 27 deg C during the months of May, June, July and August.

45. The average annual rainfall is about 1919 mm with the four monsoon months (June to September). Rainfall peaks in July. Average number of rainy days is about 146 days per annum. During monsoon months it is not uncommon to receive 75 mm to 100 mm of rainfall in a 24 hour period. Such heavy rainfall may occur from 4 to 10 times in a year.

Wind is light to gentle with maximum monthly average speed 7.22 kilometer per hour (km/hr). The post-monsoon and winter months (October-February) experience very light wind. The average monthly wind speed during pre-monsoon and monsoon are 6.10 and 5.03 km/hr respectively. The mean annual wind speed is 4.28 km/hr. The prevalent wind direction was

⁶ Storms in this time of the year are locally known as "*nor'westers*"

from the south west during most of the time in the year, except during winter when the northerly wind became significant. However, during cyclonic storms and depressions especially those occurring in September to October, high wind speed reaching around 100 km/hour is not uncommon.

46. **Air Quality.** The concentrations of air pollutants in Kolkata are highly variable over the seasons. They are at their highest during winter months (November to February) and at their lowest during monsoon months (June to September). 24-hourly suspended particulate matter (SPM) concentration in the winter months generally ranges between 300 and 400 microgram per cubic metre (ug/cum), sometimes reaching values in excess of 500 ug/cum. 24-hourly respirable particulate matter (RPM) concentration in those months is mostly in the range of 150 to 200 ug/cum but often exceeds 200 ug/cum. During monsoon months, the 24-hourly SPM and RPM concentrations come down to around 100 ug/cum and around 50 ug/cum respectively. Similarly, 24-hourly nitrogen oxides (NOX) concentrations are around 50 ug/cum during the monsoon months but rises to around 90 ug/cum, sometime exceeding 100 ug/cum, during the winter months. Except for a slight build-up during the winter months, 24-hourly sulphur dioxide (SO₂) concentrations are mostly around 5 to 7 ug/cum during most months of the year. The month of October generally shows a rapid transition from low concentrations of all pollutants to the succeeding high concentration months. But the transition from high concentration in winter months to that of low in monsoon months is rather gradual through the months of March, April and May. Seasonal variations in temperature, wind, rainfall, and other factors account for this.

47. Table 8 presents the monthly average ambient air quality of Kolkata for the year 2008 calculated from daily measurement data as reported by WBPCB. When compared with national air quality standard for residential areas as prescribed by the Central Pollution Control Board (CPCB) the ambient air quality of Kolkata does not meet the national standard in respect of SPM, RPM and NOX in terms of both arithmetic annual average and also percent of time the daily concentration exceeding the prescribed standard. However, the concentration of SO₂ adequately meets the national standard on both counts.

Table 8: Monthly average ambient air quality of Kolkata in 2008

Month	SPM		RPM		SO ₂		NOX	
	A	B	A	B	A	B	A	B
January	352	27/31	178	27/31	9	0/31	91	24/31
February	287	25/29	140	25/29	7	0/29	81	16/29
March	189	10/31	85	10/31	6	0/31	69	1/31
April	139	0/30	55	0/30	5	0/30	62	0/30
May	126	0/31	45	0/31	5	0/31	52	0/31
June	104	0/30	39	0/30	5	0/30	44	0/30
July	107	0/31	37	0/31	5	0/31	47	0/31
August	88	0/31	32	0/31	5	0/31	43	0/31
September	99	0/30	39	0/30	6	0/30	43	0/30
October	177	8/31	81	4/31	7	0/31	62	1/31
November	250	25/30	123	25/30	8	0/30	85	24/30
December	329	31/31	173	31/31	11	0/31	93	25/31
Whole Year	187	126/366	86	122/366	7	0/366	64	91/366
		34.40%		33.30%		0%		24.90%

Source: WBPCB, www.wbpcb.gov.in

Notes: SPM = Suspended Particulate Matter; RPM = Respirable Particulate Matter; SO₂ = Sulphur Dioxide; NO_x = Nitrogen Oxides

A = Arithmetic mean concentration in microgram/cum from 24-hourly data

B = Number of days the daily value exceeded the standard out of total days monitored based on 24-hourly data

48. Ambient air quality at Behala Chowrasta close to the Garden Reach Project site showed the same pattern from October, 2010 to September, 2011 as given in Table 9.

Table 9: Month-Wise Average Ambient Air Quality at Behala Chowrasta

October, 2010 to September, 2011 (Arithmetic Mean Concentration in ug/cum from 24-Hourly Data)

	NO ₂	PM ₁₀	SO ₂
September, 2011	45.71	52.00	7.06
August, 2011	36.15	39.52	5.43
July, 2011	39.02	40.37	5.84
June, 2011	42.66	44.8	5.48
May, 2011	45.69	50.75	6.21
April, 2011	48.18	71.04	5.82
March, 2011	64.01	99.42	6.39
February, 2011	94.93	193.55	9.66
January, 2011	111.11	221.13	10.28
December, 2010	91.75	170.5	11.75
November, 2010	76.78	148.11	9.67
October, 2010	59.25	73.25	7.5
Yearly Mean	62.73	99.59	7.65

Source: WBPCB, www.wbpcb.gov.in

October, 2010 to September, 2011 (Arithmetic Mean Concentration in ug/cum from 24-Hourly Data)

Notes: NO₂ = Nitrogen Oxide_; PM₁₀ = Particulate matter having diameter equal or less than 10 micron; SO₂ = Sulphur Dioxide

49. Results of limited time air quality monitoring carried out in the subproject area are presented in the succeeding tables (Table 10 and 11). The values are comparable with the general air quality level of Kolkata and surrounding areas which is not in compliance with the national ambient air quality standards in respect of PM₁₀ and NO_x. However, Palta water works area is relatively less polluted compared with Garden Reach water works area.

Table 10 : Ambient Air Quality around Garden Reach Pumping Station

Date	Shift wise sample no.	Pollutants level in ug/cum				
		PM ₁₀	SPM	SO ₂	NO _x	CO
20.10.2011	1/1	123.8	238.5	6.2	32.5	<125
to	1/2	123.7	230.8	6.0	30.0	<125
21.10.2011	1/3	120.8	238.5	5.8	28.5	<125
22.10.2011	2/1	126.8	241.8	6.2	30.0	<125
to	2/2	120.5	218.3	6.0	25.0	<125
23.10.2011	2/3	126.8	223.8	5.8	28.3	<125
24.10.2011	3/1	140.7	243.8	6.0	32.6	<125
to	3/2	136.7	231.8	5.8	28.5	<125
25.10.2011	3/3	118.8	216.2	6.0	31.2	<125
29.10.2011	4/1	110.9	221.8	5.7	25.0	<125
to	4/2	102.8	212.5	5.6	21.8	<125
30.10.2011	4/3	116.7	218.3	6.0	26.5	<125
31.10.2011	5/1	112.6	210.5	6.0	26.5	<125
to	5/2	116.8	186.2	5.5	21.8	<125
01.11.2011	5/3	120.5	218.3	5.6	25.0	<125
03.11.2011	6/1	116.8	218.3	6.1	28.2	<125
to	6/2	112.7	210.8	5.6	23.5	<125
04.11.2011	6/3	120.8	208.3	5.8	25.0	<125
07.11.2011	7/1	132.7	236.8	6.0	35.0	<125
to	7/2	120.5	212.1	5.6	26.2	<125
08.11.2011	7/3	126.7	218.3	5.9	25.0	<125
09.11.2011	8/1	106.8	190.2	5.6	25.0	<125
to	8/2	102.7	186.2	5.5	21.8	<125
10.11.2011	8/3	116.2	210.8	5.8	26.5	<125

Source: Primary data generated under KEIP_Phase 2__

Notes: PM₁₀ = Particulate matter having diameter equal or less than 10 micron ; SPM = Suspended Particulate Matter; SO₂ = Sulphur Dioxide; NO_x = Nitrogen Oxides; CO = Carbon Monoxide;**Table 11 : Ambient Air Quality from Palta (Badamtala)**

Date	Shift wise sample no.	Pollutants level in ug/cum				
		PM ₁₀	SPM	SO ₂	NO _x	CO
19.10.2011	1/1	108.7	216.8	5.8	30.0	<125

Date	Shift wise sample no.	Pollutants level in ug/cum				
		PM ₁₀	SPM	SO ₂	NO _x	CO
to 20.10.2011	1/2	93.5	180.2	5.0	23.5	<125
	1/3	102.8	191.7	4.8	21.5	<125
21.10.2011	2/1	105.7	212.8	5.2	25.0	<125
to	2/2	91.7	183.5	4.8	21.8	<125
22.10.2011	2/3	106.9	210.8	5.0	23.8	<125
24.10.2011	3/1	110.7	183.5	6.0	28.2	<125
to	3/2	80.5	167.2	5.0	23.6	<125
25.10.2011	3/3	102.7	179.2	5.6	25.0	<125
27.10.2011	4/1	108.5	216.8	5.8	32.5	<125
to	4/2	110.7	210.5	5.3	30.0	<125
28.10.2011	4/3	116.7	212.5	5.6	26.5	<125
01.11.2011	5/1	90.1	186.2	5.6	28.2	<125
to	5/2	86.5	180.2	4.8	25.0	<125
02.11.2011	5/3	112.5	192.5	5.2	26.5	<125
04.11.2011	6/1	108.5	210.8	5.2	26.8	<125
to	6/2	91.2	182.5	4.6	23.2	<125
05.11.2011	6/3	102.5	206.7	5.0	25.0	<125
07.11.2011	7/1	118.5	231.8	6.0	35.0	<125
to	7/2	92.8	183.5	5.0	23.2	<125
08.11.2011	7/3	106.5	216.8	5.2	26.8	<125
10.11.2011	8/1	112.7	226.8	5.6	32.8	<125
to	8/2	102.8	210.7	5.0	23.2	<125
11.11.2011	8/3	110.5	216.7	5.3	28.5	<125

Source: Primary data generated under Tranche 1 ____

Notes: PM₁₀ = Particulate matter having diameter equal or less than 10 micron ; SPM = Suspended Particulate Matter; SO₂ = Sulphur Dioxide; NO_x = Nitrogen Oxides; CO = Carbon Monoxide;

50. **Surface Water Quality.** The primary surface water resource for Kolkata is the Hooghly river that skirts the western margin of Kolkata. In addition, the subproject area has a large number of waterbodies and canals that are heavily used for everything: from bathing, washing, aquaculture and waste disposal. Industrial and domestic pollution⁷ along with runoff from adjoining areas has led to deterioration in river water quality. Summary of chemical analysis of water samples collected from Hooghly river water at the Palta and Garden Reach water works are given in Table 12:

Table 12: Water Quality of Hooghly River at Palta and Garden Reach Water Works

Sl No.	Parameter	Unit	Palta			Garden Reach		
			Test result (dated 17.01.10)	Test result (dated 08.04.11)	Test result (dated 15.07.10)	Test result (dated 11.01.11)	Test result (dated 07.04.11)	Test result (dated 08.07.10)
1	Conductivity	us/cm	342	353	175	336	371	214
2	Dissolved Oxygen (DO)	mg/l	11	7.2	6.4	12.2	4.4	5.7
3	pH	Unit	8.2	8	8.4	8.27	8.03	7.4
4	Temperature	deg C	19	30	30.5	16	29	27
5	Biological Oxygen Demand (BOD)	mg/l	2.4	1.8	1.1	5.55	3.8	5.9
6	Nitrate-N	mg/l	0.14	0.68	0.3	0.04	1	0.31
7	Fecal Coliform	MPN/100ml	50,000	110000	110000	250000	8000	22000
8	Total Coliform	MPN/100ml	80,000	140000	140000	350000	11000	33000
9	Ammonia-N	mg/l	BDL	BDL	0.114	BDL	0.164	0.225
10	Phosphate - P	mg/l		0.073			0.25	0.04
11	Chloride	mg/l		16.1			29.14	14.56
12	Lead	ug/l					7.48	

Source: WBPCB, www.wbpcb.gov.in

Notes: us/cm = micro siemen per centimeter; mg/l = milligram per litre; MPN/100 mL = Most Probable Number per one hundred millilitre; BDL = Below Detection Limit; ug/l = Microgram per litre; There are no government standards for (tidal) river water

⁷ To identify industry specific pollutants is beyond the scope of the IEE with the available data base. However present treated water supply from the two water works at the consumer end meets the national drinking water standard.

51. Table 13 presents the results of chemical analysis of water samples taken from Hooghly river near Palta and Garden Reach. The collection and analysis of the water samples were carried out by Tranche 1 during November and December 2011 as part of IEE preparation. The results show the same characteristics of the water samples collected by WBPCB and also captures the subtle variation between high and low tide. The water samples have been noted to have high coliform contamination.

Table 13 : Chemical analysis of Hooghly river water near Garden Reach and clear supply water

Date Parameters	20.10.11			14.11.11		
	SW-1 Hooghly River near Garden Reach (Low Tide)	SW-2 Hooghly River near Garden Reach (High Tide)	SW-3 Supply clear water – Garden Reach Water Works	SW-5 Hooghly River near Palta (Low Tide)	SW-6 Hooghly River near Palta (High Tide)	SW-7 Supply clear water – Palta Water Works
Temperature (deg C)	20.5	21.5	18.50	19.50	21.0	19.0
Color unit	1.0	2.0	1.0	2.0	2.0	1.0
Turbidity (NTU)	23.5	20.37	1.2	31.50	26.5	1.2
Odor (TON)	No odor observed	No odor observed	No odor observed	No odor observed	No odor observed	No odor observed
pH	7.58	7.67	7.67	6.80	7.33	7.83
Total solids (mg/l)	278.0	248.0	193.0	425.0	268.0	223.0
TDS (mg/l)	180.0	170.0	182.0	260.0	202.0	235.0
TSS (mg/l)	48.0	39.0	<10	68.0	32.0	<10
TVS (mg/l)	35.0	28.5	<10	82.0	50.0	<10
DO (mg/l)	6.2	6.4	7.0	5.6	5.6	7.2
BOD (mg/l)	6.0	5.0	<2.0	8.0	3.0	<2.0
COD (mg/l)	40.0	30.0	<5.0	24.30	9.72	<5.0
Oil and Grease (mg/l)	<1.0	<1.0	<1.0	2.0	<1.0	<1.0
Lead (mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chromium (III) (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Chromium (VI) (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Copper (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc (mg/l)	0.08	0.04	0.06	0.11	0.07	0.17
Iron (mg/l)	1.97	1.11	0.57	2.53	1.93	0.53
Ammoniacal Nitrogen (mg/l)	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Kjeldahl Nitrogen (mg/l)	5.25	4.50	1.65	3.36	2.35	<0.2
Total Nitrogen (mg/l)	18.5	15.0	8.50	20.0	16.50	10.50
Total Ammonia (mg/l)	<0.1	<0.1	<0.1	0.80	1.50	<0.1
Free Ammonia (mg/l)	0.0	0.0	0.0	0.0	0.0	0.0
Sulphide (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Salinity (ppt)	0.03	0.029	0.03	0.023	0.026	0.23
Faecal coliform (MPN/100 ml)	6.7 X 10 ³	5.6 X 10 ³	<2	2.8 X 10 ³	2.3 X 10 ³	<2

Source; Primary data generated by Tranche 1:

Notes: SW = surface water; NTU = Nephelometric Turbidity Unit; TON = Threshold Odor Number; mg/l = milligram per litre; ppt = parts per thousand; MPN/100 ml = Most Probable Number per one hundred millilitre; BOD = Biochemical Oxygen Demand; COD = Chemical Oxygen Demand. There are no government standards for (tidal) river water

52. Kolkata has a number of man-made lakes within its municipal borders, as shown in Table 14. They provide habitat for a number of aquatic and avian species and accommodate various recreation activities. Urban development has adversely affected the environment of all urban lakes. Perhaps most important of these from an ecological perspective are Subhash and Rabindra lakes. However, the subproject area is not adjacent or within these lakes.

Table 14 . Lakes in KMC with Surface Area over 1 Hectare

Lake	Area (ha)	Main uses
Brace Bridge Jhil	65.0	Recreation, boating swimming, sports, waterfowl habitat, nature conservation
Rabindra Lake	29.5	Pisciculture, waterfowl habitat, nature conservation, sewage disposal, domestic Rabindra Lake 29.5 Pisciculture, waterfowl habitat, nature conservation, sewage disposal, domestic waste disposal, defecation, water supply, washing, bathing
Victoria Memorial Hall Pond	24.2	Recreation
Subhash Lake	16.0	Recreation
Zoo Garden Pond	4.0	Recreation
Eden Garden Jheel	4.0	Recreation
Lal Dighi	1.2	Angling, nature conservation, waste disposal, defecation, water supply, washing, bathing
College Square Pond	1.0	Recreation, swimming, sports, washing, bathing

53. Chemical analysis of water collected from ponds, jheels, and lakes) from seventeen wards (wards 108-115, 122-127 & 139-141) around the various Subproject sites within KMC area shows the following characteristics : TDS (345 to 977 mg/l), DO (5.0 to 8.0 mg/l), COD (18.88 to 79.04 mg/l), BOD (4.0 to 18.0 mg/l), Chloride (61.54 to 325.29 mg/l), total nitrogen (4.1 to 19.5 mg/l), total coliform (1.1 to 4.5×10^3 CFU/ml). Concentrations of heavy metals like lead, cadmium, mercury, arsenic, chromium (III) and (VI) are always below their respective detection limits.

54. Effluents from the WTPs have been analyzed as part of the Tranche 1 IEE preparation The results are given in Table 15 and compared with CPCB Standards for Effluents. which shows that iron concentration is high:

Table 15 . Chemical analysis of (after treatment) waste water

Parameters	Wastewater (Effluent)		
	Garden Reach WTPs	Palta WTPs	Applicable CPCB Standards for discharge in inland surface water
Temperature (deg C)	21.50	19.5	Not exceeding 50 °C
Colour unit	1.0	1.0	-
Turbidity (NTU)	18.50	2.5	-
Odour (TON)	No odor observed	No odor observed	-
pH	7.20	7.85	5.5-8.0
Total solids (mg/l)	460.0	260.0	-
Total dissolved solids (mg/l)	375.0	240.0	-
Total suspended solid (mg/l)	47.0	23.0	100
Total volatile solids (mg/l)	20.0	10.0	-
Dissolved oxygen (mg/l)	5.6	6.0	-
BOD (3 days, 27 deg C (mg/l)	8.0	7.0	30
COD (mg/l)	60.0	29.16	250
Oil and Grease (mg/l)	<1.0	<1.0	10
Lead (mg/l)	<0.03	<0.03	0.1
Chromium (III) (mg/l)	<0.20	<0.20	-

Parameters	Wastewater (Effluent)		
	Garden Reach WTPs	Palta WTPs	Applicable CPCB Standards for discharge in inland surface water
Chromium (VI) (mg/l)	<0.05	<0.05	0.1
Arsenic (mg/l)	<0.01	<0.01	0.2
Cadmium (mg/l)	<0.01	<0.01	2.0
Nickel (mg/l)	<0.20	<0.20	3.0
Copper (mg/l)	<0.05	<0.05	3.0
Zinc (mg/l)	0.11	0.08	5.0
Iron (mg/l)	5.05	2.68	3.0
Ammoniacal Nitrogen (mg/l)	<0.08	<0.08	50
Kjeldahl Nitrogen (mg/l)	3.50	4.37	100
Total Nitrogen (mg/l)	18.50	15.0	-
Total Ammonia (mg/l)	<0.1	<0.1	-
Free Ammonia (mg/l)	0.0	0.0	5.0
Sulphide (mg/l)	<0.01	<0.01	2.0
Mercury (mg/l)	<0.0001	<0.0001	0.1
Salinity (ppt)	0.04	0.038	-
Faecal Coliform (MPN/100 ml)	<2	<2	-

Source:: Primary data generated during present IEE preparation

Notes: WTP = water treatment plant; NTU = Nephelometric Turbidity Units; TON = Threshold Odor Number; mg/l = milligram/litre; ppt = parts per thousand; MPN/100 ml = Most Probable Number per one hundred millilitre; BOD = Biochemical Oxygen Demand COD = Chemical Oxygen Demand

55. **Groundwater.** The aquifers that are tapped for ground water in Kolkata are under confined condition because of the presence of a thick clay layer near the surface. Such aquifers occur at various depths separated by other clay layers. Generally the first aquifer is encountered at a depth of about 15 m followed by other aquifers with a principal one at about 90 m depth. The shallow aquifer is not used for bulk water tapping purposes, and is generally only tapped for spot supply of through hand pumps.

56. A further deep aquifer occurs at depths approximately between 150 to 200m, and majority of deep tube wells for organized supply of drinking water tap this aquifer. The earliest geohydrological data for the configuration of the piezometric surface beneath Kolkata are available for the post-monsoon period of 1956. It shows that in the northern part of the city, the piezometric surface was about 0.5 to 1.0 m above sea level and progressively declined below mean sea level towards the south. There was a drastic change in the pattern in the pre-monsoon of 1958 when a small depression in the piezometric surface was created with the center near Park Street lying at 5 m below mean sea level. The piezometric surface contour plan therefore defined a centripetal ground water flow pattern changing from an open north to south to a closed one. This ovoid ground water trough with long axis trending northwest-southeast persisted since then progressively going down with the central part having piezometric surface lying at (-) 13 m below the mean sea level in the pre-monsoon of 1998. The fall in elevation of the piezometric surface over a period of 40 years is of the order of at least 5 m at the extreme eastern part of Kolkata. The fall of piezometric surface in Command Hospital (Alipore), Kudghat and Tiljala area are 2.08, 3.06 and 3.24 m respectively. The area of depression is roughly bounded by the triangle formed by Narkeldanga, Park Circus and Alipore National Library.

57. As part of investment program DPR preparation geohydrological investigations were carried out in January, 2009 in seventeen wards distributed in Borough XI to XV. In these areas, ground water occurs mainly under confined to semi-confined conditions in 13 wards

(108, 109, 111, 115, 122, 123, 124, 125, 126, 127, 139, 140 and 141). Depths of piezometric surface from ground level in these wards varied between 9.3 to 14.11 m. In wards 110, 112, 113 and 114, due to presence of near surface aquifers under water table conditions the depths to water level in the tube wells in these wards are between 1.3m to 2.9m. An aquitard occurs near surface over the entire studied area and ground water from this aquitard is tapped by dug wells. The depths to water table varied between 0.50 to 7.95 m in these dug wells. With most areas reporting water levels within 1 to 2 m from the ground surface.

58. In Palta and Garden Reach sectors, groundwater occurs in both shallow as well as in deep aquifers. Ground water levels in these sectors were measured during November 2011 under Tranche 1. The depth to piezometric surface was measured in two types of water abstracting structures – dug well and tube well (cylinder type) in this area. The depth to piezometric surface or depth to water levels in dug wells (generally present within the clay horizon – aquiclude) is very close to the land surface. The depth generally ranges between 1.0 to 1.22 m below ground level (bgl). During the same period the piezometric surface in the deeper aquifer zones (>40 m bgl) rested at a deeper level generally ranging between 9.5 and 10.7 m bgl.

59. In the Taratala – Garden Reach sector, the depth to piezometric surface or depth to water levels in dug wells is very close to the land surface. The depth ranges between 0.42 to 0.9 m bgl. The depth to water level is low at the Garden Reach site than the Taratala region. During the same period the piezometric surface in the deeper aquifer zones (>40 m bgl) rested at a deeper level – generally above 15 m bgl.

60. Chemical analysis of tube well water as given in Table 15 from the seventeen wards shows the following characteristics : TDS (mean 924.6 varying from 580.0 to 1,735.0 mg/l), total hardness (mean 418.87 varying from 235.2 to 725.2 mg/l), chloride (mean 213.77 varying from 70.33 to 470.36 mg/l) and calcium (mean 95.89 varying from 51.06 to 176.75 mg/l). When compared with drinking water standard, concentrations of TDS and iron are above the desirable concentration. Total hardness and concentrations of chloride and calcium are above their respective desirable limits in some of the samples. Concentrations of all other constituents are within the limits of their respective desirable values.

61. Ground water quality was monitored under Tranche 1 around the project sites during November, 2011 and the results are reproduced in Table 16 below. No metal pollution especially that of arsenic has been detected:

Table 16: Results of chemical analysis of ground water

Parameters	GW – 1 Near Taratala More, Garden Reach (Tube Well)	GW – 8 Near Moyla Depot, Garden Reach (Tube Well)	GW – 9 Near Moyla Depot, Garden Reach (Well)	GW – 10 Air force Station, Palta (Tube Well)	GW – 11 Ghusipara, Palta (Tube Well)	GW – 12 Badamtala, Palta (Tube Well)	National drinking water standard Permissible limit
Temperature(OC)	20.5	18.5	18.0	21.5	23.0	23.5	-
Colour unit	1.0	1.0	1.0	1.0	1.0	1.0	5
Turbidity(NTU)	2.8	5.1	6.8	3.86	1.5	3.1	1
Odour	No odour observed	No odour observed	No odour observed	No odour observed	No odour observed	No odour observed	Agreable
pH	7.57	7.45	7.76	7.16	7.18	7.2	6.5-8.5
TSS (mg/l)	<10	<10	<10	<10	<10	<10	-
TDS(mg/l)	560.0	617.0	615.0	870.0	850.0	820.0	500
Total hardness(mg/l)	240.0	380.0	388.0	220.0	320.0	290.0	200
Chloride(mg/l)	72.53	79.12	74.73	226.38	263.75	182.43	250
Sulphate(mg/l)	5.5	36.5	44.5	20.0	25.5	20.5	200
Nitrate(mg/l)	10.5	31.6	32.5	35.0	25.0	12.0	45
Sodium(mg/l)	120.5	228.67	238.5	280.0	260.5	350.0	-
Potassium(mg/l)	35.0	36.8	30.0	30.0	35.0	45.0	-

Calcium(mg/l)	59.32	99.4	96.19	49.70	76.95	82.56	75
Magnesium(mg/l)	22.08	31.68	35.52	23.04	30.72	20.16	30
Iron(mg/l)	0.62	2.12	2.27	1.20	0.90	1.12	0.3
Zinc(mg/l)	0.82	0.05	0.12	0.65	0.80	0.45	5.0
Phosphorus(mg/l)	0.08	0.55	0.92	1.6	1.5	1.5	-
Fluoride(mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.0
Lead(mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.01
Cadmium(mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.003
Arsenic(mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Chromium (III) (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
Chromium(VI) (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Phenolic compound(mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cyanide(mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Mercury(mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Total coliform (MPN/100 ml)	<2	<2	<2	<2	<2	<2	Not detectable

Table 17 : Quality of ground water in seventeen wards of KMC

Parameters	Sample No																
	GW 1	GW 2	GW 3	GW 4	GW 5	GW 6	GW 7	GW 8	GW 9	GW 10	GW 11	GW 12	GW 13	GW 14	GW 15	GW 16	GW 17
pH	7.09	7.02	7.07	7.01	7.21	7.25	7.06	7.43	7.40	7.63	7.49	7.48	7.41	7.37	7.14	7.24	7.96
TSS (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
TDS (mg/l)	1143	594	791	1625	968	1113	1735	723	917	787	773	744	625	580	890	1050	661
Total hardness (mg/l)	646.8	470.4	362.6	588.0	294.0	666.4	725.2	323.4	362.6	294.0	284.2	235.2	254.8	245.0	519.4	490.0	358.8
Chloride (mg/l)	316.5	70.33	167.04	461.56	222.19	325.29	470.35	109.89	241.77	167.04	162.65	153.85	109.9	160.0	171.44	167.04	157.15
Sulphate (mg/l)	4.82	18.35	12.46	26.82	34.23	18.82	18.35	21.50	19.41	30.28	11.00	28.5	3.00	35.00	36.17	38.50	30.00
Nitrate (mg/l)	21.5	12.5	15.0	23.0	18.5	18.5	26.5	16.5	42.0	16.5	16.5	15.0	15.0	16.5	19.5	20.5	16.5
Sodium (mg/l)	160.0	32.0	78.5	235.0	123.47	142.5	238.5	48.5	118.0	85.0	132.5	80.5	58.0	70.0	90.5	89.0	80.0
Potassium (mg/l)	16.5	8.5	11.5	25.0	15.0	16.5	20.0	12.5	15.0	15.0	15.0	12.5	10.5	10.5	16.5	18.5	12.5
Calcium (mg/l)	145.33	102.12	82.49	145.33	66.77	168.9	176.75	78.56	82.49	62.85	58.92	58.92	58.92	51.06	145.33	70.70	74.63
Magnesium (mg/l)	68.21	51.74	37.63	54.1	30.58	58.8	68.21	30.58	37.63	32.93	32.93	21.17	25.87	28.22	37.63	32.93	39.98
Phosphorus (mg/l)	0.78	0.18	0.21	0.12	0.60	0.18	0.23	0.16	0.14	0.12	0.27	0.37	0.19	0.50	1.01	0.26	0.25
Zinc (mg/l)	0.20	1.02	0.97	1.48	0.72	0.85	0.99	0.50	0.61	1.21	0.50	0.44	0.41	0.60	0.80	0.90	0.80
Iron (mg/l)	1.37	1.93	0.71	0.80	5.49	0.76	1.80	1.13	1.40	0.84	2.00	0.40	0.64	1.20	1.25	4.31	0.67
Lead (mg/l)	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cadmium (mg/l)	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Mercury (mg/l)	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Fluoride (mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
As +5 (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As +3 (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cr +3 (mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cr +6 (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenolic Compound (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cyanide (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Coliform (CFU/100 ml)	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
GW 1	Birji Road, Borough XI, Ward 110								Santosh Roy Road, Borough XIII, Ward 123								
GW 2	Boral Main Road, Borough XI, Ward 111								Barisha Purba Para Road, Borough XIV, Ward 124								
GW 3	Near 112 No. Ward Office, Borough XI, Ward 112								Dakshin Para Road, Borough XIV, Ward 125								
GW 4	Near Kalitala Market, Borough XI, Ward 113								Dakshin Behala Road, Borough XIV, Ward 126								
GW 5	Bandipur Road, Borough XI, Ward 114								Near Law College, Borough XIV, Ward 127								
GW 6	Hossainpur, Borough XII, Ward 108								Near Sheikh Masjid, Borough XV, Ward 139								
GW 7	Mukundapur Primary Health Centre, Borough XII, Ward 109								Satghara Road, Borough XV, Ward 140								
GW 8	Mahatma Gandhi Road, near Lokenath Mandir, Borough XIII, Ward 115								Jelia Para Road, Borough XV, Ward 141								
GW 9	Ustad Amir Khan Sarani, Borough XIII, Ward 122																

62. **Noise.** Noise level in Kolkata high and exceeds the national standard. As part of DPR preparation of KEIP a noise level survey was carried out in the seventeen wards during day time (ref. Table 18). Average noise level in typical residential areas away from the busy streets varies between 47.9 to 66.9 dBA with only 22% of the measurement sites have noise level conforming to the prescribed noise level of 55 dBA (residential area; day time). Noise level near busy roads of the area expectedly have relatively high but variable noise level depending on the density of vehicle moving on the roads at the time of measurements. The range of measured noise levels was between 58.7 and 88.7 with more than 85% of the measurements show a value above 70 dBA. The measurement sites included some roads in front of school/college/hospital.

Table 18: Noise level measurement within seventeen wards in Borough XI-XV

Sl. No.	Ward	Location	Landuse	Mean noise level in db(A)
1	108	Martin Para	Residential area	58.1
			Busy road	83.3
		Dr B R Ambedkar School	Busy road near school	78.0
2	109	R N Tagore Hospital	Busy road near hospital	71.5
		Netaji Nagar	Busy road side	81.8
			Residential area	56.1
3	110	Andrews College	Busy road near college	77.8
		BRWS Hospital	Busy road near hospital	61.2
		Sreerampur road	Busy road	82.4
			Residential area	66.7
4	111	Satindra Palli	Residential area	56.2
			Busy road	74.3
5	112	Rishi Rajnarayan Road	Residential area	63.0
			Busy road	81.6
6	113	Niranjan Palli	Residential area	59.7
			Busy road	72.9
7	114	Purba Putiary	Busy road near school	73.3
			Busy road	88.7
			Residential area	62.5
8	115	Paschim Putiary Road	Busy road	70.3
			Residential area	51.4
				55.2
9	122	Ustad Amir Khan Sarani	Residential area	61.3
			Busy road	79.5
10	123	Santal Palli	Busy road	74.2
			Residential area	57.0
11	124	Purba Para Road	Residential area	66.9
			Busy road	77.7
12	125	Subodh Kr Mukherjee Road	Busy road	58.7
			Residential area	49.8
13	126	Sabarna {ara Road	Busy road	81.9
			Residential area	47.9
14	127	Nanda Gopal Mukherjee Road	Busy road	80.3
			Residential area	62.5
15	139	Halder Para	Busy road	79.3
			Residential area	61.3
		Parchur College	Inside college	78.0
			Busy road in front of college	80.9
16	140	Mullick Para Lane	Residential area	56.4
			Busy road	70.8
17	141	Bagdi Para	Residential area	52.7
			Road side	61.9

63. Ambient noise level monitoring was carried out in the two subproject area and the results are reproduced in Tables 19 and 20 below. The day and night Leq level is around 70 dBA in Garden Reach area in most monitoring sites whereas it is generally below 70 dBA in Palta area.

Table 19 : Noise level in Garden Reach area

Station No.	Location	Date and time	Minimum dB(A)	Maximum dB(A)	Leq dB(A)
N1	Santoshpur new road 1 No. railway gate	20.10.2011 (day time)	68.5	73.9	71.89
		20.10.2011 (Night time)	63.7	70.2	67.89
N2	Santoshpur Panchadeep Market	20.10.2011 (day time)	67.9	78.5	74.26
		20.10.2011 (Night time)	64.2	72.1	70.18
N3	Near Brace Bridge Railway Station	20.10.2011 (day time)	78.5	85.3	80.16
		20.10.2011 (Night time)	61.2	73.8	69.18
N4	Near State Bus Terminal	20.10.2011 (day time)	78.3	85.4	81.10
		20.10.2011 (Night time)	63.8	78.9	70.18
N5	Near Water Works Main Gate	20.10.2011 (day time)	68.3	75.3	72.36
		20.10.2011 (Night time)	58.7	68.5	65.89
N6	Near Philips Main Gate	20.10.2011 (day time)	72.1	84.2	79.89
		20.10.2011 (Night time)	61.8	70.2	67.89
N7	Near Nature Park	20.10.2011 (day time)	69.9	84.3	80.68
		20.10.2011 (Night time)	58.7	67.8	64.18
N8	Garden Reach Water Works Pump Room	20.10.2011 (day time)	64.3	75.5	71.30
		20.10.2011 (Night time)	62.7	72.8	69.50
N9	Near Gas Factory Main Gate	20.10.2011 (day time)	70.4	76.8	74.78
		20.10.2011 (Night time)	63.7	69.2	66.18
N10	Near Garden Reach Pumping Station	20.10.2011 (day time)	58.1	68.5	63.78
		20.10.2011 (Night time)	53.2	67.5	62.89

Table 20 : Noise level in Palta area

Station No.	Location	Date and time	Minimum dB(A)	Maximum dB(A)	Leq dB(A)
N25	Badamtala	28.10.2011 (day time)	58.1	62.7	60.58
		28.10.2011 (Night time)	41.7	56.8	48.10
N26	Near Indragandhi Water Treatment Plant	28.10.2011 (day time)	61.2	64.5	63.15
		28.10.2011 (Night time)	42.8	51.8	48.67
N27	Near Airforce Gate	28.10.2011 (day time)	62.7	72.5	68.5
		28.10.2011 (Night time)	53.8	68.7	64.18
N28	Ghusipara road side	28.10.2011 (day time)	62.8	70.6	68.10
		28.10.2011 (Night time)	56.1	62.8	58.48

Station No.	Location	Date and time	Minimum dB(A)	Maximum dB(A)	Leq dB(A)
N29	Palta Air Port	28.10.2011 (day time)	63.7	76.1	70.89
		28.10.2011 (Night time)	56.2	67.8	64.18
N30	Prasasanik Bhawan	28.10.2011 (day time)	56.1	63.8	60.50
		28.10.2011 (Night time)	43.8	60.5	51.67
N31	Modern School	28.10.2011 (day time)	62.5	70.1	67.10
		28.10.2011 (Night time)	52.6	61.5	58.78
N32	B.N.Bose Hospital	28.10.2011 (day time)	61.5	68.6	67.10
		28.10.2011 (Night time)	53.1	60.8	57.18

B. Ecological Resources

64. **East Kolkata Wetlands.** The East Kolkata Wetlands (EKW), located on the eastern fringes of Kolkata city, is a part of the extensive inter-distributory wetland regimes formed by the Gangetic delta. The total area is 12,500 ha. Only a small part of KMC area falls within the limits of EKW. The EKW area includes one of the largest assemblages of sewage fed fish ponds. The importance of this wetland lies in the fact that these sustain the world's largest and oldest integrated resource recovery practice based on a combination of agriculture and aquaculture, and provide livelihood support to a large, economically underprivileged population of around 27,000 families which depend upon various wetland products, primarily fish and vegetables for sustenance. Based on its immense ecological and socio cultural importance, the Government of India, declared East Kolkata Wetlands as Wetland of International Importance under Ramsar Convention in 2002. EKW is a classical example of harnessing natural resources of the wetland system for fisheries and agriculture through ingenuity of local communities with their traditional knowledge. The wetland has been included by the Ramsar Convention as one of the 17 case studies on wise use of wetlands at the global level. The wetland provides strong arguments for integration of traditional knowledge of local communities into conservation and management practices. More than 1000 MLD of untreated sewage from Kolkata are discharged in to the fisheries of EKW for natural treatment in the fish ponds.

65. The ecology of the EKW area has undergone a dramatic change since the beginning of the 19th century due to cessation of tidal (brackish water) influx from Bidyadhari and Matla rivers in to the then saline marshy area with brackish water fisheries. The change is not only due to natural causes like siltation but also due to developmental activities and hydrological interventions. The brackish water fisheries of earlier years were converted in to sewage fed fisheries bringing in a changed ecosystem and establishing a new biodiversity in the EKW areas.

66. There is no forest patch within EKW. There are no endangered species but there are a number of rare mammals, reptiles, fish and bird species. According to the Ramsar information database, there are rare mammals such as Marsh mongoose, small Indian mongoose, Palm civet and small Indian civet which are significant in and around the EKW.

67. The representative aquatic flora and fauna of the EKW are listed in Tables 21 and Table 22 respectively.

Table 21 : Representative Aquatic Flora of the EKW

Type of flora	Species
Free floating forms	<i>Eichhornia sp., Spirodella sp., Pistia sp., Ceratophyllum/Utricularia sp., Axolla sp.,</i>
Fixed anchored forms	<i>Vallisneria sp., Hydrilla sp., Najas sp., Nymphaea sp., Nymphoides sp</i>
Emergent amphibious forms	<i>Marsilea sp., Impomoea sp., Enhydra sp., Colocasia sp.,</i>
Facultative forms	<i>Typha sp., Cyperus sp.,</i>
Algal forms	<i>Synandra sp., Spirogyra sp., Zygnema sp., Nitelea sp.,</i>

Source: Utilization scenario of Kolkata Wetlands (1996) 2. Urban Ecology, Ghosh A.K 1988.

Table 22: Representative Fauna of the EKW

Type of Fauna	Species
Waterfowl	<i>Phalacrocorax niger, Ardeola gravii; Babulcus ibis; Egretta garzatta</i>
Waders	<i>Tringa hypoleucos; Calibris minuta</i>
Kingfisher	<i>Ceryle rudies; Alcedo athhis; Pelargopsis capensis; Halcyon Smyrnesis</i>
Aquatic reptiles	<i>Lissemys punctata, Enhydris enhydris, xenochrophis piscator</i>
Amphibians	<i>Rana cyanophyctis; Rana tigerina, Rana limnocharis, Microphyla ornata; Bufo melanostictus</i>
Fish	<i>Catla catla; Labeo rohita; L.calbasu; L.bata; Cirrhinus mrigala, Hypophthalmich thysmolitrix, Microvertebrates Puntius sarana, P.ticto, Amblypharygodon mola; etc.</i>
Mollusca	<i>Bellamyia bengalensis; Pila globosa; Diagnostoma sp., Lymnea sp., Gyrulus sp., Thiara sp., etc.</i>
Annelida	<i>Oligochaeta; Brachuria; Limno drilus sp., Hirudines – Glassophonina sp.,</i>
Insecta	<i>Hemiptera : Anisops sp., Limnogonus sp., Plea sp., Hydrometra sp., Micronecta sp.,</i>

Source: Utilization scenario of Kolkata Wetlands (1996) 2. Urban Ecology, Ghosh A.K 1988.

68. **Vegetation.** The Kolkata region, except a small part that is falling in East Kolkata Wetlands to the east is in a region of moist tropical deciduous vegetation with fresh water aquatic plants. Because of the continuous expansion of human habitation and heavy population pressure, the nature of the vegetation is rapidly changing and there are fewer herbaceous plants in some parts of the area. The few undisturbed areas along canal banks, road sides and small orchards within the residential area offer more varied vegetation. There is no demarcated forest.

69. Ward-wise rapid ecological survey carried out in connection with the Detailed Project Report (DPR) preparation of investment program indicates that road side plantation in the semi-urban to semi-rural wards 109, 110, 111, 126, 127, 139, 140 and 141 is characterized predominantly by Subabul (*Leucaena glauca*), Kadam (*Anthocephalus cadamba*), Bilaiti babul (*Pithecellobium dulce*), Krishnachura (*Caesalpinia pulcherrima*) etc. In the semi-urban ward 112 the road side plantation species are mainly Kadam (*Anthocephalus cadamba*), Chatim (*Alstonia schoparis*), etc. The urbanized wards 113, 114, 115, 122, 123, 124 and 125 have road side plantation with main species like Subabul (*Leucaena glauca*), Krishnachura (*Caesalpinia pulcherrima*), Bot (*Ficus benghalensis*), Ashwatha (*Ficus religiosa*), Kadam (*Anthocephalus cadamba*), Simul (*Bombax ceiba*), Baash (*Bambusa arundinaceae*), etc. Private plantation within residential area include different types of fruit, ornamental trees, flowering plants, etc., the main species being Mango (*Mangifera indica*), Kanch kala (*Musa paradisiaca*), Coconut (*Cocos nucifera*), Supari (*Areca catechu*), Rangan (*Ixora chinensis*), Kolkey phul (*Thevetia peruviana*), Kamini (*Murraya exotica*), Jaba (*Hibiscus rosasinensis*), Bel (*Aejle marmelos*), Mussaenda (*Mussaenda phillipica*), Nim (*Azadirachta indica*), Tentul (*Tamarindus indica*) etc.

70. **Wildlife.** Common jungle cats, foxes (*Vulpes bengalensis*), house rats (*Rattus rattus*), and mice (*Mus muscatus*), kingfisher (*Alcedo sp.*) are present. Of the reptiles, garden lizards (*Calotes versicolor*), snakes (*Natrix sp., Viper sp.*), and kraits (*Bungarus caeruleus*) are common. The bird life includes house crows (*Acridotheres tristis*), house sparrows (*Paser domesticus*), and pigeons (*Coluamba livia*). Amphibians such as Indian bullfrogs (*Rana tigrina*), annelids such as earthworms (*Eisenia foetida*), and arthropods such as cockroaches

(*Periplanata americana*), butterflies and ants (*Tapinoma sessile*) are common. There are no endangered faunal species in the subproject area.

71. **Aquatic Flora and Fauna.** The following is a list of aquatic ecology of water bodies (other than Hooghly river) present in the southern part of KMC: anchored and free floating and submerged hydrophytes like Kachuri pana (*Eichhornia crassipes*), Azolla (*Azolla pinnata*), Sagittaria (*Sagittaria sp.*), Hogla (*Typha angustifolia*) etc can be seen in the many open waterbodies, which often contain fishes such as Rohu (*Labeo rohita*), Catla (*Catla catla*), and Bata (*Labeo bata*). Phytoplankton like *Spirogyra sp.*, *Zygnema sp.*, *Navicula sp.*, *Nostoc sp.*, *Hydrodistyom sp.*, etc and zooplankton like *Cyclops sp.*, *Paramecium sp.*, *Euglena sp.*, *Diaptomus sp.*, larvae of *Culex sp.* etc are ubiquitous.

72. The aquatic ecology of Hooghly river is not known precisely. However, it is known that pollution-resistant species of phytoplankton and zooplankton dominates. The fish resources include the ubiquitous Hilsa.

73. Under present Tranche 1 limited aquatic ecological survey was carried out in Hooghly river near Palta and Garden Reach areas during November-December, 2011 at the following locations:

- (i) Dhobi Ghat (Palta) - (AW1)
- (ii) Mangal Pandey Ghat (Palta) - (AW2)
- (iii) Budge Budge Ferry Ghat (Near Budge Budge Station) –Garden Reach; (AW3)
- (iv) Charial Bazar Ghat (Near Budge Budge Police Station) – Garden Reach - (AW4)
- (v) Pujali Ferry Ghat (Near Pujali Guest House) – Garden Reach - (AW5)
- (vi) New Raw Water intake jetty (Near CESC Southern Generating Station) – Garden Reach - (AW6)
- (vii) Old Raw Water intake jetty (Near CESC Southern Generating Station) – Garden Reach - (AW7)
- (viii) Bichali Ghat (Near CESC Southern Generating Station) – Garden Reach - (AW8)

74. The data are given in the Tables 23, 24, 25 and 26.

Table 23 : Phytoplankton Spectrum In Water Bodies During High Tide

	Phytoplankton Species	Sampling Station [plankton count x 10 ³ /m ³]							
		AW 1	AW2	AW3	AW4	AW5	AW6	AW7	AW8
1.	<i>Melosira sp.</i>	0.9	1.3	1.2	1.4	1.6	1.3	1.8	1.1
2.	<i>Spirogyra sp.</i>	1.7	1.2	1.6	1.5	1.3	1.9	1.2	0.8
3.	<i>Microcystis sp.</i>	1.2	0.8	1.8	1.7	1.4	1.1	1.4	1.3
4.	<i>Anabaena sp.</i>	0.6	0.3	0.9	1.1	1.6	0.8	1.5	0.9
5.	<i>Nitzschia sp.</i>	1.6	1.1	1.7	2.1	2.3	1.7	2.2	1.9
6.	<i>Tetraedron sp.</i>	1.4	1.2	1.6	1.9	1.8	1.9	1.8	2.3
7.	<i>Oscillatoria sp.,</i>	1.8	1.7	2.1	2.5	2.7	1.8	2.8	2.1
8.	<i>Spirulina sp.</i>	2.1	2.1	2.6	2.1	2.4	0.8	2.5	1.6
9.	<i>Euglena sp.</i>	1.3	1.1	1.4	1.8	1.7	0.6	1.8	0.8
10.	<i>Eudorina sp.</i>	1.4	0.8	1.7	1.9	2.0	1.2	2.0	1.8
N = Total Plankton Count X 10³/m³		14.0	11.6	16.6	18.0	18.8	13.10	19.00	14.60
H = Shannon-Weaver Index		2.25	2.21	2.27	2.28	2.28	2.23	2.27	2.30

Table – 24 :Phytoplankton Spectrum In Water Bodies During Low Tide

	Phytoplankton Species	Sampling Station [plankton count x 10 ³ /m ³]							
		AW1	AW2	AW3	AW4	AW5	AW6	AW7	AW8
1.	<i>Melosira sp.</i>	0.3	0.9	1.0	0.9	1.5	1.5	1.9	1.6
2.	<i>Spirogyra sp.</i>	0.8	0.8	0.9	0.8	1.1	1.0	0.8	1.1
3.	<i>Microcystis sp.</i>	0.9	0.3	1.2	1.1	0.8	0.8	0.9	1.0
4.	<i>Anabaena sp.</i>	-	-	0.3	0.3	0.2	0.2	0.2	0.3
5.	<i>Nitzschia sp.</i>	0.8	0.5	1.2	1.3	0.4	0.5	1.5	0.6
6.	<i>Tetraedron sp.</i>	1.0	0.8	0.9	1.7	1.8	1.7	1.7	1.8
7.	<i>Oscillatoria sp.,</i>	1.1	1.3	1.2	1.8	2.1	2.0	2.2	2.1
8.	<i>Spirulina sp.</i>	1.3	1.8	1.3	1.6	1.9	1.8	1.0	1.7
9.	<i>Euglena sp.</i>	0.8	1.3	1.1	1.3	1.5	1.5	1.2	1.4
10.	<i>Eudorina sp.</i>	0.3	0.4	1.3	1.2	1.3	1.4	1.2	1.3
N = Total Plankton Count X 10³/m³		7.3	8.1	10.4	12.0	12.6	12.40	12.60	12.90
H = Shannon-Weaver Index		2.11	2.06	2.25	2.23	2.17	2.18	2.19	2.20

Table – 25 : Zooplankton Spectrum In Water Bodies (Number/M³) During High Tide

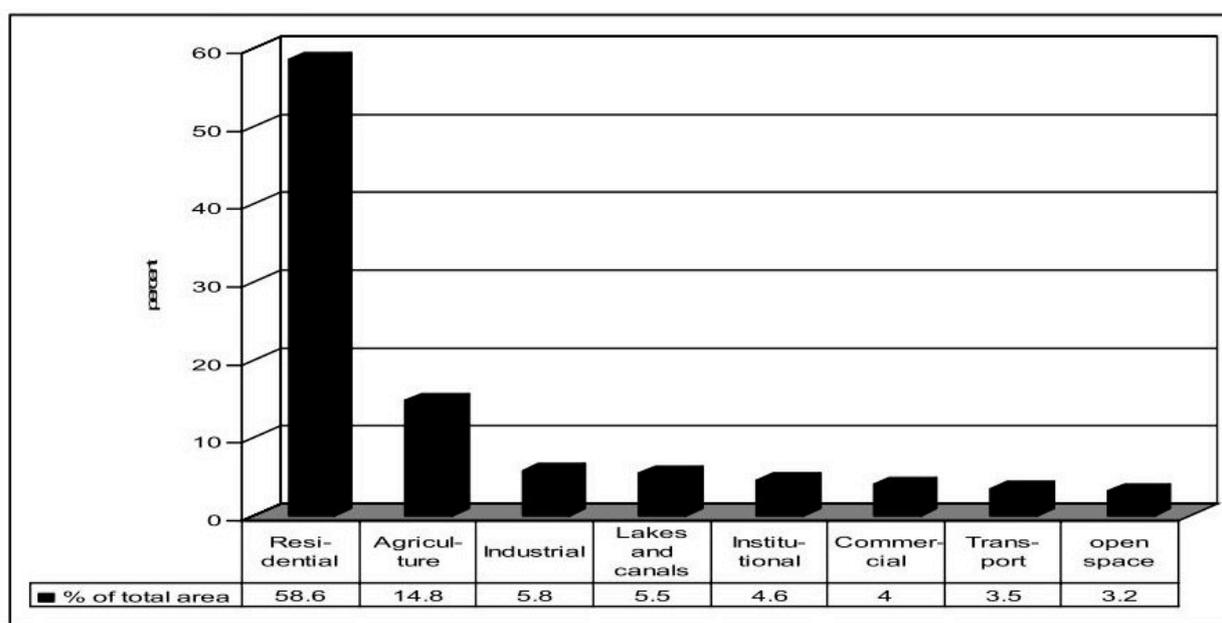
I	Zooplankton species	Sampling Station [plankton count x 10 ³ /m ³]							
		AW1	AW2	AW3	AW4	AW5	AW6	AW7	AW8
I Cladocera									
1	<i>Diaphanosoma sp.</i>	130	90	210	190	320	125	80	215
2	<i>Moina.sp</i>	400	370	470	380	480	350	380	412
II Copepoda									
3	<i>Acartiella sp</i>	230	210	280	470	480	225	223	260
4	Diaptomus	300	290	430	550	580	320	280	318
5	<i>Pseudodiaptomus sp</i>	60	60	150	140	270	65	72	120
6	<i>Cyclopina sp</i>	80	70	130	180	140	90	315	135
III Nauplia									
7	<i>Lamellibranchs</i>	350	330	450	480	370	326	290	415
IV Miscellaneous									
8	<i>Lucifer sp</i>	320	280	370	310	280	290	310	350
N = Total Plankton Count X 10³/m³		1870	1700	2490	2700	2920	1791	1950	2225
H = Shannon-Weaver Index		1.92	1.91	1.99	1.98	2.00	1.94	1.96	1.99

Table 26 : Zooplankton Spectrum In Water Bodies (Number/M³) During Low Tide

	Zooplankton species	Sampling Station [plankton count x 10 ³ /m ³]							
		AW1	AW2	AW3	AW4	AW5	AW6	AW7	AW8
I Cladocera									
1	<i>Diaphanosoma sp.</i>	80	70	130	90	120	90	72	185
2	<i>Moina.sp</i>	370	360	370	240	340	310	352	240
II Copepoda									
3	<i>Acartiella sp</i>	190	180	180	260	260	212	180	235
4	Diaptomus	280	270	300	310	380	285	260	280
5	<i>Pseudodiaptomus sp</i>	60	50	120	90	190	52	60	112
6	<i>Cyclopina sp</i>	60	70	80	110	80	81	280	120
III Nauplia									
7	<i>Lamellibranchs</i>	300	280	350	260	350	280	265	370
IV Miscellaneous									
8	<i>Lucifer sp</i>	290	270	170	310	170	260	290	326
N = Total Plankton Count X 10³/m³		1630	1550	1700	1670	1890	1570	1759	1868
H = Shannon-Weaver Index		1.90	1.89	1.95	1.97	1.97	1.93	1.95	2.00

C. Economic Development

75. **Land use.** The metropolitan area of Kolkata has grown from a few small villages to its present status as India's most populous city. The predominant land use in the KMC is residential, as shown in Figure below. However, for most residential areas a more exact description will be mixed use. There are industrial sites throughout the city, in all 15 Boroughs and in 71 of the 141 wards. Urban planning is one of the responsibilities of the KMC. The KMDA also has a role in land planning, with a broader geographic scope than KMC.



76. Land use 3 km around the Palta water works reveals the following (Tranche 1 data) Table 27:

Table 27 : Land Use around Palta Water Works

	Land use/Land cover	Land use type	Mapping symbol	Area in ha	Percentage
1	Settlement	Urban	1	747	43.58
2	Commercial/Industrial area	Commerce/Industry	2	54	3.15
3	Agriculture	Cultivated land	3	5	0.29
4	Plantation and habitation	Plantation around habitation	4	291	16.96
5	Grassland/barren	Grassland/barren	5	20	1.17
7	Water bodies	Pond/tank/river	6	215	12.54
8	Palta water works	Plantation, water bodies and buildings		147	8.58
9	Secured area	Secured area		235	13.71
				1717	100.00

77. Land use 3 km around the Garden Reach water works reveals the following (Tranche 1 data) Table 28:

Table 28 : Land Use around Garden Reach Water Works

	Land use/Land cover	Land use type	Mapping symbol	Area in ha	Percentage
1	Settlement	Urban	1	1,629	95.04
2	Commercial/Industrial area	Commerce/Industry	2	30	1.75
3	Agriculture	Cultivated land	3	-	-

	Land use/Land cover	Land use type	Mapping symbol	Area in ha	Percentage
4	Plantation and habitation	Plantation around habitation	4	6	0.35
5	Grassland/barren	Grassland/barren	5	34	1.98
7	Water bodies	Pond/tank/river	6	4	0.23
8	Garden Reach water works	Plantation, water bodies and buildings		1	0.07
9	Nature Park	Plantation and grass Secured area		10	0.58
				1714	100.00

78. **Commerce and industry.** Kolkata is a service center rather than an industrial center. As shown on Figure below, the proportion of the population working in industry is similar to the India urban average, but below that of the rest of urban West Bengal.

79. Industrial growth has been accelerating in West Bengal the introduction of the New Economic Policy (1992), the average annual growth of industrial production has moved up to 5.05%. While the organized industries are located in Cossipore area (Borough I), small scale industries as lead recycling, tanneries etc. are located in the Tiljala/Topsia area (Borough VII). It may be noted that all the tanneries are being relocated to a specially designated site at Karaidanga about 25 km away with all environmental safeguards. Only green i.e. non-polluting industries are permitted to be set up in KMC area. Permission from WBPCB is mandatory for discharging of waste in to municipal sewer or land or inland surface water body. For discharge to municipal sewer, industries must treat the effluent to the acceptable discharge limit as prescribed. Port related industries such as oil handling facilities etc. are found in the Garden Reach area viz Borough XV.

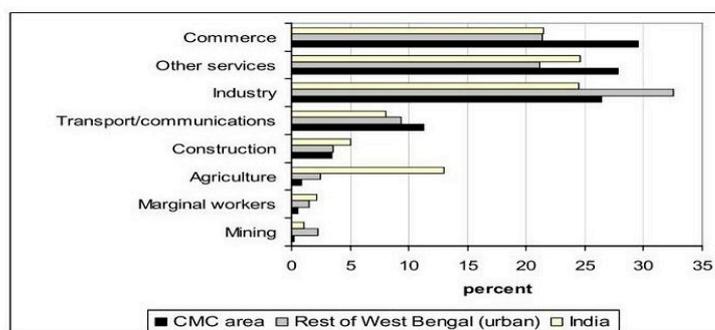


Figure 3.8

80. **Water supply.** The water supply system of Kolkata is very old, operated from 1865. Present average per capita supply is 134 lpcd, which is very near to desired supply of 150 lpcd (for metropolitan cities). But the supply is very uneven, ranging from 310 lpcd to 40 lpcd. Unaccounted for water (UFW) is 40%. Average supply period is 8 hours a day. Residual pressure is very low. The average terminal pressure at consumer end is around 2.5 m of water head. In some areas it ranges around 0.5 m-1.0 m of water head. About 10% of supply in Kolkata is from ground water. The source is affected by arsenic in some locations and TDS and Fe values are often above permissible values. From quality and health point of view the ground water source needs to be replaced. Coverage by piped water supply is 92% which is nearing 100%. But the rest 8% is near the periphery of the study area, and far from surface water source. Hence the service is far from desired level. The two main water works are Palta and Garden Reach.

81. Major heavy metal analysis of sludge samples from the WTPs as given in Table 29 indicates that they are non-hazardous when compared with the limits set in the relevant national rule.

Table 29 : Heavy metal content of sludge from WTP

Date of sampling	Parameters	Results (mg./kg)					
		SL-1	SL-2	SL-3	SL-4	SL-5	Standard
		Garden Reach Sludge Pond (North Side)	Garden Reach Sludge Pond (South Side)	Garden Reach Sludge Pond (West Side)	Palta Sludge Pond (Main Entrance)	Palta Sludge Pond (Final Discharge)	
20.10.11	Arsenic (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0	50
	Lead (mg/kg)	4.5	5.2	4.8	3.2	3.6	5000
	Chromium (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0	50
	Cadmium (mg/kg)	1.5	1.85	1.8	1.6	1.6	50
	Mercury (mg/kg)	<0.01	<0.01	<0.01	<0.01	<0.01	50

82. **Transportation.** The Kolkata's transportation system is multi-modal and highly heterogeneous. Public transportation comprises everything from human-powered rickshaws to a subway system. Main thoroughfares in Kolkata are crowded with taxis, buses, two-wheelers, three-wheelers, hawkers, and a myriad of pedestrians all vying for limited space on the streets.

83. **Electrical Power.** Power supply in Kolkata dates back to 1898, when Calcutta Electric Supply Corporation was formed for generation, transmission and distribution of electrical energy in and around the city of Kolkata. From about 100 kw demand in 1898, the system has grown to about 1200 MW in 1998. Apart from its own generation, CESC Limited, presently a licensee of WBSEB, purchases power from the latter and also from Damodar Valley Corporation (DVC). The generating stations that operate in Kolkata area are: Mulajore, capacity 150 MW, New Cossipore 160 MW, Titagarh 240 MW, Southern 135 MW, and Budge-budge 250 MW. In addition, 300-400 MW of power is supplied by West Bengal State Power Development Corporation and Damodar Valley Corporation. All these power plants are coal-based.

84. **Sanitation and Sewerage.** In the core city area all properties, except the slums, are directly connected to the underground sewer network, meaning a total number of 358,750 households directly connected which is equivalent to 75% of all households in the core city area. The slum areas are in general served by communal toilets connected to septic tanks. In the outer areas served by KEIP a total number of 70,000 house connections would be constructed once the project is finalized in June 2012. This means a coverage of 22% of the total population in the KEIP areas. In the outer areas not yet served house connections to underground sewers don't exist by lack of any underground sewer system, meaning 0% coverage. This brings the average total for the entire KMC area at 44% as compared to the national target level of 100% but nevertheless it is way above the national average of 28%.

85. According to the 2001 Census 96% of the KMC population has access to individual or community toilets within walking distance in the service area. This compares favorably with the national average of 82% and is near the national benchmark of 100%. Most of the KMC slum areas are provided with communal toilet facilities within walking distance. Only 4% of the KMC population has no sanitation facilities and uses gutters, open drains, channels or vacant land for sanitation. This is mostly in the urban fringe areas where population densities are still relatively low. The 2011 Census results in this respect are not yet available but it is likely that the percentage of the population without toilets would further decrease over the years.

86. The collection efficiency of sewage is 71%, which is higher than the percentage of people with direct sewer connections because it also includes sewage collected through the interceptor sewer system. The collection efficiency is around 90% in the core city area as

well as in the KEIP areas. The remaining outer areas have no formal sewer system yet and collection is zero.

87. The treatment capacity of the existing treatment plants and the East Kolkata Wetlands (EKW) is sufficient to serve the entire central city (100%) and the KEIP areas (100%). The total average for KMC is 88% because the outer areas not yet served by KEIP generate 12% of the waste water for the entire KMC. The effluent quality at the outlets of the East Kolkata Wetlands and the existing treatment plants fully comply with national norms.

88. The extent of re-use is very high because 90% of all sewage from KMC ends up in the fisheries of the EKW where it serves as quality food for the fisheries. Effluent from other treatment facilities is partially re-used for agricultural purposes before it finally discharges into the Hooghly River. On average 93% of waste water generated in KMC is re-used, comparing very favourable to the national target of 20%.

89. **Solid Waste Management.** The solid waste management system consists of three main components: Collection, Transportation and Disposal.

90. The majority (90%) of collection is done by KMC and 10% is contracted out to private contractors. House-to-house (doorstep) collection has been introduced in 75% of the KMC area. Other areas are served by street sweepers who operate manually. Many roads are too narrow to allow access for motorized collection vehicles. Primary collection is mostly by open hand carts and delivery at secondary collection sites (vats). There are 694 such collection points – 392 open vats and 302 bulk containers or direct loading. Open vats are generally poorly managed with spillage of disposed waste from the bulk containers or from open vat boundaries creating in most cases an unhygienic environment. In 2011 source segregation has been introduced as a pilot project in 7 wards.

91. In 2011 75% of the KMC area is served by a door-to-door collection system and 25% by street sweeping. This compares favorably to the national average of 51% but is still far below the 100% benchmark target. In the core city area 80% of the population is served by door-to-door collection. In the outer areas this is less (60% - 70%). Collection frequency also differs. The central city and most of the surrounding outer areas are served daily, but some of the lower density fringe areas are only served once or twice per week.

92. KMC estimates that only 3% of waste generated is not collected but (illegally) disposed in channels, vacant land and used for infill, meaning that collection efficiency is close to the national benchmark target of 100%.

93. In 2011 source segregation has been introduced as a pilot project in 7 wards (33, 47, 64, 103, 110, 115 and 130) covering only 4.4 % of the KMC population. Informal segregation takes place at all stages of waste processing. Status baseline 2011 is 13% recycling and 7% composting making a total of 20%. Compared to the national target benchmark of 80% KMC still has a long way to go. In the central city area the level of waste recovery is higher (22%) than in the outer urban areas (15%). Recycling is mainly practiced informally by rag pickers. The privately operated composting plant at Dhapa processes 300 tonnes of biodegradable waste per day, mainly collected from markets.

94. From secondary collection sites the waste is transported in trucks to the final disposal site. KMC transports 30% of waste, while 70% of solid waste transportation is contracted out to the private sector. Private contractors mostly use open trucks with a tarpaulin covering the waste. They make about 600 trips per day carrying an average of about 5.5 MT per trip. The remaining 30% of the total collected waste is transported by municipal vehicles making about 315 daily trips carrying on average about 3.5-4.9 MT per trip. KMC has 125 tipper trucks and 137 dumper placers, 15 tractor trailers, 17 wheel loaders and 12 mechanical

sweepers, 32 street sweeping/washing vehicles and 8 wrecker vans daily in operation. KMC has eight garages where transportation vehicles are stationed. Major vat points that accommodate garbage more than 30 MT are serviced from Dhapa garage with Pay loaders and 11 m³ capacity Tipper Trucks. Other vats are serviced by manual loading vehicles and Dumper placers. The street washing vehicles clean major thoroughfares every day. Three of the refuse collector vehicles are engaged for cleaning wastes from 300 trash bins along sixteen major roads.

95. KMC has two waste disposal sites. The Garden Reach dumping ground is a small facility with little remaining capacity. It receives currently about 10 MT/day of waste mainly from borough XV nearby. The main dumping ground is at Dhapa in the east of KMC at approximately 8 km from the city centre. This dump site is nearing its maximum capacity and has been authorized by West Bengal Pollution Control Board to operate for one more year only. It received an average of 4286 MT/day solid waste in 2011 out of which 300 MT/day was diverted to the privately operated Dhapa composting plant.

96. The extent of scientific disposal of solid waste is currently zero and should become 100% in accordance with the national benchmark target. Both the Dhapa and the Garden Reach dump site are not operated as sanitary landfill in accordance with national standards. There is no formal leachate treatment, no proper soil cover and informal, unorganized rag pickers operate at the sites. KMC has an interim permit from WBPCB to operate the Dhapa landfill facility for one year.

97. West Bengal has one Common Hazardous Waste Treatment, Storage and Disposal Facility (CHWTSDF) at Haldia (about 100 km south of Kolkata) that commenced operations in 2005. The facility was jointly developed by the Haldia Development Authority and the Hyderabad based private company, M/s Ramky Enviro Engineers Ltd. who formed a joint venture company named M/s West Bengal Waste Management limited (WBWML) for the development and operation of the facility. The CHWTSDF at Haldia operated by M/s WBWML has completed almost four years of successful operation. The facility caters to units in the entire state of West Bengal. As on March 2009, the membership strength of the unit was 466 and it increased to 528 in March 2010. The first cell of the landfill which was initially built over 1.99 acres was later extended over 2.92 acre. Further expansion by construction of another cell over 2.64 acres has been undertaken recently. Till March 2009, 64594.431 MT of hazardous waste had been disposed in the landfill and the quantity rose to 93215.059 MT in March 2010.

D. Social and Cultural Resources

98. **Communities and Population.** The population of the KMC area is 4.45 million with a growth rate -1.93% (2001 to 2011). Approximately one third (32%) of the KMC population lives in bustees and substandard housing. The Project team prepared population projections to 2022 based on the using previous census data of 2001, 1991 and 1981. These projections show a declining population trend for the KMC area, increasing from 4.38 million in 1991 to 4.56 million in 2022. This hike will indicate a general growth of population in the south and south-eastern part of Kolkata which has a tremendous growth potential.

99. **Institutions.** A number of institutions are present in the KMC area and may have a role in the Project's development. These can be classified in to several categories, as follows: government administration and services, police and security, urban development, and environmental protection.

100. **Government administration and services.** . The agency with the most important role in the Project is KMC. Municipal administration in Kolkata dates from 1727. The functions of the first Corporation were then limited to provision of local roads and drainage

and conservancy service. The present system of municipal government has come through an evolutionary process over a long period, resulting in KMC being assigned the responsibility for the following services: regulation of land use; regulation of construction of buildings; planning for economic and social development; roads and bridges; water supply; public health, sanitation, conservancy and solid waste management; urban forestry, protection of the environment and promotion of ecological aspects; safeguarding interests of weaker sections of society, including the handicapped; slum improvement; urban poverty alleviation; provision of urban amenities such as parks gardens, playgrounds; promotion of cultural, educational and aesthetic aspects; burials and burial grounds, cremation and cremation grounds; cattle grounds, prevention of cruelty to animals; vital statistics including registration of births and deaths; public amenities including street lighting, parking lots, bus stops and public conveyance; and regulation of slaughterhouses and tanneries.

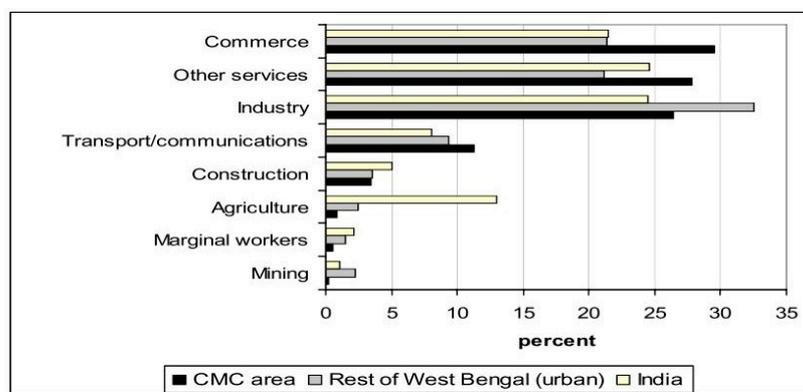
101. **Environmental protection.** The WBPCB has the overall responsibility to set policy and standards for the protection of the environment, following the lead of the Central Pollution Control Board. This includes air, noise, hazardous waste, and water quality standards, and the requirement for the preparation of EIAs. The WBPCB also carries out water and air quality monitoring, and might be involved in the environmental quality monitoring program that will be a part of this project. No designated protected area lies within 10 km radius of the water supply subproject sites. Kolkata does not fall under the Coastal Regulation Zone (CRZ).

102. **Education.** The population of is fairly literate, around 90% of males and females being literate. School enrollment is moderately for all segments of the population. 85% of males and 80% of females report at least a primary school education. 27% of the population has completed secondary school and 9% have graduated from college.

103. **Religion.** About 80% of the residents of KMC are Hindus. Most belong to general castes (84%), with the balance belonging to scheduled caste or scheduled tribes. There are significant concentrations of Muslims in the bustees.

104. **Languages.** The mother tongue reported by 74% of the population is Bengali, with Hindi and Urdu represented by 14% and 12% of the population respectively. Interestingly, those living in standard residential housing report 91% Bengali, while those in sub-standard housing reporting only 58% Bengali and 25% Hindi.

105. **Occupation.** About 6% of households report unemployment: 5% for those living in standard residential areas and 7% for those in bustees and refugee colonies. Of those employed, there is a broad variety of employment types, with no single category predominant over others.



106. **Education, Health and Health Care Facilities.** A survey in 2009 in Boroughs XI-XV indicated that there are more than 150 government and private educational institutes within the Boroughs. The list includes primary, secondary and higher secondary schools, degree colleges, technical and professional institutes. A number of reputed institutions has recently been established in ward 108. Public health varies according to socio-economic level and location. As of 2008, there are more than forty health centers, government hospitals/dispensaries, private hospitals and nursing homes within the study area. Mention may be made of Ruby General Hospital (ward 108), Manovikash Kendra (ward 108), R N Tagore International Institute for Cardiac Sciences (ward 109), Peerless Hospital and B K Roy Research Centre (ward 109) and Thakurpukur Cancer Hospital (ward 124). Health care facilities appear to be on the low side in wards 112, 113 and 122. Malaria is seasonally prevalent. Cardio-vascular diseases are increasingly prevalent among people over 40, while waterborne diseases such as gastrointestinal diseases are common among children less than 15 years of age.

107. **Aesthetic Resources.** Kolkata's main aesthetic resources consist of her historic buildings and many small lakes and other water bodies. Both of these resources are recognized as being in need of restoration, and a number of efforts are under way to accomplish this. Foreign tourism is not yet a well-developed industry in Kolkata, and there are opportunities for making tourism a profitable industry while still conserving the urban beauty of the area. The subproject area is not within tourist destinations.

108. **Cultural Resources.** The buildings of north Kolkata reflect the traditional culture of the zamindar and rajas, whereas the structures in central Kolkata reflect the British colonial style. The buildings and churches in this area are around 50 to 100 years old. Most of the archaeological monuments are maintained either by the Department of Archaeology or by private concerns like Rama Krishna Mission or Trusts. Some of the valuable monuments are: Metcalfe Hall, Gwalior Monument, Victoria Memorial, Shahid Minar, Indian Museum, Cossipore, Club, Town Hall, Tagore's Baitak Khana, Fort William, Vivekananda's house, and Roy's Naroiial – Cossipore. There are also a few monuments at Tollygunge and Kalighat areas

109. As the subproject is concentrated primarily in the added areas of KMC, the project will not hamper any precincts of cultural or historical significance.

110. **Recreational and other facilities.** More than twenty large play grounds are present in Boroughs XI to XV area. There are innumerable temples, maths, mosques and a few churches scattered over the area. Housing complexes with their own recreational areas have come up especially in wards, 108, 109 and 110.

ANTICIPATED IMPACTS AND MITIGATION MEASURES

111. **Methodology.** Issues for consideration have been raised by the following means: (i) input from interested and affected people; (ii) desktop research of information relevant to the proposed subproject; (iii) site visit and professional assessment by environment specialist engaged by the implementing agency; and (iv) evaluation of proposed design scope and potential impacts based on the environment specialist's past experience.

112. The methodology used to rate the impacts was qualitative. Each category was divided into a number of different levels. These levels were then assigned various criteria as indicated in Table 30:

Table 30 : Summary of Quantifiers and Qualifiers Used for Assessment Purposes

Duration (time-scale)	Short-term	Impact restricted to construction (0-18 months).
	Medium-term	Impact will continue throughout operation (after construction-30 years).
	Long-term	Impacts will exist beyond the life of the road (>30 years)
	Permanent	Impacts will have permanent potential
Geographic spatial scale	Site	The impact will be limited to within the site boundaries.
	Local	The impact will affect surrounding areas.
	Regional	The impact will affect areas far beyond the site boundary but limited to the State of West Bengal.
Significance rating before mitigation (positive / negative)	Low	The impact will have a minimal effect on the environment.
	Medium	The impact will result in a measurable deterioration in the environment.
	High	The impact will cause a significant deterioration in the environment.
Mitigation	n/a	No mitigation necessary.
	Full	Full mitigation/reversal of the impact is possible.
	Partial	Only partial mitigation/reversal of the impact is possible
	None	No mitigation or reversal of the impact is possible
Degree of Certainty	Definite	(>90%)
	Possible	(50%)
	Unsure	(<40%)

113. Categorization of the subproject has been undertaken using ADB's REA Checklist for Water Supply (Appendix 5)

A. Planning and Design Phase

114. The subproject will be located in properties held by KMC and through public ROWs and existing roads. Hence land acquisition and encroachment on private property will not be required.

115. The plan and technical design of the subproject are based on the specifications of the Manual on Water Supply and Treatment developed by the Ministry of Urban Development's Central Public Health and Environmental Engineering Organization. Engineering decisions considered the results of the demand-supply gap analysis, area and population to be served, design period, the per capita rate of water supply, other water needs in the area, the nature and location of facilities to be provided, the optimum utilization of the existing WTPs, points of water supply intake and wastewater disposal. Water supply management aims at improving the supply by minimizing losses and wastage and UFW at the transmission mains and distribution system. The salient design features are presented in Table 31.

Table 31 : Design Consideration

Parameter	Design Consideration
Design Period	The subproject is designed to meet the requirements over a 30-year period after

Parameter	Design Consideration
	completion.
Design Population	The forecasted population of 5292815 is estimated with due regard to all the factors governing the future growth and development of KMC until year 2042
Per capita supply ⁸	150 lpcd for 100% of population; the proposed supply will be sustainable taking in to consideration that semi-diurnal tide (two highs and two lows in a 24 hour period) in Hooghly river will always provide sufficient water for the WTP even if the freshet discharge becomes limited during dry season; water of tidal Hooghly river at Palta and Garden Reach is of well mixed type and therefore salinity of raw water will not be a problem
Pressure requirements	The subproject is designed on continuous 24 hours basis to distribute water to consumers at adequate pressure at all points. The minimum residual pressure is 12 m in general (7m in some specific location).
Quality standards	The rehabilitation and refurbishment of the WTPs are designed to ensure that the water supplied is free from pathogenic organisms, clear, palatable and free from undesirable taste and odor, of reasonable temperature, neither corrosive nor scale-forming and free from minerals, industrial pollutants and heavy metals which can produce undesirable physiological effects. quality of drinking water shall be in accordance with the recommended guidelines presented in Tables 2.2 to 2.3 of the CPHEEO Manual.
WTPs	The existing WTPs will be rehabilitated considering ; (i) improvement in performance; and (ii) replacement of outmoded, deteriorated, non-functioning or irreparable equipment and systems. (iii) initiation of proper sludge management
Intake jetties	The existing jetties will be rehabilitated considering (i) withdrawal of water can cope up with seasonal variations of depth of water, (ii) factor of safety to allow forces to be resisted by the intakes, (iii) protection against blows from moving objects, water currents or overturning pressures; and (iv) siltation on the intake structures.and intake (suction) pipe
Alignment of transmission mains	Alignment of the 4.0 km transmission mains is guided by public ROWs and existing road alignment.
Design of the transmission mains	The design velocity considered will eliminate any possibility of siltation and abrasion inside the pipe and will ensure the stipulated discharge capacity.
Pipe materials	The pipe materials considered in the design will ensure durability, life and overall cost which include pipe cost, installation and maintenance costs necessary to ensure the required function and performance of the pipeline throughout its designed life time.
Pipe laying	The transmission mains will be laid using micro-tunneling. Micro-tunneling is a process that uses a remotely controlled Micro-tunnel Boring Machine (MTBM) combined with the pipe jacking technique to directly install the pipelines underground in a single pass. This process avoids the need to have long stretches of open trench for pipe laying.
Wastewater and sludge management	The subproject includes the conduct of a study to improve the current sludge management system. The design of the study will ensure an acceptable arrangement for treatment of water charged sludge leading to plans for the dewatering, disposal/use of the dry sludge and disposal effluent to acceptable water bodies/drains
Unaccounted for water	The subproject includes updating the consumer database, implementing full metering and leak detection, updating the water supply master plan to include comprehensive pressure zoning and upgrading the control system using hydraulic modeling.
Sanitation systems	Improvements on sewerage are being implemented in KEIP Phase 1.
Drainage and hydrology	The subproject has been designed to drain freely in order to prevent standing water on the tunnels and open sites. Pollutants settling on the road surface and litter will be washed off during rain. Runoff from the subproject will produce a highly variable discharge in terms of volume and quality and in most instances will have no discernable environmental impact.
Ecological diversity	The subproject is situated within an existing built up area and no areas of ecological diversity occur within the subproject. Due to the nature and locality of the subproject there is unlikely to any impacts on biodiversity within the area. However the subproject may affect existing roadside trees. Permission will be obtained from the Forest prior to start of civil works. Any landscaping to be undertaken will be done with locally indigenous species and low maintenance requirements.
Land use and livelihoods	The key efforts undertaken to minimize impacts are: (i) before the preparation of engineering design, a detailed survey of the properties of the transmission mains alignment was conducted with regard to their ownership with the objective that

⁸ In Hooghly river the upland flow is negligible during dry seasons compared to semidiurnal peak tidal discharge estimated to be 260,000 (flood) and 109,000 (ebb) cumec at the mouth of the main branch of the estuary. Because of highly confidential nature of freshet discharge data, it could only be said that a maximum of 40000 cusec is available during the driest period. In an official document of KMC mention of discharge data is better to be avoided in respect of Hooghly river

Parameter	Design Consideration
	minimum proprietary land is utilized for the subproject; (ii) diverting the alignment towards the available government land and ROWs to avoid land acquisition; and (iii) use of micro-tunneling, as it is particularly suited for the urban environment where the disruption of business, traffic and other utilities is not acceptable for commercial, political and safety reasons.
Traffic flow and access	Due to the location and nature of the subproject, there will be interference with accesses along the 4.0 km stretch of Taratala – Garden Reach road. A Traffic Management Plan will be developed to provide vehicle and pedestrian access and maintain community linkages. Local communities along the alignment will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signages, etc. The implementation of the road detours will also be dependent on advance road signages indicating the road detour and alternative routes. KMC will coordinate with the traffic police for the implementation of the Traffic Management Plan.
Infrastructure and services	There are a number of existing infrastructure (roads, one railway line, telecommunication lines, power lines and various pipelines along the alignment of the transmission mains. To mitigate the adverse impacts due to relocation of the utilities, PMU will (i) identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) require construction contractors to prepare a contingency plan
Environmental Monitoring	The environmental laws place a responsibility on KMC to monitor outflows from the WTPs and transmit the results of such monitoring to WBPCB. The regulations also specify the parameters to be monitored, the frequency of monitoring and the method of sampling. The WBPCB can independently sample the quality of the receiving waters, and this data can be used to assess whether the WTPs are discharging effluents of acceptable quality.
Sludge Management Study	This is a study item for both water works in order to develop an environmentally compliant design of a modified sludge management system. The study will take into consideration quantity and quality of sludge that is being generated, evolve a modified design of its treatment, re-use and compliant disposal of both solid waste and supernatant liquid after treatment if required. Other aspects of the study will include cost benefit analysis of the sludge management system to be proposed including the environmental benefit that will accrue and an implementation schedule.

116. The design considerations were discussed with the specialists responsible for the engineering aspects, and as a result measures have already been included in the subproject design. for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design. Alternatives of project components in respect to location, technology and design are discussed in Tables 32 to 34.

Table 32 : Construction of a 81.8 MLD Rapid Gravity Filter Unit at Palta Water Works Comparison between Different Filtration Process Technologies in WTP

	Parameter	Slow Sand Filter	Rapid Sand Filter	Pressure Filter
1	Relative Area requirement	Large	Medium	Low
2	Relative Power requirement	Low	Medium	High
3	Relative Ease in construction	Easy	Moderate	Difficult
4	Relative Level of Construction cost	Moderate	Low	High
5	Relative Ease in Operation	Low	Moderate	Difficult/Hazardous
6	Relative Level of Operation cost	Low	Moderate	High
7	Relative Level of Maintenance Cost	Low	Moderate	High
8	Relative level of Maintenance method	Moderate	Easy	High
9	Relative efficiency of treatment	High	Moderate	Moderate
10	Automation level	Low	Moderate	High
11	Rate of sludge generation	Low	Moderate	Very Low
12	Rate of production/filtration	Low	High	Moderate
13	Application	Community Supply in City/Town	Community Supply in City/Town	Industrial or Small Township
	Recommendation		Back Washing Rapid Sand Gravity	

Parameter	Slow Sand Filter	Rapid Sand Filter	Pressure Filter
		Filter	

Table 33 : Design Considerations for the Transmission Mains Construction Methodology

	Parameters	Micro-Tunneling	Open Trenching
1	Construction methodology	Modern; boring with pipe jacking technique	Primitive; manual
2	Accidental damage to utilities	Below utility lines	Invasive through or avoiding the utility lines; often utility lines are required to be shifted
3	Waste (solid and liquid) handling and disposal during construction	Solid waste handling volume is less; disposal of waste is somewhat complicated	Handling volume is more; some part of the excavated material need to be put back again to fill up the trench after pipe is placed; construction method is hazardous
4	Pollution potential (air, noise, vibration, surface water, etc) during construction	Less severe as operation is below the ground without disturbing the surface	Open trenching gives rise air, water and noise pollution
5	Relative hazards during construction	Same degree	Same degree
6	Relative loss of business due to construction	Loss of business is minimal	Loss of business is likely to be more if the roads are narrow and traffic is heavy
7	Inconvenience to people using ROW	Less likely	More likely
8	Cost	More compared to trenching	Much less
9	Construction time	Less	More
10	Maintenance	Same effort is required	Same effort is required
	Recommendation	Micro-tunneling	

Table 34: Summary of Design Considerations for Pipe Materials

	Factors for selection of pipes	Ductile Iron (DI)	Mild Steel (MS)	High Density Polyethylene (HDPE)
1	Hydraulic smoothness (C value)	140	130	150
2	Structural strength for external loads	Very good	Very good	Good in resisting external loads
3	Ease in handling, transportation and storage	Pipes are heavy and hence difficult to handle	Lighter than DI pipes, but still heavy to handle	Light and easy to handle; lighter equipment are used in jointing and installation
4	Resistance to internal corrosion	Internally protected by cement mortar lining	Anti corrosive painting is necessary	Does not rust, rot or corrode
5	Economy	Very costly	Costly	Much cheaper than DI or MS pipes at lower dia.
6	Availability of spares and replacements	To be imported	To be imported	To be imported but cost will be less as it is light and can be brought in large consignment
7	Availability of skilled personnel for installation and maintenance	Skilled personnel are available as DI pipes were laid before in Kolkata	Available	This can be used with little training even by novice workers
8	Capacity to withstand damage in handling and maintenance	Damage to internal cement mortar lining is possible during handling	Better than DI pipes	Very good in withstanding damage due to handling
9	Reliability and effective joints	Reliable	Welded joints are reliable	Fusion joints or butt joints are very reliable
10	Capability to absorb surge pressure	Capable	Capable	These can withstand surge pressure

	Factors for selection of pipes	Ductile Iron (DI)	Mild Steel (MS)	High Density Polyethylene (HDPE)
11	Ease in maintenance and repair	Handling of heavy materials is required	Lighter than DI pipes and spares	Materials are light and very easy to handle
12	Durability (sustainable trouble-free maintenance)	Durable if external corrosion protection is made	Durable if external corrosion protection is made.	Durable. Very resistant to breaking
13	Resistance to tampering by anti-social elements	Fairly good	Fairly good	Not good.
	Recommendation	DI is recommended for more than 300mm internal diameter up to 600 mm.	MS For pipes above 600mm	HDPE pipe is recommended for diameter 300mm or less (Internal diameter).

B. Construction Phase

117. **Rehabilitation works.** The works, except construction of the transmission mains, will involve earth-moving and excavation; mostly those involved in common and simple construction works. Materials will be brought in on trucks and offloaded by hand. Excavation, if necessary will be by backhoe and supplemented by manual digging. Excess spoils generated will be loaded into trucks for disposal.

118. **Micro-tunneling for the transmission mains.** The works will be along or adjacent to roads' un-used ROWs below the level of utilities avoiding properties. Intermittent shafts of access will be dug using a backhoe digger, supplemented by manual digging where necessary. Excavated soil will be placed alongside and also the pipes (brought to site on trucks and stored on unused land nearby).

119. Table 35 presents an indication of what activities and facilities are likely to be undertaken during construction of the subproject, including the associated inputs and outputs.

Table 35: Summary of Activities and Facilities, Resource Use, and Produced Outputs during Construction Phase

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
Construction camp and its associated facilities (including lay-down areas)	Cement	Old asphalt (removed from road carriageway during road restoration) ⁹
Storage camps and lay-down areas	Chemical additives used in concrete / asphalt (i.e. retarders)	Waste concrete and other construction rubble
Materials and equipment stockpiles	Paving blocks/bricks	Used fuels, lubricants, solvents and other hazardous waste
Handling and storage of hazardous materials including chemicals additives, gravel, cement, concrete and lubricants	Aggregate (sand and stone)	General waste
Source of water	Gravel	Contaminated soil
Vegetation clearance	Water	Soil contaminated with petrochemicals (i.e. oils and lubricants) and other chemicals
Bulk earthworks, grading and contouring.	Drinking, cooking and sanitation at construction camps	Sewage and grey water (temporary construction camp sanitation)
Drilling and blasting	Water for dust suppression	Spoil material (excess soil removed during excavations)
Movement of construction staff, equipment and materials	Water applied to base and sub-base layers during compaction	Noise and vibrations (construction vehicles and machinery)
Importation of selected materials	Water for application to sub-base and base layers prior to compaction	Lighting at construction camps, equipment yards and lay-down areas
Temporary detours	Petrochemicals	
Noise and vibrations	Other chemicals/lubricants/paints	
Dust suppression	Construction vehicles, machinery and equipment	
Waste production and temporary storage/disposal i.e. used fuels, waste	Temporary energy supply to construction camps	
	Topsoil used during revegetation	

⁹ The opening of small portions of the roads for micro-tunnelling may involve the stripping and demolition of old asphalt layers. Ideally, old asphalt shall be reused during restoration of the road in order to avoid large quantities of waste being produced. However, depending on the availability and cost of virgin aggregate in the area through which the road is aligned, reusing the old asphalt may be more costly than using virgin aggregate.

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
concrete and bitumen, spoil materials and general waste Use of asphalt/bitumen (and associated storage and mixing areas, chemicals) Concrete batching plan (and associated storage and mixing areas, chemicals) Rehabilitation of disturbed areas Interaction between construction workforce and local communities Management of the passing pedestrians and points of congestion Implementation of the Resettlement Plan prior to start of construction Reminders to affected people of construction with timeframes	and rehabilitation Plant material for re-vegetation (seeds, sods, plant specimens) Labor Recruitment of construction workforce Skills training Public movement control need barriers (not just danger tape) to protect people from trenches during construction	Plant material removed from servitude/right-of-way during vegetation clearance Smoke and fumes Burning of waste Burning of vegetation cover Fires used for cooking and space heating (construction camps) Vehicle exhaust emissions

120. The following table (Table 36) outlines potential impacts during the construction phase gathered from a process that included a review of available documentation, verified during the site visit, i.e. how, where and when the proposed development can interact and affect the environment significantly, and details what mitigation measures may be taken to counteract these impacts.

Table 36: Summary of Anticipated Potential Environmental Impacts During Construction Phase

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
Climate	The nature and intensity of rainfall events in an area, has implications for storm water management. Smoke from burning activities could be wider spread on windy days especially when dust could be blown off site.	Consider seasonal climatic variations during scheduling of construction activities in the area. Do excavations and other clearing activities only during agreed working times and permitted weather conditions. Implement storm water control as per method approved by PMU. No open fires permitted on site	Low (negative)	Site	Short-term	Full Mitigation Possible
Air Quality	Sensitive receptors (e.g. hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts during the construction phase (from the proposed detour). Fugitive dust can also impact on roadside air quality during construction. Exhaust fumes from construction machinery, and potential smoke from cooking fires. Burning of waste and cleared vegetation Odors from use of toilet 'facilities' other than provided facilities.	Guidelines that deal with the control of air pollution and dusts on site have been outlined in the Environmental Management Plan (EMP) Ensure compliance with the Air Act. Ensure compliance with emission standards Undertake monitoring of air pollution levels in potential problem areas. Manage (including storage, transport, handling and disposal) hazardous substances used. Avoid dust generating construction activities during strong winds. Cover soil loads in transit. Cover stockpiles of soil or apply suitable dust palliative such as water or commercial dust suppressants. Regularly service vehicles off-site in order to limit gaseous emissions. No open fires permitted on site Place portable toilets on-site and maintain on a daily basis.	Medium (negative)	Local	Short-term	Partial Mitigation Possible
Geology and soil	Strong water flows into open excavations below the water table will occur, causing micro-tunnel collapse. Layers of mixed fill cover natural ground surface in many places. Contamination from spillage of	The design of the site drainage system is adequate to control runoff from the micro-tunnels and open areas in line with topographical features of the site. Rehabilitate all sites during construction including construction camps, stockpile area, temporary access and hauling	Medium (negative)	Site	Short-term	Full Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	petroleum products, spent engine oil and oil leaks from construction vehicle maintenance taking place on site.	<p>routes, as soon as possible after the disturbance has ceased.</p> <p>Contractor to exercise strict care in the disposal of construction waste, with proof of disposal at an approved site provided after offloading each waste load and this logged/registered.</p> <p>Contain contaminated water and dispose off in the nearest municipal drain</p> <p>Dispose of waste from the oil interceptors only through suitable waste-handling contractor and request for safe disposal certificates.</p> <p>Mix cement, concrete and chemicals on a concrete plinth and contain spillages or overflows into the soil.</p> <p>Do not allow vehicle maintenance on site.</p> <p>Stockpile subsoil and overburden in all construction and lay down areas. Protect topsoil and subsoil from contamination. Return for backfilling in the correct soil horizon order.</p>				
Drainage and hydrology	The proposed development is situated within an existing built up area where the water supply infrastructures already exist. Due to the nature and locality of the subproject there is unlikely any significant impacts on water resources within the immediate area.	<p>The site surface has been engineered and shaped in such a way that rapid and efficient evacuation of runoff is achieved.</p> <p>Provide containment areas for potential pollutants at construction camps, refueling, depots, asphalt plants and concrete batching plants.</p> <p>Implement waste management practices.</p> <p>Control and manage transport, storage, handling and disposal of hazardous substances.</p>	Medium (negative)	Site	Short-term	Full Mitigation Possible
Biodiversity Fauna and Flora	The proposed development is situated within an existing built up area where the water supply	Obtain permission will be obtained from the Forest Directorate, Government of West Bengal for the cutting/felling of	Low (negative)	Site	Short-term	Full Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	infrastructures already exist. No areas of ecological diversity occur within the subproject location. Due to the nature and locality of the subproject there is unlikely to any significant impacts on biodiversity within the area The pipe laying for the transmission mains may however affect existing roadside trees.	trees prior to start of civil works. Ensure any landscaping to be undertaken will be done with locally indigenous species and low maintenance requirements.				
Land Uses	Due to the location and nature of the subproject, there will be interference with access Existing public transport facilities and operations will be affected by the road closure and detours. Shops and establishments are located along the transmission mains alignment therefore will need to be relocated during construction. This may impact on livelihoods. There will be disruptions to health services, education services, local businesses, transport services, pedestrian movements, due to traffic and construction related noise, visual, and air pollution.	KMC has consulted with various organizations, departments, etc within the area and will be continued during the construction phase. Put a sign of "Keep Clear" near critical roads (e.g. in front of fire and police stations and hospitals). Consult with local departments, organizations, etc regarding location of construction camps, access and hauling routes, and other likely disturbances during construction. Provide clear and realistic information regarding detours and alternative accesses for local communities and businesses in order to prevent unrealistic expectations. Provide clear and realistic information regarding employment opportunities and other benefits for local communities in order to prevent unrealistic expectations. Make use of local labor, materials, goods and services as far as possible Provide walkways and metal sheets where required to maintain access across for people and vehicles. Increase workforce in front of critical	Medium (negative)	Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		<p>areas such as institutions, place of worship, business establishment, hospitals, and schools.</p> <p>Consult businesses and institutions regarding operating hours and factoring this in work schedules.</p> <p>Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.</p>				
Infrastructure and Services	<p>There is likely to have temporary disruption of infrastructure and services during the pipelaying of the transmission mains.</p> <p>There are a number of existing infrastructure and services (roads, railway lines, telecommunication lines, power lines and various pipelines within the vicinity of the subproject.</p>	<p>Undertake utility shifting prior to commencing pipe laying/micro-tunneling.</p> <p>Keep construction-related disturbances to a minimum.</p> <p>Consult with affected service providers regarding impacts on access to infrastructure and services and alternatives.</p> <p>Consult with affected communities or businesses prior to foreseeable disruptions, for example notifying residents of a temporary severance of water supply.</p> <p>Provide backup or alternative services during construction-related disruptions, for example by providing generators for power supply.</p> <p>Provide access points to infrastructure and services.</p> <p>Monitor complaints by the public.</p>	Low (negative)	Local	Short-term	Full Mitigation Possible
Traffic	<p>Increased volume of construction vehicles on the roads may lead to increased wear and tear of roads in the vicinity of the subproject site.</p> <p>Road safety concerns due to slow moving construction vehicles.</p> <p>Traffic flow within the vicinity will</p>	<p>Reroute traffic and close roads according the Traffic Management Plan (TMP). The objective of the TMP is to ensure safety of all the road-users along the work zone and to address: (i) protection of work crews from hazards associated with moving traffic; (ii) mitigation of the adverse impact to the road capacity and delays to the road-</p>	High (negative)	Regional	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	<p>be affected.</p> <p>The temporary road closure will result in a decrease in overall network performance in terms of queuing delay, travel times/speeds.</p> <p>The road closure will impact on a public transport operations and routing.</p> <p>On street parking and loading bays will be affected by the proposed road closure.</p> <p>Pedestrian movements will be affected by the road closure.</p>	<p>users; (iii) maintenance of access to adjoining properties; and (iv) issues that may delay the subproject works.</p> <p>Negotiate with privately-owned public transport operators regarding the affected public transport facilities and routing.</p> <p>Negotiate with business owners and social service operations regarding the loss of parking and loading bays.</p> <p>Clear roads signs will be erected for the full length of the construction period.</p> <p>Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.</p> <p>Ensure the City Traffic Police will be available on site.</p> <p>Communicate road closure together with the proposed detour via advertising, pamphlets, radio broadcasts, road signage, etc. The implementation of the road detour is also dependent on advance road signage indicating the road detour and alternative routes.</p> <p>Define clearly construction routes.</p> <p>Strictly control access of all construction and material delivery vehicles.</p> <p>Enforce speed limits.</p> <p>Do not allow deliveries during peak traffic hours</p>				
Health and Safety	<p>Danger of construction related injuries.</p> <p>Open fires in construction camp can result in accidents</p> <p>Safety of workers and general public must be ensured.</p> <p>Poor waste management practices and unhygienic</p>	<p>Implement good housekeeping practices at the construction camp.</p> <p>Strictly implement health and safety measures and audit on a regular basis.</p> <p>Secure enclosed construction site.</p> <p>Use reputable contractors.</p> <p>Provide warning signs of hazardous working areas.</p>	High (negative)	Site and Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	<p>conditions at temporary ablation facilities can breed diseases. Standing water due to inadequate storm water drainage systems, inadequate waste management practices, pose a health hazard to providing breeding grounds for disease vectors such as mosquitoes, flies and snails. The use of hazardous chemicals in the micro-tunneling and restoration of roads can pose potential environmental, health and safety risks. Road safety may be affected during construction, especially when traffic is detoured.</p>	<p>Clearly demarcate excavations and provide barriers (not just danger tape) to protect pedestrians from open trenches. Thoroughly train workers assigned to dangerous equipment. Workers have the right to refuse work in unsafe conditions. Undertake waste management practices. Control speed and movement of construction vehicles Exclude public from the site Ensure all workers are provided with and use Personal Protective Equipment. Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas Ensure that qualified first-aid can be provided at all times. Ensure equipped first-aid stations are easily accessible throughout the site; Provide medical insurance coverage for workers. Provide clean eating areas where workers are not exposed to hazardous or noxious substances; Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; Ensure moving equipment is outfitted with audible back-up alarms; Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment,</p>				

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.				
Noise and Vibrations	Sensitive receptors (hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts Use of heavy vehicles and equipment may generate high levels of noise. Vibrations resulting from blasting, bulk earthworks, micro-tunneling, and compaction may create significant disturbances to nearby people and businesses. Disturbance from afterhours work.	Locate concrete batching, asphalt, crushing plants, lay down areas and construction camps away from sensitive receptors. Restrict construction activities to reasonable working hours where near sensitive receptors. Keep adjacent landowners informed of unusually noisy activities planned. Regulate roadworthiness of vehicles. Ensure that machinery in a good state of maintenance. Fit and maintain silencers to all machinery on site. Monitor noise levels in potential problem areas.	High (negative)	Local	Short-term	Partial Mitigation Possible
Aesthetics, Landscape Character, and Sense of Place	The presence of heavy duty vehicles and equipment, temporary structures at construction camps, stockpiles, may result in impacts on aesthetics and landscape character	Properly fence off storage areas. Collect all domestic solid waste central point of disposal and feed into the city waste collection system. Contractor to exercise strict care in disposing construction waste, with proof of disposal at the approved site provided after offloading each waste load and this logged/registered. Identify suitable waste disposal site with enough capacity to hold additional waste to be generated by the construction activities. Retain mature trees on and around the site where possible. Remove unwanted material and litter on a frequent basis.	Medium (negative)	Local	Short-term	Partial Mitigation Definite
Workers	Construction workers on site	Ensure strict control of laborers	Low (negative)	Local	Short-term	Full Mitigation

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
Conduct	disrupting adjacent land uses by creating noise, generating litter, and possible loitering.	Minimize working hours to normal working times Control littering Ensure no overnight accommodation is provided.				Definite
Employment Generation	The subproject will provide employment opportunities for local people during construction. Expectations regarding new employment will be high especially among the unemployed individuals in the area. Labor gathering at the site for work can be a safety and security issue, and must be avoided. The training of unskilled or previously unemployed persons will add to the skills base of the area.	Employ local (unskilled) labor if possible Training of labor to benefit individuals beyond completion of the subproject. Ensure recruitment of labors will take place offsite. Ensure at least 50% of all labor is from surrounding communities in the contractual documentation.	Medium (positive)	Local	Short-term	Partial Mitigation Possible
Archaeological and Cultural Characteristics	The proposed development will not require demolition of ASI- or state-protected monuments and buildings	Ensure that construction staff members are aware of the likelihood of heritage resources being unearthed and of the scientific importance of such discoveries. Contact ASI or the State Department of Archaeology if any graves be discovered and all activities will be ceased until further notice. Contact ASI or the State Department of Archaeology if any heritage resources or objects, defined in the Act, be discovered and all activities will be ceased until further notice. Cease all activities immediately and do not move any heritage object found without prior consultation with ASI or the State Department of Archaeology No structures older than 100 years will				

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		be allowed to be demolished, altered or destroyed without a permit from ASI or the State Department of Archaeology.				

C. Operation and Maintenance Phase

121. The system have a design life of 30 years, during which shall not require major repairs or refurbishments and shall operate with little maintenance beyond routine actions required to keep the pumps and other equipment in working order. The stability and integrity of the system will be monitored periodically to detect problems and allow remedial action if required. Repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

122. The main requirement for maintenance of the transmission main and distribution system will be for the detection and repair of leaks. The generally flat topography and the usage of good quality pipes shall mean that pipeline breaks are very rare, and that leaks are mainly limited to joints between pipes.

123. Table 37 presents an indication of what activities and facilities are likely to be undertaken during operation and maintenance of the subproject, including the associated inputs and outputs.

Table 37 : Summary of Activities and Facilities, Resource Use, and Produced Outputs during Operation and Maintenance Phase

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
Operation activities Wastewater generation Sludge generation Chemicals for water treatment Maintenance activities Upkeep and repair of pumps, transmission and distribution system Upkeep and repair of jetties and water intake systems Sludge removal	Herbicides for eradication and control of invasive vegetation species Labor Vehicles and equipment used for inspections and maintenance Chemicals for the WTPs Fuels and lubricants	Wastewater Sludge Spent chemicals and containers Wastes from rinsing and backwashing of filter media containing debris, chemical precipitates, straining of Vehicle exhaust emissions Potential for water source contamination

124. The following table (Table 38) outlines potential impacts during the operation and maintenance phase gathered from a process that included a review of available documentation, verified during the site visit, i.e. how, where and when the proposed development can interact and affect the environment significantly, and details what mitigation measures may be taken to counteract these impacts.

Table 38: Summary of Anticipated Potential Environmental Impacts During Operation and Maintenance Phase

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
Air Quality	Sensitive receptors (e.g. hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts during transmission mains and distribution network maintenance.	Ensure compliance with the Air Act. Ensure compliance with emission standards Regularly service vehicles off-site in order to limit gaseous emissions.	Low (negative)	Local	Short-term	Partial Mitigation Possible
Biodiversity Fauna and Flora	The proposed development is situated within an existing built up area where the water supply infrastructures already exist. No areas of ecological diversity occur within the subproject location. Due to the nature and locality of the subproject there is unlikely to any significant impacts on biodiversity within the area during maintenance works The use of fertilizers and herbicides in maintenance of newly planted trees, landscape and vegetation may however affect the environment.	Ensure only approved fertilizers and organic herbicides are used.	Low (negative)	Site	Short-term	Full Mitigation Possible
Land Uses	Due to the location and nature of the subproject, there will be interference with access during maintenance works Existing public transport facilities and operations will be affected by the road closure and detours. There will be disruptions to health services, education services, local businesses, transport services, pedestrian movements, due to traffic and maintenance-related noise, visual, and air pollution.	Put a sign of "Keep Clear" near critical roads (e.g. in front of fire and police stations and hospitals). Consult with local departments, organizations, etc regarding location of construction camps, access and hauling routes, and other likely disturbances. Provide clear and realistic information regarding detours and alternative accesses for local communities and businesses in order to prevent unrealistic expectations. Provide walkways and metal sheets where required to maintain access across for people and vehicles. Increase workforce in front of critical	Low (negative)	Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		<p>areas such as institutions, place of worship, business establishment, hospitals, and schools.</p> <p>Consult businesses and institutions regarding operating hours and factoring this in work schedules.</p> <p>Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.</p>				
Health and Safety	<p>Danger of operations and maintenance-related injuries. Safety of workers and general public must be ensured.</p> <p>Poor waste management practices and unhygienic conditions at the improved facilities can breed diseases.</p> <p>Standing water due to inadequate storm water drainage systems, inadequate waste management practices, pose a health hazard to providing breeding grounds for disease vectors such as mosquitoes, flies and snails.</p> <p>The use of hazardous chemicals in the WTPs can pose potential environmental, health and safety risks.</p>	<p>Implement good housekeeping practices at all WTPs and all pumping stations.</p> <p>Strictly implement health and safety measures and audit on a regular basis.</p> <p>Provide warning signs of hazardous working areas.</p> <p>Clearly demarcate excavations and provide barriers (not just danger tape) to protect pedestrians from open trenches.</p> <p>Thoroughly train workers assigned to dangerous equipment.</p> <p>Workers have the right to refuse work in unsafe conditions.</p> <p>Undertake waste management practices.</p> <p>Ensure all workers are provided with Personal Protective Equipment.</p> <p>Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas</p> <p>Ensure that qualified first-aid can be provided at all times. Ensure equipped first-aid stations are easily accessible throughout the site;</p> <p>Provide medical insurance coverage for workers.</p> <p>Provide clean eating areas where</p>	Low (negative)	Site and Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		workers are not exposed to hazardous or noxious substances; Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; Ensure moving equipment is outfitted with audible back-up alarms; Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.				
Noise and Vibrations	Sensitive receptors (hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts Disturbance from afterhours work.	Restrict maintenance activities to reasonable working hours where near sensitive receptors. Keep adjacent landowners informed of unusually noisy activities planned. Fit and maintain silencers to all machinery on site. Monitor noise levels in potential problem areas.	Low (negative)	Local	Short-term	Partial Mitigation Possible
Workers Conduct	Maintenance workers on site disrupting adjacent land uses by creating noise, generating litter, and possible loitering.	Ensure strict control of laborers Minimize working hours to normal working times Control littering	Low (negative)	Local	Short-term	Full Mitigation Definite
Solid Waste	Solid waste residuals which may be generated by the WTPs include process residuals, used filtration membranes, spent media and miscellaneous wastes. Process residuals primarily	Minimize quantity of solids generated by the water treatment process through optimizing coagulation processes; Explore options to reuse sludge such as brick making Monitor impact of solid waste disposal on land whenever done so as to	High (negative)	Local	Medium-term to Long-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	consist of settled suspended solids from source water and chemicals added in the treatment process.	confirm that required disposal standards are achieved				
Wastewater	Wastewater from the WTPs include filter backwash and supernatant liquid from the sludge beds/ponds. These waste streams may contain suspended solids and organics from the raw water, dissolved solids, high or low pH, heavy metals, etc.	Ensure compliance of the effluents to CPCB Standards	High (negative)	Local	Medium-term to Long-term	Partial Mitigation Possible
Hazardous chemicals	Water treatment involves the use of chemicals for coagulation, disinfection and water conditioning.	Minimize amount of chlorine and chemicals stored on site Develop and implement a Chemicals Management Plan that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures; and Develop and implement of an Emergency and Contingency Plan for responding to accidental releases of stored chemicals.	Medium (negative)	Site	Medium-term	Partial Mitigation Possible

D. Cumulative Impact Assessment

125. The subproject in and around the Palta and Garden Reach water works are mainly isolated civil construction works. No other major civil construction activities are known to be taking place in the premises of water works and in immediate vicinities of the water works. Only the construction of water transmission line from Garden Reach to Taratala will be through areas that may be used by other agencies for their development activities and may give rise to cumulative impact during the construction stage only. Such cumulative impact is likely to be in the nature of transient elevation in the level of air pollution and noise and inconveniences to people using the same space.

126. Table 39 summarizes the cumulative impacts resulting from the subproject when added to other past, present, and reasonably future actions. The cumulative analysis must consider past and current projects that have resulted in the existing condition, and relevant, foreseeable future projects over the KMC's 30-year period. During this time period, it is expected that many other actions will be implemented that will affect the environmental conditions.

Table 39. Cumulative Impact Assessment of Water Supply Subproject

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Environmental Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
Improvement in water supply	Increased in amount of sewerage	KMC undertaking sewerage and drainage improvement subproject	High (negative)	Site/Local	Long-term	Full Mitigation Definite
Cumulative land use and growth-inducing impacts	With sufficient water, development can proceed to the degree that water supply is not a constraint	KMC to develop additional supplies if necessary beyond the year 2042 to accommodate growth if it is to occur	High (negative)	Site/Local	Long-term	Full Mitigation Possible
Growth and development will result in the replacement of open space areas with residential and commercial development.	This development will substantially change the visual character of the area from existing conditions. This will be a significant and unavoidable cumulative aesthetic impact.	KMC to implement City Land Use plan and Zoning	High (negative)	Site/Local	Long-term	Full Mitigation Possible
Cumulative Air Quality Impacts	The subproject can collectively generate construction-related air emissions.	See mitigation measures in the EMP	Low (negative)	Site/Local	Short-term	Partial Mitigation Possible
Cumulative Noise Impacts	Noise is a localized issue that diminishes in intensity with distance from the	Such cumulative noise impacts will be temporary and will not likely	Low (negative)	Site/Local	Short-term	Partial Mitigation Possible

	Summary of Implications and Mitigation		Assessment of Environmental Impacts			
Environmental Aspect	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	source. Construction of the proposed facilities along with construction activities of other development in the subproject area can potentially increase construction-related noise impacts on land uses directly adjacent to the construction sites.	occur during sensitive nighttime hours. See mitigation measures in the EMP				
Cumulative Transportation Impacts	The subproject in combination with future growth and development could result in potentially significant construction-related traffic impacts. These include adding traffic to local roadways and lane closures when facilities (pipelines) are being installed in roadways. Minor amount of employee trips will be generated	The impacts will be temporary in nature, and standard traffic controls and notifications will be implemented during project construction. Minor employee trips will not contribute substantially to cumulative long-term operational traffic impacts	Low (negative)	Site/Local	Short-term	Partial Mitigation Possible
Cumulative Water Source Impacts	Based on the design criteria and operating parameters with respect to flow volume, water quality will not be substantially impacted. Any flow-related impacts on Hooghly river will be less than significant. No substantial change in temperature will occur in Hooghly river for all months of the year.	No mitigation required	Low (negative)	Local	Medium-term	n/a
Groundwater impacts	Groundwater pumping will exceed	Impacts of additional water withdrawals on	Low (negative)	Local	Medium-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Environmental Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	sustainable yield	other users will need to be assessed when and if the expansion occurs.				

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Public participation during the preparation of the IEE

127. The public participation process included identifying interested and affected people (stakeholders); informing and providing the stakeholders with sufficient background and technical information regarding the proposed development; creating opportunities and mechanisms whereby they can participate and raise their viewpoints (issues, comments and concerns) with regard to the proposed development; giving the stakeholders feedback on process findings and recommendations; and ensuring compliance to process requirements with regards to the environmental and related legislation.

128. The primary stakeholders are: (i) local residents, shopkeepers and businesspeople who live and work along side the roads where pipeline will be lay and facilities will be provided; (ii) custodians and users of socially- and culturally-important buildings in affected areas.

129. The secondary stakeholders are: (i) KMC as the executing agency; (ii) KEIP officials as implementation agency; (iii) WBPCB, government department (like Environment department, Government of West Bengal, Forest Directorate, Government of West Bengal, Ministry of Environment & Forests, Government of India) and relevant government agencies (like CPCB, NEERI), including state and local authorities responsible for land acquisition, (iv) non-government organizations, university professors, and community-based organizations (CBOs) working in the affected communities; (v) other community representatives (prominent citizens, religious leaders, elders, women's groups); (vi) beneficiary community in general; and (vii) ADB, the government, and Ministry of Finance.

130. The following methodologies have been used for carrying out public consultation:

- (i) Local communities, Individuals affected, traders and local shopkeepers who are directly affected were given priority while conducting public consultation.
- (ii) Walk-through informal group consultations along the proposed transmission mains stretch.
- (iii) The local communities had been informed through public consultation with briefing on project interventions including its benefits.
- (iv) The environmental concerns and suggestions made by the participants were listed out, discussed and suggestions were accordingly incorporated in the EMP.

131. Formal consultations have been carried out with Mayor and engineers of KMC on 5.8.2011 and 18.11.2011 to prioritise and finalise items of work to be taken under the Proect. These were supplemented by series of informal discussions by the PMC engineering Consultants with Chief Engineers of KMC and Director General (Projects), PMU mainly on understanding current situation and optimum design to be adopted in order to attain the objectives of taking up the work items. On specific environmental fronts Team Leader, Deputy Team Leader and Environmental Expert, PMC arranged a meeting at the WBPCB

office on 13 September, 2011 in which Chairman, Member Secretary, Chief Engineer (Planning), Chief Scientist and other engineers of WBPCB were present, The officials of WBPCB were appraised about the proposed work program of Tranche 1-4 at it stood on that date.

B. Future Consultation and Disclosure

132. The public consultation and disclosure program will remain a continuous process throughout the subproject implementation and shall include the following:

i. Consultation during detailed design

133. Focus-group discussions with affected persons and other stakeholders to hear their views and concerns, so that these can be addressed in subproject design wherever necessary. Regular updates on the environmental component of the subproject will kept available at the PMU office of KMC.

134. KMC will conduct information dissemination sessions at major intersections and solicit the help of the local community leaders/prominent citizens to encourage the participation of the people to discuss various environmental issues.

135. The PMU, with assistance of DSC will conduct information dissemination sessions in the subproject area. During EMP implementation PMU and DSC will organize public meetings and will apprise the communities about the progress on the implementation of EMP in the subproject works.

ii. Consultation during construction:

136. Public meetings with affected communities (if any) to discuss and plan work programs and allow issues to be raised and addressed once construction has started; and

137. Smaller-scale meetings to discuss and plan construction work with local communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;

A summary of the proposed Consultations is given in Appendix 6. Some of the scheduled consultations may be combined in to a single composite consultation if the situation so demands.

iii. Project disclosure

138. A communications strategy is of vital importance in terms of accommodating traffic during road closure. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signages, etc.

139. A public information campaign via newspaper/radio/TV, is proposed to explain the subproject details to a wider population. Public disclosure meetings at key project stages to inform the public of progress and future plans.

140. For the benefit of the community the IEE will be translated in the local language and made available at the offices of KMC, PMU and DSC. Hard copies of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE will be placed in the official website of

the KMC/PMU/ State Government and the official website of ADB after approval of the IEE by Government and ADB. The PMU will issue Notification on the start date of implementation of the Water Supply subproject in KEIP web site one month ahead of the implementation works.

VII. GRIEVANCE REDRESS MECHANISM

141. **Common Grievance Redress Mechanism:** A common grievance redress mechanism (GRM) will be in place for social, environmental or any other subproject related grievances.

142. **Grievance Redress Process.** PMU will maintain a Complaint Cell headed by a designated Grievance Officer at its office. The Grievance Registration/Suggestion Form (Appendix 7) will be available at the Complaints Cell and in Borough Offices and will also be downloadable from the KEIP website.

143. Grievances/suggestions of affected persons can be dropped in suggestion boxes or conveyed through phone or mail. Affected Persons will also be able to register grievances - social, environmental or other, personally at the Complaint Cell and at Borough offices of KMC. The Grievance Officer and designated official at the Boroughs will be able to correctly interpret/record verbal grievances of non-literate persons and those received over telephone. The Complaint Cell will also serve as Public Information Centers, where, apart from grievance registration, information on the Project, subprojects, social and environmental safeguards can be provided.

144. The Grievance Officer will resolve simple issues and in case of complicated issues, consult/seek the assistance of the Environment/Social Coordinator of the PMU. Grievances not redressed through this process within one month of registration will be brought to the notice of the Project Director, KEIP. The draft Grievance Redress Process will be discussed with the stakeholders at the proposed disclosure workshop.

145. Periodic community meetings with affected communities to understand their concerns and help them through the process of grievance redress (including translation from local dialect/language, recording and registering grievances of non-literate affected persons and explaining the process of grievance redress) will be conducted if required.

146. **Grievance Redressal Committee (GRC):** An apex GRC will be considered, if required, to address grievances pertaining to broader concerns related to the program/subproject. The membership of the Committee will be decided by Commissioner, KMC later on.

147. **Consultation Arrangements.** This will include (i) group meetings and discussions with affected persons, to be announced in advance and conducted at the time of day agreed on with affected persons (based on their availability) and conducted to address general/common grievances; and (ii) availability of Environment/Social Coordinator of PMU on a fixed day as required for one-to-one consultations. Non-literate affected persons/vulnerable affected persons will be assisted to understand the grievance redress process, to register complaints and with follow-up actions at different stages in the process.

148. **Record-keeping.** Records will be kept by PMU of all grievances received including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were in effect, and final outcome.

149. **Information Dissemination Methods of the GRM.** Grievances received and responses provided will be documented and reported back to the affected persons

(Appendix 6) has the Sample Grievance Registration Form). The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the offices of the different Boroughs of KMC and web. The phone number where grievances are to be recorded will be prominently displayed at the construction sites.

150. **Periodic Review and Documentation of Lessons Learned.** PMU will periodically review the functioning of the GRM and effectiveness of the mechanism, especially on the Project's ability to prevent and address grievances.

151. **Costs.** All costs involved in resolving the complaints (meetings, consultations, communication and reporting / information dissemination) will be borne by PMU.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

152. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between the PMU, DSC, and the contractors. The EMP identifies activities according to the following three phases of development: (i) Site Establishment and Preliminary Activities; (ii) Construction Phase; and (iii) Post Construction/Operational Phase.

153. The purpose of the EMP is to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives of: (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with.

154. A copy of the EMP must be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance. It shall be noted that the Supreme Court of India¹⁰ mandates those responsible for environmental damage must pay the repair costs both to the environment and human health and the preventative measures to reduce or prevent further pollution and/or environmental damage. (The polluter pays principle).

155. The Contractor is deemed not to have complied with the EMP if:

- (i). Within the boundaries of the site, site extensions and haul/ access roads there is evidence of contravention of clauses.
- (ii). If environmental damage ensues due to negligence.
- (iii). The contractor fails to comply with corrective or other instructions issued by the PMU/DSC within a specified time.
- (iv). The Contractor fails to respond adequately to complaints from the public.

A. Institutional Arrangement

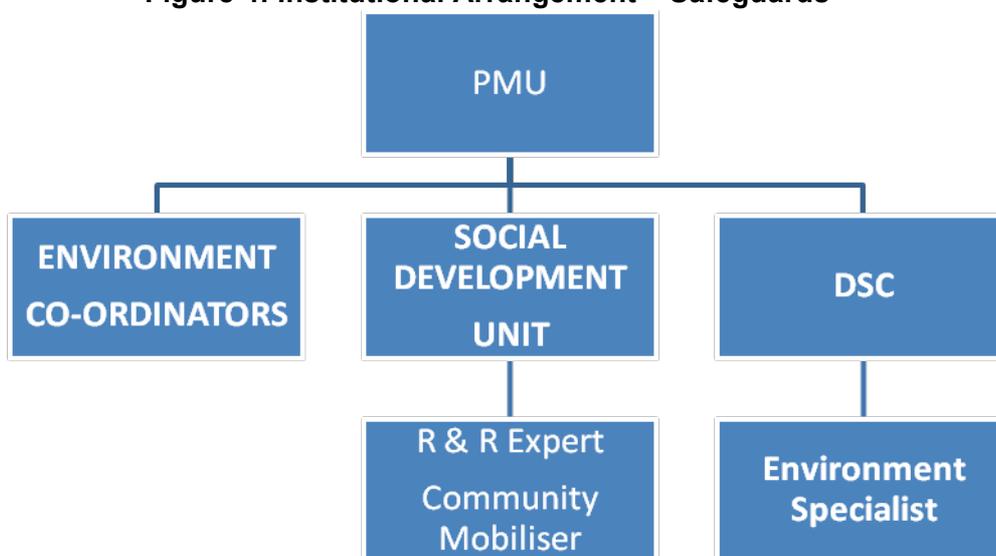
The existing institutional arrangement for implementation of the KEIP which has been functioning satisfactorily will continue (Figure 4). The subproject will be implemented and

¹⁰ Writ Petition No. 657 of 1995. The Supreme Court, in its order dated Feb.4, 2005, that "The Polluter Pays Principle means that absolute liability of harm to the environment extends not only to compensate the victims of pollution, but also to the cost of restoring environmental degradation. Remediation of damaged environment is part of the process of sustainable development."

monitored by the Project Management Unit (PMU). The KEIP Special Officer (Co-ordination) and Deputy Chief Engineer I will be PMU's Environmental Coordinators. The responsibilities of the Environmental Coordinators will ensure that (i) environmental and social safeguard issues are addressed; (ii) EMP is implemented; (iii) physical and non-physical activities under the subproject are monitored; and (iv) monitoring reports are prepared on time and submitted to ADB.

156. PMU will be supported by the Design and Supervision Consultants (DSC). An Environment Specialist will be engaged to ensure: (i) EMP is implemented; (ii) surveys and measurements are undertaken; (iii) inspections and observations throughout the construction period are recorded to ensure that safeguards and mitigation measures are provided as intended; and (iv) statutory clearances and permits from government agencies/other entities are obtained prior to start of civil works.

Figure 4: Institutional Arrangement – Safeguards



Notes: PMU = Project Management Unit; DSC = Design and Supervision Consultants; R & R = Resettlement & Rehabilitation

157. Table 40 gives the institutional roles and responsibilities in all phases of the subproject.

Table 40: Institutional Roles and Responsibilities: Environmental Safeguard

Phase	PMU	DSC	ADB
Subproject appraisal stage	<ul style="list-style-type: none"> PMU to review the REA checklists and draft IEE. PMU to disclose on its website the approved IEE. PMU to ensure disclosure of information throughout the duration of the subproject. 	<ul style="list-style-type: none"> DSC to conduct REA for each subproject using checklists and to prepare IEE 	<ul style="list-style-type: none"> ADB to review the REA checklists and reconfirm the categorization. ADB will review and approve EIA reports (Category A) and IEE reports (Category B) subprojects. ADB to disclose on its website the submitted EIA/IEE report.
Detailed Design Phase	<ul style="list-style-type: none"> PMU with the assistance of DSC to incorporate the EMP, environmental mitigation and monitoring measures into contract documents. 	<ul style="list-style-type: none"> DSC to revise the IEE and EMP in accordance with detailed design changes if warranted. DSC to ensure incorporation of EMP in bid documents and contracts. 	<ul style="list-style-type: none"> ADB will review and approve updated EIA reports (Category A) and IEE reports (Category B) subprojects. ADB to disclose on its website updated

Phase	PMU	DSC	ADB
		<ul style="list-style-type: none"> DSC to prepare inventory of utilities to be affected by the subproject. 	EIA/IEE report.
Pre-construction Phase	<ul style="list-style-type: none"> PMC and DSC to conduct public consultation and disclosure during IEE process and comments will be reflected in the IEE report. PMU to monitor the disclosure and public consultation. PMU and DSC to approve contractor's proposed locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes 	<ul style="list-style-type: none"> DSC to ensure statutory clearances and permits from government agencies/other entities are obtained prior to start of civil works. DSC to consult affected people and ensure RP is implemented prior to start of civil works. DSC to ensure disclosure of information prior to start of civil works and throughout the duration of the construction period. DSC to approve contractor's site-specific environmental plan (such as traffic management plan, waste management plan, locations for camp sites, storage areas, lay down areas, and other sites/plans specified in the EMP). <ul style="list-style-type: none"> DSC to conduct baseline environmental conditions and inventory of affected trees 	
Construction Phase	<ul style="list-style-type: none"> PMU will review 6-monthly monitoring and EMP implementation report including the status of Project compliance with statutory clearances and with relevant loan covenants and submit the 6-monthly report to ADB and seek permission to disclose the same in the Project web site. 	<p>DSC to monitor the implementation of mitigation measures by Contractor.</p> <ul style="list-style-type: none"> DSC to prepare monthly progress reports including a section on implementation of the mitigation measures (application of EMP and monitoring plan) DSC (as per EMP) will conduct environmental quality monitoring during construction stage (ambient air and noise, and water quality). DSC to prepare the 6 monthly monitoring report on environment by focusing on the progress in implementation of the EMP and issues encountered and measures adopted, follow-up actions required, if any. 	<p>ADB to review the 6 monthly report, provide necessary advice if needed to the PMU and approve the same.</p> <ul style="list-style-type: none"> ADB to disclose on its website environmental monitoring reports.
Pre-operation Phase (Commissioning and Defect Liability Period)	<ul style="list-style-type: none"> PMU to review monitoring report of DSC on post-construction activities by the contractors as specified in the EMP 	<ul style="list-style-type: none"> DSC to apply for the WTPs CTO prior to commissioning. DSC to monitor and approve post-construction activities by the contractors as specified in the EMP. 	

Phase	PMU	DSC	ADB
Operation Phase	<ul style="list-style-type: none"> • KMC to conduct monitoring, as specified in the environmental monitoring plan. • WBPCB to monitor the compliance of the standards regarding drinking water quality, ground water, ambient air, effluent quality from treatment plant, as applicable. 		

Notes: WBPCB = West Bengal State Pollution Control Board, KMC = Kolkata Municipal Corporation, CTE = Consent to Establish, CTO = Consent to Operate, DSC = Design and Supervision Consultant, EIA = Environmental Impact Assessment, EMP = Environmental Management Plan, IEE = Initial Environmental Examination, PMU = Project Management Unit; REA = Rapid Environmental Assessment, WTP = water treatment plant

158. The Contractor will be required to:

- (i) Comply with all applicable legislation, is conversant with the requirements of the EMP;
- (ii) Brief his staff, employees, and laborer about the requirements of the EMP;
- (iii) Ensure any sub-contractors/ suppliers who are utilized within the context of the contract comply with the environmental requirements of the EMP. The Contractor will be held responsible for non-compliance on their behalf;
- (iv) Supply method statements for all activities requiring special attention as specified and/or requested by the DSC Environment Specialist during the duration of the Contract;
- (v) Provide environmental awareness training to staff, employees, and laborers;
- (vi) Bear the costs of any damages/compensation resulting from non-adherence to the EMP or written site instructions;
- (vii) Conduct all activities in a manner that minimizes disturbance to directly affected residents and the public in general, and foreseeable impacts on the environment.
- (viii) Ensure that the PMU Environment Coordinators are timely informed of any foreseeable activities that will require input from the DSC Environment Specialist.

159. Table 41 outlines the site establishment and preliminary activities.

Table 41: Site Establishment and Preliminary Activities

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Legislation, Permits and Agreements	In all instances, KMC, service providers, contractors and consultants must remain in compliance with relevant local and national legislation.	PMU and DSC	Prior to moving onto site and during construction
		DSC to obtain statutory clearances and permits from government agencies/other entities	PMU	Prior to start of civil works
		Contractor to submit proof of compliance to Air Act (in relation to hot mixing, stone crushers, diesel generators)	DSC Environment Specialist	Prior to moving onto site and during construction
		A copy of the EMP must be kept on site during the construction period	PMU Environment Coordinator and DSC Environment Specialist	At all times
2.	Access to Site	Access to site will be via existing roads.	DSC Environment	Prior to moving

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		The Contractor will need to ascertain the existing condition of the roads and repair damage shall not occur due to construction.	Specialist	onto site and during construction
		The Local Traffic Department shall be involved in the planning stages of the road closure and detour and available on site in the monitoring of traffic in the early stages of the operations during road closure	DSC Environment Specialist	Prior to moving onto site
		The Local Traffic Department must be informed at least a week in advance if the traffic in the area will be affected.	DSC Environment Specialist	Prior to moving onto site
		The location of all affected services and servitudes must be identified and confirmed.	DSC Environment Specialist	Prior to moving onto site
		All roads for construction access must be planned and approved ahead of construction activities. They shall not be created on an ad-hoc basis.	PMU Environment Coordinator and DSC Environment Specialist	Prior to moving onto site and during construction.
		No trees/shrubs/groundcover may be removed or vegetation stripped without the prior permission.	PMU Environment Coordinator and DSC Environment Specialist	Before and during construction.
		Contractors shall construct formal drainage on all temporary haulage roads in the form of side drains and mitre drains to prevent erosion and point source discharge of run-off.	DSC Environment Specialist	Prior to moving onto site.
3.	Setting up of Construction Camp ¹¹	Choice of site for the contractor's camp requires the DSC Environment Specialist's permission and must take into account location of local residents, businesses and existing land uses, including flood zones and slip / unstable zones. A site plan must be submitted to the DSC Environment Specialist for approval.	DSC Environment Specialist and PMU Environment Coordinator	During surveys and preliminary investigations and prior to moving onto the site
		The construction camp may not be situated on a floodplain or on slopes greater than 1:3.	PMU Environment Coordinator and DSC Environment Specialist	During surveys and preliminary investigations and prior to moving onto the site
		If the Contractor chooses to locate the camp site on private land, he must get prior permission from both the DSC Environment Specialist and the landowner.	PMU Environment Coordinator and DSC Environment Specialist	During site establishment and ongoing – weekly inspections
		In most cases, on-site accommodation will not be required. The construction camp can thus be comprised of: <ul style="list-style-type: none"> • site office • toilet facilities • designated first aid area • eating areas • staff lockers and showers (where water and waterborne sewers are available) • storage areas 	DSC Environment Specialist	During set-up

¹¹ Careful planning of the construction camp can ensure that time and costs associated with environmental management and rehabilitation are reduced.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		<ul style="list-style-type: none"> batching plant (if required) refuelling areas (if required) maintenance areas (if required) crushers (if required) 		
		Cut and fill must be avoided where possible during the set up of the construction camp.	DSC Environment Specialist	During site set-up
		The contractor shall make adequate provision for temporary toilets for the use of their employees during the construction phase. Such facilities, which shall comply with local authority regulations, shall be maintained in a clean and hygienic condition. Their use shall be strictly enforced.	DSC Environment Specialist	During site establishment and ongoing – weekly inspections
		Under no circumstances may open areas or the surrounding bush be used as a toilet facility.	DSC Environment Specialist	Ongoing
		Bins and/or skips shall be provided at convenient intervals for disposal of waste within the construction camp.	DSC Environment Specialist	During site set-up and ongoing
		Bins shall have liner bags for efficient control and safe disposal of waste	DSC Environment Specialist	Ongoing
		Recycling and the provision of separate waste receptacles for different types of waste shall be encouraged.	DSC Environment Specialist	During site set-up and ongoing
4.	Establishing Equipment Lay-down and Storage Area ¹²	Choice of location for equipment lay-down and storage areas must take into account prevailing winds, distances to adjacent land uses, general on – site topography and water erosion potential of the soil. Impervious surfaces must be provided where necessary	PMU Environment Coordinator and DSC Environment Specialist	During site set-up
		Storage areas shall be secure so as to minimize the risk of crime. They shall also be safe from access by children / animals etc.	DSC Environment Specialist	During site set-up
		It is very important that the proximity of residents, businesses, schools etc is taken into account when deciding on storage areas for hazardous substances or materials. Residents living adjacent to the construction site must be notified of the existence of the hazardous storage area	PMU Environment Coordinator and DSC Environment Specialist	During site set-up
		Equipment lay-down and storage areas must be designated, demarcated and fenced if necessary.	DSC Environment Specialist	During site set-up
		Fire prevention facilities must be present at all storage facilities	DSC Environment Specialist	During site set-up
		Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the temporary storage area(s). These pollution prevention measures for storage shall include a bund wall high enough to contain at least 110% of any stored volume. The contractor shall	DSC Environment Specialist	During site set-up and ongoing

¹² Storage areas can be hazardous, unsightly and can cause environmental pollution if not designed and managed carefully

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		submit a method statement for approval		
		These storage facilities (including any tanks) must be on an impermeable surface that is protected from the ingress of storm water from surrounding areas in order to ensure that accidental spillage does not pollute local soil or water resources	DSC Environment Specialist	During site set-up and ongoing
		Fuel tanks must meet relevant specifications and be elevated so that leaks may be easily detected.	DSC Environment Specialist	During site setup and monitored
		Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site. Where possible the available, MSDSs shall additionally include information on ecological impacts and measures to minimize negative environmental impacts during accidental releases or escapes	DSC Environment Specialist and Contractor	Ongoing
		Staff dealing with these materials/substances must be aware of their potential impacts and follow the appropriate safety measures. The contractor must ensure that its staff is made aware of the health risks associated with any hazardous substances used and has been provided with the appropriate protective clothing/equipment in case of spillages or accidents and have received the necessary training	DSC Environment Specialist and Contractor	Ongoing
		Contractors shall submit a method statement and plans for the storage of hazardous materials and emergency procedures.	DSC Environment Specialist	Prior to establishment of storage area
5.	Materials Management Sourcing ¹³ –	Contractors shall prepare a source statement indicating the sources of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners etc), and submit these to the DSC Environment Specialist for approval prior to commencement of any work.	PMU Environment Coordinator and DSC Environment Specialist	On award of contract
		Where possible, a signed document from the supplier of natural materials shall be obtained confirming that they have been obtained in a sustainable manner and in compliance with relevant legislation	PMU Environment Coordinator and DSC Environment Specialist	On receipt of natural materials
		Where materials are borrowed (mined), proof must be provided of authorization to utilize these materials from the landowner/material rights owner and the Department of Mines, Government of West Bengal	DSC Environment Specialist	On receipt of borrowed (mined) materials
6.	Education of site staff on general and Environmental Conduct ¹⁴	Ensure that all site personnel have a basic level of environmental awareness training	PMU Environment Coordinator, DSC Environment Specialist and	During staff induction and ongoing

¹³ Materials must be sourced in a legal and sustainable way to prevent offsite environmental degradation.

¹⁴ These points need to be made clear to all staff on site before the subproject begin.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
			Contractor	
		Staff operating equipment (such as excavators, loaders, etc.) shall be adequately trained and sensitized to any potential hazards associated with their task	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
		No operator shall be permitted to operate critical items of mechanical equipment without having been trained by the Contractor and certified competent by DSC	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
		All employees must undergo safety training and wear the necessary protective clothing	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
		A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: <ul style="list-style-type: none"> • No alcohol / drugs to be present on site; • Prevent excessive noise • Construction staff are to make use of the facilities provided for them, as opposed to ad-hoc alternatives (e.g. fires for cooking, the use of surrounding bus as a toilet facility are forbidden) • No fires to be permitted on site • Trespassing on private / commercial properties adjoining the site is forbidden • Other than pre-approved security staff, no workers shall be permitted to live on the construction site • No worker may be forced to do work that is potentially dangerous or for what he / she is not trained to do 	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
6.	Social Impacts ¹⁵	Open liaison channels shall be established between the site owner, the developer, operator, the contractors and interested and affected people such that any queries, complaints or suggestions can be dealt with quickly and by the appropriate person(s).	PMU Environment Coordinator and DSC Environment Specialist	Prior to moving onto site and ongoing
		A communications strategy is of vital importance in terms of accommodating traffic during road closure. The road closure together with the proposed detour needs to be communicated via advertising, pamphlets, radio broadcasts, road signage, etc	PMU Environment Coordinator	Prior to moving onto site and ongoing
		Advance road signage indicating the road detour and alternative routes. Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	PMU Environment Coordinator	Prior to moving onto site and ongoing

¹⁵ It is important to take notice of the needs and wishes of those living or working adjacent to the site. Failure to do so can cause disruption to work.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		Storage facilities, elevated tanks and other temporary structures on site shall be located such that they have as little visual impact on local residents as possible.	DSC Environment Specialist and PMU Environment Coordinator	During surveys and preliminary investigations and site set-up.
		In areas where the visual environment is particularly important or privacy concerns for surrounding buildings exist, the site may require screening. This could be in the form of shade cloth, temporary walls, or other suitable materials prior to the beginning of construction.	DSC Environment Specialist and PMU Environment Coordinator	During surveys and preliminary investigations and site set-up.
		Special attention shall be given to the screening of highly reflective materials on site.	PMU Environment Coordinator	During site set-up
7.	Noise Impacts	Construction vehicles are to be fitted with standard silencers prior to the beginning of construction		
		Equipment that is fitted with noise reduction facilities (e.g. side flaps, silencers, etc) will be used as per operating instructions and maintained properly during site operations		
8.	Dust/Air Pollution ¹⁶	Vehicles travelling along the access roads must adhere to speed limits to avoid creating excessive dust.	PMU Environment Coordinator	Ongoing.
		Camp construction / haulage road construction – areas that have been stripped of vegetation must be dampened periodically to avoid excessive dust.	PMU Environment Coordinator	Ongoing – more frequently during dry and windy conditions
		The Contractor must make alternative arrangements (other than fires) for cooking and / or heating requirements. LPG gas cookers may be used provided that all safety regulations are followed.	DSC Environment Specialist	Ongoing.
9.	Soil Erosion	The time that stripped areas are left open to exposure shall be minimised wherever possible. Care shall be taken to ensure that lead times are not excessive.	DSC Environment Specialist and PMU Environment Coordinator	Throughout the duration of the subproject.
		Wind screening and stormwater control shall be undertaken to prevent soil loss from the site.	DSC Environment Specialist and PMU Environment Coordinator	During site set-up
		Procedures that are in place to conserve topsoil during the construction phase of the subproject are to be applied to the set up phase. i.e. topsoil is to be conserved while providing access to the site and setting up the camp.	DSC Environment Specialist and PMU Environment Coordinator	Ongoing monitoring, during site set-up
10.	Stormwater ¹⁷	To prevent stormwater damage, the increase in storm water run-off resulting from construction activities must be estimated and the drainage system assessed accordingly. A drainage plan must be submitted to the DSC Environment Specialist for approval and	DSC Environment Specialist	During surveys and preliminary Investigations.

¹⁶ Establishment of the camp site, and related temporary works can reduce air quality.

¹⁷ Serious financial and environmental impacts can be caused by unmanaged storm water.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		must include the location and design criteria of any temporary stream crossings (siting and return period etc).		
		During site establishment, stormwater culverts and drains are to be located and covered with metal grids to prevent blockages if deemed necessary by the DSC Environment Specialist. (e.g. due to demolition work).	DSC Environment Specialist	During site setup.
		Temporary cut off drains and berms may be required to capture storm water and promote infiltration.	PMU Environment Coordinator	During site setup.
11.	Water Quality ¹⁸ .	Storage areas that contain hazardous substances must be bunded with an approved impermeable liner	DSC Environment Specialist	During site setup.
		Spills in bunded areas must be cleaned up, removed and disposed of safely from the bunded area as soon after detection as possible to minimise pollution risk and reduced bunding capacity.	DSC Environment Specialist and PMU Environment Coordinator	During site setup.
		A designated, bunded area is to be set aside for vehicle washing and maintenance. Materials caught in this bunded area must be disposed of to a suitable waste site or as directed by the DSC Environment Specialist	DSC Environment Specialist and PMU Environment Coordinator	During site setup.
		Provision shall be made during set up for all polluted run off to be treated to the DSC Environment Specialist's approval before being discharged into the stormwater system. (This will be required for the duration of the project.)	DSC Environment Specialist and PMU Environment Coordinator	During site setup and to be monitored weekly
12.	Conservation of the Natural Environment ¹⁹	No vegetation may be cleared without prior permission from the DSC Environment Specialist.	DSC Environment Specialist and PMU Environment Coordinator	During site setup and ongoing.
		Trees that are not to be cleared shall be marked beforehand with danger tape. The PMU Environment Coordinator must be given a chance to mark vegetation that is to be conserved before the Contractor begins clearing the site	DSC Environment Specialist and PMU Environment Coordinator	During site set-up
		Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material)	PMU Environment Coordinator	Ongoing in camp Site, haulage Areas
13.	Set-up of Waste Management Procedure	The excavation and use of rubbish pits on site is forbidden	PMU Environment Coordinator	Ongoing
		Burning of waste is forbidden.	PMU Environment Coordinator	Ongoing
14.	Cultural Environment	Prior to the commencement of construction, all staff need to know what possible archaeological or historical objects of value may look like, and to notify the DSC Environment Specialist/Contractor shall such an item	PMU Environment Coordinator	During site set-up And ongoing.

¹⁸ Incorrect disposal of substances and materials and polluted run-off can have serious negative effects on groundwater quality

¹⁹ Alien plant encroachment is particularly damaging to natural habitats and is often associated with disturbance to the soil during construction activities. Care must be taken to conserve existing plant and animal life on and surrounding the site.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		be uncovered.		
15.	Security and Safety	Lighting on site is to be set out to provide maximum security and to enable easier policing of the site, without creating a visual nuisance to local residents or businesses.	DSC Environment Specialist	During site set-up
		Material stockpiles or stacks, such as, pipes must be stable and well secured to avoid collapse and possible injury to site workers / local residents.	PMU Environment Coordinator	Ongoing
		Flammable materials shall be stored as far as possible from adjacent residents / businesses.	PMU Environment Coordinator	Ongoing
		All interested and affected persons shall be notified in advance of any known potential risks associated with the construction site and the activities on it. Examples are: <ul style="list-style-type: none"> • stringing of power lines • excavation for the micro-tunnel equipment • earthworks/earthmoving machinery on beside houses/infrastructure/sensitive receptors • risk to residences/sensitive receptors along haulage roads / access routes 	PMU Environment Coordinator and DSC Environment	24 hours prior to activity in question

160. Table 42 outlines management of construction activities and workforce .

Table 42: Management of Construction and Workforce Activities

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Access to Site	Contractor shall ensure that all side and mitre drains and scour check walls on access and haul roads are functioning properly and are well maintained.	DSC Environment Specialist	Weekly and after heavy rains.
		Contractor shall ensure that access roads are maintained in good condition by attending to potholes, corrugations and stormwater damage as soon as these develop.	DSC Environment Specialist	Weekly inspection.
		If necessary, contractor to employ a staff to clean surface roads adjacent to construction sites where materials have been spilt.	DSC Environment Specialist	When necessary
		Contractor to avoid unnecessary compaction of soils by heavy vehicles.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to restrict construction vehicles to demarcated access, haulage routes and turning areas.	DSC Environment Specialist	Ongoing monitoring.
2.	Maintenance of Construction Camp	Contractor to monitor and manage drainage of the camp site to avoid standing water and soil erosion.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure run-off from the camp site must not discharge into neighbors' properties.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to maintain toilets in a clean state and shall be moved to ensure that they adequately service the work areas	DSC Environment Specialist	Weekly inspection

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		Contractor to ensure that open areas or the surrounding bush are not being used as a toilet facility.	DSC Environment Specialist	Weekly inspection
		Contractor to ensure all litter is collected from the work and camp areas daily.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to empty bins and/or skips regularly, dispose wastes at the pre-approved sites, keep all disposal waybills for review.	DSC Environment Specialist	Weekly inspection
		Contractor to ensure eating areas are regularly serviced and cleaned to the highest possible standards of hygiene and cleanliness.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure that his camp and working areas are kept clean and tidy at all times.	DSC Environment Specialist	Weekly monitoring
3.	Staff Conduct	Contractor to monitor performance of construction workers, ensure points relayed during their induction have been properly understood and are being followed. If necessary, the DSC Environment Specialist and/or a translator shall be called to the site to further explain aspects of environmental or social behavior that are unclear.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure rules that are explained in the worker conduct section, ²⁰ must be followed at all times	DSC Environment Specialist	Ongoing monitoring.
4.	Dust and Air Pollution ²¹	Contractor to ensure vehicles travelling to and from the construction site adhere to speed limits so as to avoid producing excessive dust.	DSC Environment Specialist	Ongoing monitoring.
		A speed limit of 30km/hr must be adhered to on all dirt roads.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to dampen access and other cleared surfaces whenever possible and especially in dry and windy conditions to avoid excessive dust.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to utilize screening using wooden supports and shade cloth where dust is unavoidable in residential/commercial/sensitive receptors areas	DSC Environment Specialist	As directed by the DSC Environment Specialist.
		Contractor to keep vehicles and machinery in good working order and meet manufacturers specifications for safety, fuel consumption etc.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to check and repair equipment as soon as possible if excessive emissions are observed.	DSC Environment Specialist	As directed by the DSC Environment Specialist.
		No fires are allowed on site except for	DSC Environment	Ongoing monitoring.

²⁰ (i) no alcohol / drugs to be present on site; (ii) prevent excessive noise; (iii) construction staff are to make use of the facilities provided for them, as opposed to ad-hoc alternatives (e.g. fires for cooking, the use of surrounding bus as a toilet facility are forbidden); (iv) no fires to be permitted on site; (v) trespassing on private / commercial properties adjoining the site is forbidden; (vi) other than pre-approved security staff, no workers shall be permitted to live on the construction site; (vii) no worker may be forced to do work that is potentially dangerous or for what he / she is not trained to do

²¹ Main causes of air pollution during construction are dust from vehicle movements and stockpiles, vehicle emissions and fires.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		the burning of firebreaks.	Specialist	
5.	Soil Erosion	Once an area has been cleared of vegetation, the top layer (nominally 150mm) of soil shall be removed and contractor to stockpile in the designated area.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to commence top soiling and revegetation immediately after completion of an activity and at an agreed distance behind any particular work front.	DSC Environment Specialist	As each activity is completed.
		Contractor to ensure stormwater control and wind screening to prevent soil loss from the site.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to dispose unusable soils and spoils to pre-approved disposal sites ²² .	DSC Environment Specialist	Ongoing monitoring.
		Contractor to protect all embankments, unless otherwise directed by the DSC Environment Specialist, by a cut off drain to prevent water from cascading down the face of the embankment and causing erosion.	DSC Environment Specialist	Immediately after the creation of the embankment/stripping of vegetation.
6.	Stormwater	Contractor shall not in any way modify nor damage the banks or bed of streams, rivers, wetlands, other open water bodies and drainage lines adjacent to or within the designated area, unless required as part of the construction project specification. Where such disturbance is unavoidable, modification of water bodies shall be kept to a minimum in terms of: (i) removal of riparian vegetation; and (ii) opening up of the stream channel	PMU Environment Coordinator and DSC Environment Specialist	Ongoing monitoring.
		Contractor to dispose earth, stones, and rubbles and prevent obstruction of natural water pathway, i.e.: these materials must not be placed in stormwater channels, drainage lines or rivers.	DSC Environment Specialist	Monitoring throughout the duration of the subproject.
		Contractor to check periodically sites' drainage system to ensure that the water flow is unobstructed.	DSC Environment Specialist	Monthly inspection.
		Contractor to control un-channeled flows. Where large areas of soil are left exposed, rows of straw/ hay or bundles of cut vegetation shall be dug into the soil in contours to slow surface wash and capture eroded soil.	DSC Environment Specialist	As surfaces become exposed.
		Contractor to slow down flows where surface run-off is concentrated (e.g. along exposed roadways/tracks by contouring with hay bales or bundled vegetation generated during site clearance operation. If the area must be used for construction vehicles, berms may be used instead. The	DSC Environment Specialist	Ongoing monitoring.

²² Estimated total volume of unused excavated material to be disposed is about 4,800 cubic meters for Palta water works and 157,000 cubic meters (inclusive of 1500 cubic meters of road crust) for Garden Reach water works.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		berms must be at least 30 cm high and well compacted. The berms shall channel concentrated flow into detention ponds or areas protected with hay bales for flow reduction and sediment capture		
7.	Water Quality ²³	Contractor to ensure mixing/decanting of all chemicals and hazardous substances take place either on a tray or on an impermeable surface and dispose waste from these to pre-approved disposal sites.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor to ensure every effort is made that any chemicals or hazardous substances do not contaminate the soil, Hooghly river, or groundwater on site.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor to ensure run-off from vehicle or plant washing does not enter Hooghly river or the groundwater and ensure wash water passes through an oil-grease trap prior to discharge.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor to prohibit site staff in using any stream, river, other open water body or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing or for any construction or related activities. Municipal water (or another source approved by the DSC Environment Specialist) shall instead be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting etc.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor shall refer to emergency contact numbers of WBPCB in order to deal with spillages and contamination of aquatic environments.	PMU Environment Coordinator and DSC Environment Specialist	As necessary
8.	Conservation of Natural Environment	Contractor is to check vegetation clearing and tree-felling have prior permission as the work front progresses.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure only trees that have been marked beforehand are to be removed.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to prohibit site staff from gathering firewood, fruits, plants, crops or any other natural material on-site or in areas adjacent to the sites.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to prohibit site staff from hunting of birds and animals on-site or in areas adjacent to the sites.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to immediately re-vegetate stripped areas and remove aliens species by weeding. This significantly reduces the amount of time and money that must be spent on alien	DSC Environment Specialist	Ongoing monitoring.

²³ Water quality is affected by the incorrect handling of substances and materials. Soil erosion and sediment is also detrimental to water quality. Mismanagement of polluted run-off from vehicle and plant washing and wind dispersal of dry materials into rivers and watercourses are detrimental to water quality.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		plant management during rehabilitation.		
		Contractor to ensure, where possible, cleared indigenous vegetation is kept in a nursery for use at a later stage (such as site rehabilitation process).	DSC Environment Specialist	As the work front progresses.
9.	Materials Management	Contractor to ensure stockpiles do not obstruct natural water pathways.	DSC Environment Specialist.	As necessary.
		Contractor to ensure stockpiles do not exceed 2m in height unless otherwise permitted by the DSC Environment Specialist.	DSC Environment Specialist	As necessary.
		Contractor to cover stockpiles exposed to windy conditions or heavy rain with vegetation, cloth, or tarps.	DSC Environment Specialist	As necessary.
		Contractor to ensure stockpiles are kept clear of weeds and alien vegetation growth by regular weeding	DSC Environment Specialist	Monthly monitoring
		Contractor to ensure all concrete mixing take place on a designated, impermeable surface.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure vehicles transporting concrete to the site are not washed on-site.	Contractor	Ongoing monitoring.
		Contractor to prohibit mixing of lime and other powders during excessively windy conditions.	DSC Environment Specialist	As necessary
		Contractor to store all substances required for vehicle maintenance and repair in sealed containers until they can be disposed of/removed from the sites.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure hazardous substances/materials are transported in sealed containers or bags	DSC Environment Specialist	Ongoing monitoring
		Contractor to prohibit spraying of herbicides/pesticides during windy condition	DSC Environment Specialist	As necessary.
10.	Waste Management	Contractor to place refuse in designated skips/bins, rubbles in demarcated areas, remove from the site, and transport to the pre-approved disposal sites. Waybills proving disposal at each site shall be provided for the DSC Environment Specialist's inspection.	DSC Environment Specialist	Checked at each site meeting.
		Contractor to prohibit littering on-site and clear the site of litter at the end of each working day.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to encourage recycling by providing separate receptacles for different types of waste and make sure that staffs are aware of their uses.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to clean toilets regularly; and avoid contamination of soils, water, pollution and nuisance to adjoining areas.	DSC Environment Specialist	Weekly monitoring.
11.	Social Impacts ²⁴	Contractor to restrict activities and movement of staff to designated construction areas.	DSC Environment Specialist	Ongoing.

²⁴ Regular communication between the Contractor and the interested and affected parties is important for the duration of the contract.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		Contractor to assist in locating DSC Environment Specialist and/or PMU Environment Coordinator in the event a construction staff is approached by members of the public or other stakeholders.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure conduct of construction staff, when dealing with the public or other stakeholders, shall be in a manner that is polite and courteous at all times. Failure to adhere to this requirement may result in the removal of staff from the site.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure disruption of access for local residents is minimized and approved by the DSC Environment Specialist.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to provide walkways and metal sheets where required to maintain access across for people and vehicles.	DSC Environment Specialist	Ongoing monitoring
		Contractor to increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools.	DSC Environment Specialist	Ongoing monitoring
		Contractor to consult businesses and institutions regarding operating hours and factoring this in work schedules.	DSC Environment Specialist	At least 1 week prior to the activity taking place.
		Contractor to inform affected persons in writing of disruptive activities at least 24 hours beforehand. This can take place by way of leaflets giving DSC Environment Specialist and Contractor's details or other method approved by the DSC Environment Specialist.	DSC Environment Specialist	At least 24 hrs prior to the activity taking place.
		Contractor to provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	DSC Environment Specialist	At least 1 week prior to the activity taking place.
		Contractors to ensure lighting on the construction site is be pointed downwards and away from oncoming traffic and nearby houses.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure machinery and vehicles are in good working order to minimize noise nuisance.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to restrict noisy activities to the daytime.	DSC Environment Specialist	Ongoing monitoring.
		A complaints register (refer to the Grievance Redress Mechanism) shall be housed at the site office. This shall be in carbon copy format, with numbered pages. Any missing pages must be accounted for by the Contractor. This register is to be tabled during monthly site meetings.	DSC Environment Specialist	Monthly monitoring.
		Interested and affected people' need to be made aware of the existence of the complaints book and the methods of communication available to them.	PMU Environment Coordinator and DSC Environment Specialist	Ongoing monitoring.
		Contractor to initially handle and document queries and complaints;	PMU Environment Coordinator and	As necessary.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		submit these for inclusion in complaints register; bring issues to DSC Environment Specialist's attention immediately; and take remedial action as per DSC Environment Specialist's instruction	DSC Environment Specialist	
		Contractor to assign staff for formal consultation with the interested and affected people in order to explain and answer questions on the construction process.	DSC Environment Specialist	Ongoing monitoring.
12.	Cultural Environment	Contractor to note possible items of historical or archaeological value include old stone foundations, tools, clayware, jewellery, remains, fossils etc. If something of this nature be uncovered, contractor to stop work immediately and notify the DSC Environment Specialist which in turn inform the PMU and coordinate with ASI or State Department of Archaeology.	DSC Environment Specialist	As required.

161. Table 43 outlines the post-construction activities..

Table 43 : Post-Construction Activities (Defects Liability Period)

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Construction Camp	All structures comprising the construction camp are to be removed from site.	DSC Environment Specialist	Subproject completion
		The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint etc. and these shall be cleaned up.	DSC Environment Specialist	Subproject completion
		All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top-soiled and re-grassed using the guidelines set out in the revegetation specification that forms part of this document.	DSC Environment Specialist	Subproject completion
		The Contractor must arrange the cancellation of all temporary services.	DSC Environment Specialist	Subproject completion
2.	Vegetation	All areas that have been disturbed by construction activities (including the construction camp area) must be cleared of alien vegetation.	DSC Environment Specialist	Subproject completion
		Open areas are to be re-planted as per the revegetation specification.	DSC Environment Specialist	Subproject completion
		All vegetation that has been cleared during construction is to be removed from site or used as much as per the revegetation specification, (except for seeding alien vegetation).	DSC Environment Specialist	Subproject completion
		The Contractor is to water and maintain all planted vegetation until the end of the defects liability period and is to submit a method statement regarding this to the DSC Environment Specialist.	DSC Environment Specialist	Subproject completion
3.	Land Rehabilitation	All surfaces hardened due to construction activities are to be ripped and imported materials thereon	Contractor	Subproject completion

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
		removed.		
		All rubble is to be removed from the site to an approved disposal site. Burying of rubble on site is prohibited.	Contractor	Subproject completion
		The site is to be cleared of all litter.	Contractor	Subproject completion
		Surfaces are to be checked for waste products from activities such as concreting or asphaltting and cleared in a manner approved by the DSC Environment Specialist.	Contractor	Subproject completion
		All embankments are to be trimmed, shaped and replanted to the satisfaction of the DSC Environment Specialist.	DSC Environment Specialist and Contractor	Subproject completion
		Borrow pits are to be closed and rehabilitated in accordance with the pre-approved management plan for each borrow pit. The Contractor shall liaise with the DSC Environment Specialist regarding these requirements.	DSC Environment Specialist	Subproject completion
		The Contractor is to check that all watercourses are free from building rubble, spoil materials and waste materials.	Contractor	Subproject completion
4.	Materials and Infrastructure	Fences, barriers and demarcations associated with the construction phase are to be removed from the site unless stipulated otherwise by the DSC Environment Specialist.	DSC Environment Specialist	Subproject completion
		All residual stockpiles must be removed to spoil or spread on site as directed by the DSC Environment Specialist.	DSC Environment Specialist	Subproject completion
		All leftover building materials must be returned to the depot or removed from the site.	Contractor	Subproject completion
		The Contractor must repair any damage that the construction works has caused to neighboring properties.	Contractors	As directed by the DSC Environment Specialist.
	General	A meeting is to be held on site between the DSC Environment Specialist, PMU Environment Coordinator and the Contractor to approve all remediation activities and to ensure that the site has been restored to a condition approved by the DSC Environment Specialist.	DSC Environment Specialist and PMU Environment Coordinator	On completion of the construction and maintenance phases
		Temporary roads must be closed and access across these blocked.	DSC Environment Specialist and PMU Environment Coordinator	On completion of construction
		Access or haulage roads that were built across watercourses must be rehabilitated by removing temporary bridges and any other materials placed in/or near to watercourses. Revegetation of banks or streambeds must be as necessary to stabilize these and must be approved by the DSC Environment Specialist.	DSC Environment Specialist and Contractor	On completion of construction
		All areas where temporary services were installed are to be rehabilitated to the satisfaction of the DSC Environment Specialist	DSC Environment Specialist and Contractor	On completion of construction

Table 44 : Operation and Maintenance Activities

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Pollution monitoring	Monitor the environmental quality in terms of WTPs discharge, sludge, ambient air and noise levels.	KMC	As specified in the CTO to be issued by WBPCB.
2.	Leaks detection and repairs	Conduct pipe repairs the soonest time possible to avoid disruption of service and disturbance to users/sensitive receptors.	KMC	As necessary.
3.	Sludge reuse and disposal	Implement sludge management plan	KMC	As necessary
4.	Trees and landscaping maintenance	Young trees require sufficient water until their roots are able to tap available groundwater. Make every effort to water existing trees during periods of drought. When pruning cut as close as possible to the branch collar. Do not injure or remove the collar.	KMC	

B. Environmental Monitoring Program

162. Table 45 outlines the environmental monitoring program to ensure implementation of the management and mitigation measures specified in the EMP. The table shall be read within the context of the body of the entire EMP.

Table 45: Environmental Monitoring Program

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
1. Site establishment and preliminary activities						
Legislation, Permits and Agreements	CTE and CTO for the hot mix, stone crushers, and diesel generators)	Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	-	prior to moving onto site and during construction	Contractor	PMU / DSC
	CTE and CTO for the WTPs	Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	-	prior to moving onto site	DSC	PMU
	Cutting Permit for Scheduled Trees	West Bengal Trees (Protection and Conservation in Non-Forest Areas) Act, 2006	-	prior to moving onto site	DSC	PMU
	Copy of EMP	ADB SPS	subproject site, offices, website, library, etc.	at all times	Contractor	PMU/DSC
Access to site	Existing conditions	EMP	all access and haul roads	prior to moving onto site	DSC Environment Specialist	PMU

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
	Road closures and traffic rerouting	Traffic Management Plan and EMP	all affected roads	one week in advance of the activity	DSC Environment Specialist Contractor	PMU
	Notifications and road signages	Traffic Management Plan and EMP	all affected roads	one week in advance of the activity	DSC Environment Specialist Contractor	PMU
Construction camp	Approval of location and facilities	EMP	as identified	prior to moving onto site	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Equipment Lay-down and Storage Area	Approval of location and facilities	EMP	as identified	prior to moving onto site and during site set-up	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Materials management – sourcing	Approval of sources and suppliers	EMP	as identified	prior to procurement of materials	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Education of site staff	Awareness Level Training - Environment - Health and Safety	EMP and records	-	during staff induction, followed by scheduled as determined	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Social impacts	Public Consultations, Information Disclosure, Communication Strategy	EARF, ADB SPS and EMP	subproject site	prior to moving onto site and ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)
	GRM Register	EMP	subproject site	prior to moving onto site and ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)
Noise	Baseline Data for noise level in dB(A) L_{eq}	National Noise Standards	two locations near construction sites as specified by the engineer	prior to site set-up	DSC Environment Specialist and PMU Environment Coordinator in coordination with the Environmental Monitoring Laboratory of KMC	PMU/DSC

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
Air quality	Baseline ambient data for particulate matters 10 and 2.5 (PM ₁₀ , PM _{2.5}), sulfur dioxides (SO ₂), nitrogen dioxide (NO ₂), and hydrocarbons (HC)	National Ambient Air Quality Standards	two locations near construction sites as specified by the engineer	prior to site set-up	DSC Environment Specialist and PMU Environment Coordinator in coordination with the Environmental Monitoring Laboratory of KMC	PMU/DSC
Soil erosion	Soil erosion management measures	EMP	as identified by the engineer	during site set-up and throughout the duration of the subproject	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Stormwater	Stormwater management measures	EMP	as identified by the engineer	during site set-up and throughout the duration of the subproject	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Water quality	Baseline qualitative characteristics	EMP	subproject sites ²⁵	prior to site set-up	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Conservation of Natural Environment	Existing conditions	EMP	subproject sites	prior to site set-up	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Waste management procedure	Disposal sites	EMP	as determined	prior to site set-up and ongoing throughout the subproject	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Cultural environment	Chance finds	ASI Act and EMP	as determined	prior to site set-up and ongoing throughout the subproject	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
2. Construction phase						
Access to Site	Qualitative characteristics	Pre-subproject condition and EMP	all access and haul roads	refer to EMP (table on management of construction)	Contractor	DSC Environment Specialist

²⁵ Subproject sites include approved construction site, equipment lay-down and storage area, watercourses along the subproject site, open drainages

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
				and workforce activities		
Construction camp	Qualitative characteristics	Pre-subproject condition and EMP	all access and haul roads	refer to EMP (table on management of construction and workforce activities)	Contractor	DSC Environment Specialist
Staff conduct	Site Records (Accidents, Complaints)	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Air quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ and HC	National Ambient Air Quality Standards	two locations near construction sites as specified by the engineer (dsc).	once in four months (three times in an year)	Contractor with close coordination with the DSC Environment Specialist and Environmental Monitoring Laboratory of KMC	PMU/DSC
Soil erosion	Soil erosion management measures	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Stormwater	Soil erosion management measures	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Water quality	Qualitative characteristics	EMP and pre-existing conditions	subproject sites	ongoing	Contractor	DSC Environment Specialist
Conservation of Natural Resources	Number of scheduled trees	Tree-cutting permit and EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
	Vegetation conditions	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Materials management	Qualitative characteristics	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Waste management	Qualitative characteristics	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
	Disposal manifests	EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Social impacts	Public Consultations, Information Disclosure, Communication Strategy	EARF, ADB SPS and EMP	subproject sites	ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)
	GRM Register	EMP	subproject sites	ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
Cultural environment	Chance finds	ASI Act and EMP	subproject sites	ongoing	Contractor	DSC Environment Specialist
Noise quality	Noise Level in dB(A) L_{eq}	National Noise standards	two locations near construction sites as specified by the engineer (dsc).	once in four months (three times in an year)	Environmental Monitoring Laboratory of KMC	PMU/DSC
C. Post-construction activities						
Construction camp	Pre-existing conditions	EMP	construction camp	subproject completion	Contractor	DSC Environment Specialist
Vegetation	Pre-existing conditions	Tree-cutting Permit and EMP	subproject sites	subproject completion	Contractor	DSC Environment Specialist
Land rehabilitation	Pre-existing conditions	EMP	subproject sites	subproject completion	Contractor	DSC Environment Specialist
Materials and infrastructure	Pre-existing conditions	EMP	subproject sites	subproject completion	Contractor	DSC Environment Specialist
General	Records	EMP	subproject sites	subproject completion	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
D. Operation and maintenance (defect liability period)						
Air quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂	National Ambient Air Quality Standards	two locations as specified by the era.	once in 6 months (defect liability period)	Environmental Monitoring Laboratory of KMC	PMU/DSC
Noise quality	Noise Level in dB(A) L_{eq}	As per National Noise standards	two locations as specified by the era	once in 6 months (defect liability period)	Environmental Monitoring Laboratory of KMC	PMU/DSC

163. A training program has been developed to build the capability of PMU in implementing the EMP. The suggested outline of the training program is presented in Table 46.

Table 46. Training Program on environmental safeguards and its implementation

Module	Frequency of sessions	Target participants	Conducting agency
Environmental Safeguards Requirements comprising (i) ADB's Safeguards Policy Statement of 2009 (ii) environmental documentation requirements and (iii) Environmental requirements of India particularly those applicable to Tranche 1 subprojects, international obligations (common for all subprojects)	Once in Pre-construction stage	Senior Construction Supervisors of DSC, Engineers, Safety Officers of Contractors, Tranche 1 Senior Engineers	DSC, Tranche 1 with assistance from INRM, ADB, New Delhi and WBPCB
IEE and EMP of Water Supply subproject	Once during Pre-construction	Safety officers of Contractors and	DSC, Tranche 1

Module	Frequency of sessions	Target participants	Conducting agency
	stage	Construction supervisors of DSC	
Workshop on implementation of EMP of Water Supply subproject of Tranche 1 lessons learnt and way forward	Once during Construction stage	Senior Construction Supervisors of DSC, PMC Engineers, Safety Officers of Contractors, Tranche 1 Senior Engineers	DSC, Tranche 1 with assistance from PMU

C. Environmental Management and Monitoring Cost

164. The Contractor's cost for site establishment, preliminary, construction, and defect liability activities will be incorporated into the contractual agreements, which will be binding on him for implementation. The air quality, surface water quality, and noise level monitoring of construction and defect liability phases will be conducted by the contractor.

165. The operation phase mitigation measures are again of good operating practices, which will be the responsibility of implementing agency (KMC). The air quality and noise level monitoring during the operation and maintenance phase will be arranged by KMC and therefore there are no additional costs

166. The activities identified in environmental monitoring program mainly includes site inspections and informal discussions with workers and local people and this will be the responsibility of PMU with the assistance of DSC, costs of which are part of project management.

Table 47: Indicative Costs for EMP Implementation.

Item	Parameters	Project Phase	Sampling Station	Duration and Frequency	Quantity	Unit cost (INR)	Total cost INR)	Source of funds
1. Survey and monitoring							1,500,000	Survey and Investigation /Contingency
Ambient air	PM10, PM2.5, SO2, NO2 and CO	Construction	1 station at Palta 1 station at Garden Reach	2 years per station: 26 weeks in a year (once in two weeks)	312 eight-hourly samples	1,500	468,000	DSC
Water (surface and waste)	Surface water - Total Coliform Organism, pH, Dissolved Oxygen, Biochemical Oxygen Demand Waste water - Suspended solids, pH, Temp, Oil and grease, BOD, COD, Arsenic, Chromium (VI), Lead, Nickel and Cadmium	Construction	1 surface water station at Palta 1 surface water station at Garden Reach 1 discharge point after sludge pond at Palta 1 discharge point after sludge pond at Garden Reach	2 years per station 12 months in a year (once a month)_____	96	3,500	336,000	DSC_____
Sludge/solid waste	Heavy metals – Arsenic, Chromium (VI), Lead, Nickel and Cadmium	Construction	8 working sites (location vary from month to month depending upon opened up work fronts)	2 years 4 measurements in each months for 24 months	192	2,000	384,000	
Noise	Leq in dBA	Construction	Active construction sites	2 years 50 measurements in each month for	1200 measurements	200	240,000	DSC

Item	Parameters	Project Phase	Sampling Station	Duration and Frequency	Quantity	Unit cost (INR)	Total cost INR)	Source of funds
				24 months				
Ground water	Turbidity, Dissolved Solid, Suspended solids, pH, Temp, Oil and grease, BOD, COD, Arsenic, Chromium (VI), Lead, Nickel and Cadmium, F, Cl, SO4, Iron, Zn, Mg, Ca, EC,TC	Construction	4 existing tube wells from palta and garden Reach area	2 2 months ; Once in each month	88	3,000	72,000	DSC
2. Aquatic ecology study							1,500,000	Survey and Investigation /Contingency
Phytoplankton	Species count per unit volume of water_____	Construction	1 in Palta area + 1 in Garden Reach area	Once during each quarter	16 study sessions	25,000	400,000	DSC_____
Zooplankton	Species count per unit volume of water_____	Construction	1 in Palta area + 1 in Garden Reach area	Once during each quarter	16 study sessions	25,000	400,000	DSC_____
Macrophytes	Species count per unit volume of water_____	Construction	1 in Palta area + 1 in Garden Reach area	Once during each quarter	16 study sessions	10,000	160,000	DSC_____
Other aquatic population	Species count per unit volume of water_____	Construction	1 in Palta area + 1 in Garden Reach area	Once during each quarter	16 study sessions	40,000	540,000	DSC_____
3. Capacity building/ Training/ workshop expenses							600,000	Survey and Investigation /Contingency
		Pre-construction			Per	200,000	200,000	
		Construction			2	200,000	400,000	

Item	Parameters	Project Phase	Sampling Station	Duration and Frequency	Quantity	Unit cost (INR)	Total cost INR)	Source of funds
4. Environmental Permits							100,000	Government Counterpart funds
Consent to Establish		Pre-construction	2 WTPs		2	25,000	50,000	
Consent to Operate		Construction	2 WTPs		2	25,000	50,000	
Tree-cutting		Pre-Construction	1 permit		1	10,000	10,000	Government Counterpart funds
Total (INR)							3,700,000	
Total (US\$)							82, 222 (approx)	
Note/s: INR 45 = US\$ 1								

D. Monitoring and Reporting

167. Prior to commencement of any civil work, the contractor will submit a compliance report to DSC ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP will be undertaken. DSC will review the report and thereafter PMU will allow commencement of civil works.

168. DSC will organize an induction course for the training of contractors preparing them on:

- (i). EMP implementation including environmental monitoring requirements related to identified mitigation measures; and
- (ii). taking immediate actions to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation.

169. During the construction phase, results from internal monitoring by the contractor will be reflected in their weekly EMP implementation reports to the DSC Construction Supervisors. These weekly report will be retained in DSC office for reference.

170. Monthly report will be prepared by DSC summarizing compliance with monitoring requirements, details on any noncompliance, remedial actions taken and additional environmental mitigation measures if necessary. The format of the monthly report is given in Appendix 8.

171. Environmental monitoring activities requiring external agencies will be organized by DSC. Based on monthly reports and measurements, DSC will draft a 6-monthly EMP implementation report. The suggested six-monthly monitoring report format will be as follows:

- (i). Introduction
- (ii). Construction activities
- (iii). Report on EMP implementation
- (iv). Environmental conditions
- (v). Measurement or sampling undertaken and monitoring results
- (vi). Findings on compliance status
- (vii). Summary of any non-compliance and remedial actions taken
- (viii). Recommendations for improvement/revision of the mitigation measures and/or implementation, if any.

172. The PMU will review, approve and submit to ADB the 6 monthly EMP implementation progress report. Once concurrence from the ADB is received the report will be uploaded in the Project website.

173. Based on review of environmental monitoring results, future modifications in the EMP could be undertaken with the concurrence of the ADB. These will be generally undertaken, if required, upon review of the 6-monthly EMP progress reports submitted by the PMU to ADB following agreed procedures and mechanisms.

174. For Projects likely to have anticipated adverse environmental impacts during operation, monitoring may continue at the minimum on an annual basis during the operation phase. Monitoring reports will be posted in a location accessible to the public.

175. For projects likely to have significant adverse environmental impacts, the KMC will retain qualified and experienced external experts to verify its monitoring information. The KMC external auditor will document significant monitoring results, identify the necessary

corrective actions, and reflect them in a corrective action plan. The KMC, in each quarter, will study the compliance with the action plan developed in the previous quarter. Compliance with loan covenants will be screened by the KMC.

176. ADB will review project performance against the KMC's commitments as agreed in the legal documents. The extent of ADB's monitoring and supervision activities will be commensurate with the subproject's risks and impacts. Monitoring and supervising of social and environmental safeguards will be integrated into the project performance management system

X. CONCLUSION AND RECOMMENDATIONS

177. The process described in this document has assessed the environmental impacts of all elements of the water supply subproject in Kolkata City. Potential negative impacts were identified in relation to pre- , construction and operation of the improved infrastructure, but no environmental impacts were identified as being due to either the subproject design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

178. The public participation processes undertaken during project design ensure stakeholders are engaged during the preparation of the IEE. The planned information disclosure measures and process for carrying out consultation with affected people will facilitate their participation during project implementation.

179. The subproject's Grievance Redress Mechanism will provide the citizens with a platform for redress of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance.

180. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between KMC, PMU, DSC and the contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with.

181. A copy of the EMP will be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

182. The subproject is unlikely to cause significant adverse impacts because: (i) most of the individual components involve straightforward construction and operation, so impacts will be mainly localized; (ii) in most cases the predicted impacts are likely to be associated with the construction process and are produced because the process is invasive, involving excavation, obstruction at specific construction locations, and earth movements; and (iii) being located mainly in the already constructed water supply facilities and built-up area will not cause direct impact on terrestrial biodiversity values. The potential adverse impacts that are 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.

183. Therefore per ADB SPS, the subproject is classified as environmental Category B and does not require further Environmental Impact Assessment.

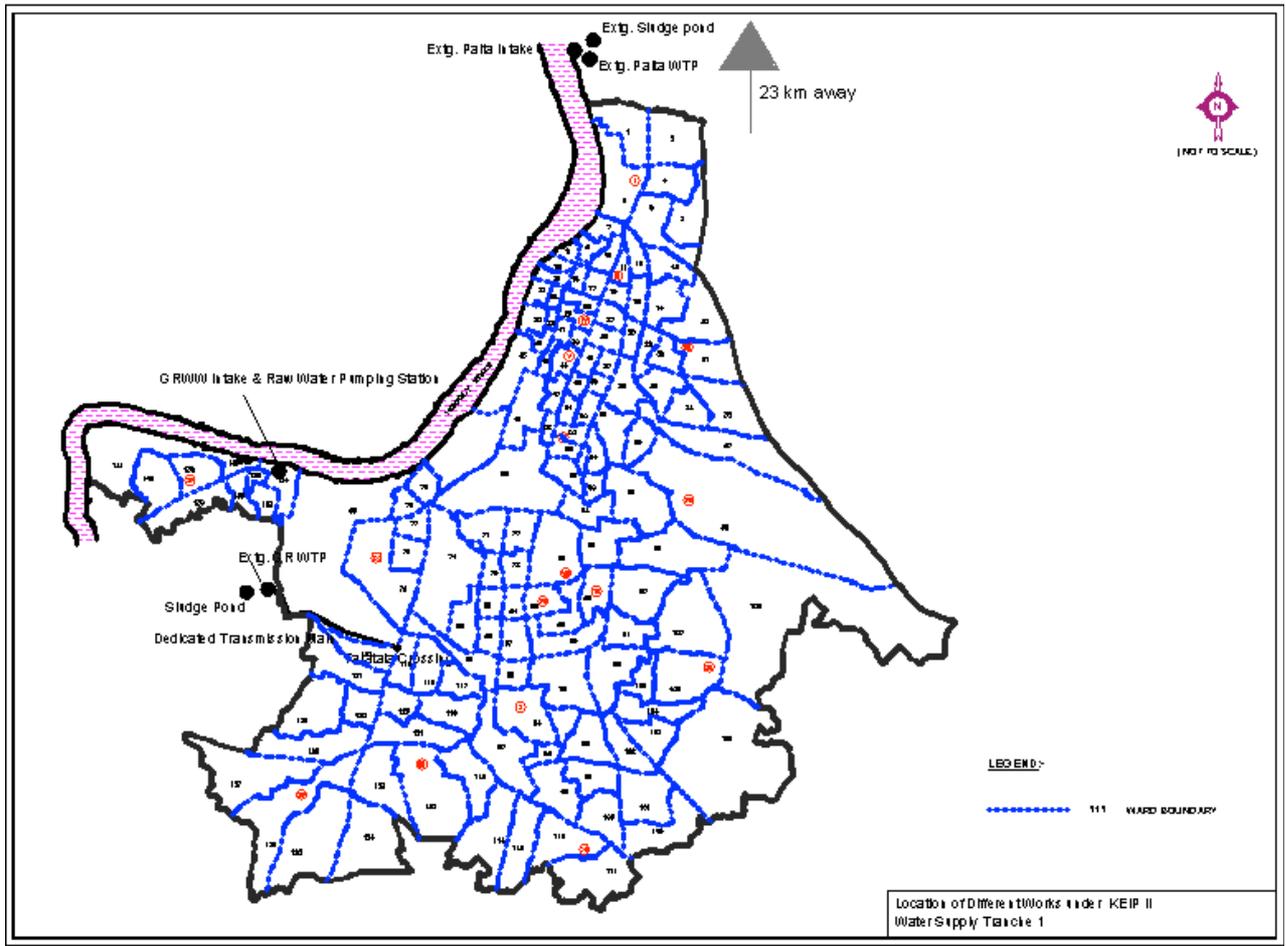


Figure 1 Location of Different Works under Tranche 1 Water Supply Subproject

Appendix 1. Standards Ambient Air, air emission, effluents, receiving water bodies, drinking water at consumer end

A) Notification by Ministry of Environment & Forests, Government of India
Environment (Protection) Seventh Amendment Rules, 2009
Ambient Air Quality Standards

Pollutant	Time Weighted Average	Industrial, Residential, Rural and Other Areas	Sensitive Area (Notified by Central Govt)	Method of Measurement
Sulphur Dioxide (SO ₂), µg/m ³	Annual*	50	20	Improved West & Gaeke method Ultraviolet Fluorescence
	24 hours**	80	80	
Nitrogen Oxide (NO ₂), µg/m ³	Annual*	40	30	Jacobs & Hochheiser modified (NaOH – NaAsO ₂) method <input type="checkbox"/> Gas Chemiluminescence
	24 hours**	80	80	
Particulate Matter (PM ₁₀) (Size <10 µm) µg/m ³	Annual*	60	60	<input type="checkbox"/> Gravimetric <input type="checkbox"/> TOEM <input type="checkbox"/> Beta Attenuation
	24 hours**	100	100	
Particulate Matter (PM _{2.5}) (Size <2.5 µm) µg/m ³	Annual*	40	40	<input type="checkbox"/> Gravimetric <input type="checkbox"/> TOEM <input type="checkbox"/> Beta Attenuation
	24 hours**	60	60	
Ozone (O ₃) µg/m ³	8 hours**	100	100	<input type="checkbox"/> UV photometric <input type="checkbox"/> Chemiluminescence <input type="checkbox"/> Chemical method
	1 hour**	180	180	
Lead (Pb) µg/m ³	Annual*	0.5	0.5	<input type="checkbox"/> AAS method after sampling using EPM 2000 or equivalent filter paper
	24 hours**	1.0	1.0	
Carbon Monoxide (CO), mg/m ³	8 hours**	2.0	2.0	<input type="checkbox"/> Non Dispersive Infrared Spectroscopy
	1 hour**	4.0	4.0	
Ammonia (NH ₃),	Annual*	100	100	<input type="checkbox"/> Chemiluminescence <input type="checkbox"/> Indophenol blue method
	24 hours**	400	400	
Benzene (C ₆ H ₆) µg/m ³	Annual*	5	5	<input type="checkbox"/> Gas Chromatography continuous analyzer <input type="checkbox"/> Adsorption & desorption followed by GC analysis
Benzo(o)pyrene (BaP) particulate phase only ng/m ³	Annual*	1	1	<input type="checkbox"/> Solvent extraction followed by GC/HPLC analysis
Arsenic (As), ng/m ³	Annual*	6	6	<input type="checkbox"/> AAS/ICP method after sampling using EPM 2000 or equivalent filter paper
Nickel (Ni) ng/m ³	Annual*	20	20	<input type="checkbox"/> AAS/ICP method after sampling using EPM 2000 or equivalent filter paper

Source: Central Pollution Control Board, New Delhi, Notification dated 18th November 2009

Notes:

* Indicates Annual Arithmetic Mean of Minimum 104 measurement in a year measured twice a week, 24 hourly at uniform intervals

** 24 hourly/8 hourly/1 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed by not on two consecutive days

B) Emission standards for diesel generator sets

1) CPCB emission regulations, Part IV, COINDS/26/1986-87

Stack Height

The minimum height of stack to be provided with each generator set can be worked out using the following formula:

$$H = h + 0.2x (KVA)^{0.5}$$

where

H = Total height of stack in metre

h = Height of the building in metres where the generator set is installed

KVA = Total generator capacity of the set in KVA

Based on the above formula the minimum stack height to be provided with different range of generator sets may be as follows:

For Generator Sets	Total Height of stack in metre
50 KVA	Height of the building + 1.5 metre
50-100 KVA	Height of the building + 2.0 metre
100-150 KVA	Height of the building + 2.5 metre
150-200 KVA	Height of the building + 3.0 metre
200-250 KVA	Height of the building + 3.5 metre
250-300 KVA	Height of the building + 3.5 metre

Similarly for higher KVA ratings a stack height can be worked out using the above formula.

2) GSR 371(E) 17 May 2002, amendment to Environment (Protection) Rules 2002 and

(The Emission Limits for new diesel engines (up to 800 KW) for Generator Sets (GENSETS) were notified by the Environment (Protection) Amendment Rules 2002 vide GSR 371(E), dated 17th May 2002 at Sl. No. 95 and as amended vide GSR 520(E), dated 1st July 2003, GSR 448 (E) dated 12th July, 2004, GSR 520(E) dated 12th August 2004 and GSR 280(E) dated 11th April, 2008 under Environment (Protection) Act, 1986)

Para 95. Emission limits for new diesel engines (up to 800 W) for gen set application

The emission limits for new diesel engines up to 800 kw, for gen set applications shall be as follows:

Capacity of diesel engine	Date of implementation	Emission limits (g/kw-hr) for				Smoke limit (light absorption coefficient, m-1) (at full load)	Test cycle	
		NO _x	HC	CO	PM		Torque %	Weight-ing factors
Up to 19 KW	1.7.2005	9.2	1.3	3.5	0.3	0.7	100 75	0.05 0.25
> 19 KW up to 176 KW	1.1.2004 1.7.2004	9.2 9.2	1.3 1.3	5.0 3.5	0.5 0.3	0.7 0.7	50 25	0.30 0.30
> 176 KW up to 800 KW	1.11.2004	9.2	1.3	3.5	0.3	0.7	10	0.10

3) Environment Protect third amendment rules 2002 vide 489(E) 9 July, 2002

Para 96. Emission standards for diesel engines (engine rating more than 0.8 Mw (800 Kw) for power plant, generator set applications and other requirements

Parameter	Area Category	Total engine rating of the plant (includes existing as well as new generator sets)	Gerator sets commissioning date		
			Before 1/7/2003	Between 1/7/2003 and 1/7/2005	On or after 1/7/2005
NO _x (as NO ₂) (AT 15% O ₂), dry basis, in ppmv	A	Up to 75MW	1100	970	710
	B	Up to 150MW			
	A	More than 75MW	1100	710	360
	B	More than 150MW			
NMHC (as C) (at 15% O ₂), mg/Nm ³	Both A and B		150	100	
PM (at 15% O ₂), mg/Nm ³	Diesel Fuels - HSD & LDO	Both A and B	75	75	
	Furnace Oils - LSHS & FO	Both A and B	150	100	
CO (at 15% O ₂), mg/Nm	Both A and B		150	150	
Sulphur content in fuel	A		<2%		
	B		<4%		

Fuel specification	For A only	Up to 5MW	Only Diesel Fuels (HSD, LDO) shall be used.
Stack height (for generator sets commissioned after 1/7/2003)	Stack height shall be maximum of the following, in meter: (i) $14 Q^{0.3}$, Q = Total SO ₂ emission from the plant in kg/hr (ii) Minimum 6 m above the building where generator set is installed. (iii) 30 m.		

Note:

- Acronyms used: MW : Mega (10⁶) Watt, FO : Furnace Oil, NO_x : Oxides of Nitrogen: HSD : High Speed Diesel, NO₂ : Nitrogen Dioxide, LDO : Light Diesel Oil; O₂ : Oxygen, LSHS : Low Sulphur Heavy Stock, NMHC : Non- Methane Hydrocarbon kPa : Kilo Pascal, C : Carbon, mm : Milli (10⁻³) metre, PM : Particulate Matter kg/hr : Kilo (10³) gram per hour, CO : Carbon Monoxide, mg/Nm³ : Milli (10⁻³) gram per ; SO₂ : Sulphur Dioxide Normal metre cubic, ppmv : part per million (10⁶) by volume
- Area categories A and B are defined as follows:

Category A: Areas within the municipal limits of towns/cities having population more than 1million and also up to 5 km beyond the municipal limits of such towns/cities.

Category B: Areas not covered by category A.

4. Individual units with engine ratings less than or equal to 800 KW are not covered by this notification.

5. Only following liquid fuels viz. High Speed Diesel, Light Diesel Oil, Low Sulphur Heavy Stock and Furnace Oil or liquid fuels with equivalent specifications shall be used in these power plants and generator sets.

6. For expansion Project, stack height of new generator sets shall be as per total Sulphur Dioxide emission (including existing as well as additional load).

7. For multi engine plants, fuels shall be grouped in cluster to get better plume rise and dispersion. Provision for any future expansion should be made in planning stage itself.

8. Particulate Matter, Non-Methane Hydrocarbon and percent moisture (dry basis). Carbon Monoxide results -are to be normalized to 25°C, 1.01 Kilo Pascal (760 mm of mercury) pressure and zero

9. Measurement shall be performed at steady load conditions of more than 85% of the rated load.

10. Continuous monitoring of Oxides of Nitrogen shall be done by the plants whose total engine capacity is more than 50 Mega Waft. However, minimum once in six month monitoring for other parameters shall be adopted by the plants.

ii) Effluent

A) Schedule VI of Environment (Protection) Rules, 1986

General standards for discharge of environmental pollutants: Effluents

Sl no	Parameter	Standards			
		Inland surface water	Public sewers	Land of Irrigation	Marine/ coastal areas
		(a)	(b)	(c)	(d)
1.	Colour and odour	remove as far as practicable			
2.	Suspended solids, mg/l. max.	100	600	200	(a) For process waste water 100 (b) For cooling water effluent 10% above total suspended matter of influent.
3.	Particle size of suspended solids	shall pass 850 micron IS Sieve			(a) Floatable solids, max. 3mm. (b) Settable solids (max 850 micron)
4.	pH value	5.5. to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5.	Temperature	shall not exceed 50°C above the receiving water temperature			shall not exceed 50°C above the receiving water temperature
6.	Oil and grease, mg./l, max.	10	20	10	20
7.	Total residual chlorine, mg/l. max.	1.0			1.0
8.	Ammonical nitrogen (as N.) mg/l max	50	50		50
9.	Total Kjeldahl Nitrogen (as NH ₃) mg/l. max	100			100
10.	Free ammonia (as NH ₃), mg/l.max	5.0			5.0
11.	Biochemical oxygen demand (3 days at 27°C), mg/l. max.	30	350	100	100
12.	Chemical oxygen demand, mg/l, max.	250			250

13.	Arsenic (as As) mg/l, max.	0.2	0.2	0.2	0.2
14.	Mercury (as Hg), mg/l, max.	0.1	0.1	0.1	0.1
15.	Lead (as Pb) mg/l, max	0.1	1.0		2.0
16.	Cadmium (as Cd) mg/l, max	2.0	1.0		2.0
17.	Hexavalent chromium (as Cr. +6). Mg/l, max	0.1	2.0		1.0
18.	Total Chromium (as Cr) mg/l, max	2.0	2.0		2.0
19.	Copper (as Cu) mg/l, max	3.0	3.0		3.0
20.	Zinc (as Zn) mg/l, max	5.0	15		15
21.	Selenium (as Se) mg/l, max	0.05	0.05		0.05
22.	Nickel (as Ni) mg/l, max	3.0	3.0		5.0
23.	Cyanide (as CN) mg/l, max	0.2	2.0	0.2	0.2
24.	Fluoride (as F) mg/l, max	2.0	15		15
25.	Dissolved phosphates (as P) mg/l, max	5.0			
26.	Sulfide (as S) mg/l, max	2.0			5.0
27.	Phenolic compounds (as C ₆ H ₅ OH) mg/l, max	1.0	5.0		5.0
28.	Radioactive materials: (a)Alfa emitters microcurie/ml, max. (b)Beta emitters micro curie/ml, max.	10 ⁻⁷ 10 ⁻⁶	10 ⁻⁷ 10 ⁻⁶	10 ⁻⁸ 10 ⁻⁷	10 ⁻⁷ 10 ⁻⁶
29.	Bio-assay test	90% Survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30.	Manganese (as Mn)	2 mg/l	2 mg/l		2 mg/l
31.	Iron (as Fe)	3 mg/l	3 mg/l		3 mg/l
32.	Vanadium (as V)	0.2 mg/l	0.2 mg/l		0.2 mg/l
33.	Nitrate Nitrogen	10 mg/l			20 mg/l

These standards shall be applicable for industries, operations or process other than those industries operations or process for which standards have been specified in schedule of the Environment Protection Rules, 1989

B) CPCB Primary Water Quality Criteria

The Central Pollution Control Board (CPCB), an apex body in the field of water quality management, has developed a concept of "designated best use". According to which, out of several uses a particular water body is put to, the use which demands highest quality of water is called its "designated best use", and accordingly the water body is designated. The CPCB has identified 5 such "designated best uses". All those water bodies, which are used for drinking without any treatment, but with disinfection (chlorination), are termed as "A" Class Water, those which are used for outdoor bathing are termed as "B" Class Water, those which are used for drinking after conventional treatment are termed as "C" Class Water, those which are used for propagation of wildlife and fisheries are termed as "D" Class Water and those which are used for irrigation, cooling and controlled waste disposal are termed as "E" Class Water. For each of these five "designated best uses", the CPCB has identified water quality requirements in terms of few chemical characteristics, known as primary water quality criteria. The "designated best uses" along with respective water quality criteria is given in Table below.

Table. Best use based classification of surface waters in India

S.No	Designated-Best-Use	Class of Water	Criteria
1	Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliform Organism MPN/100 ml: 50 or less 2. pH: between 6.5 and 8. 3. Dissolved Oxygen: 6mg/1 or more 4. Biochemical Oxygen Demand 5 days 20°C: 2mg/1 or less
2	Outdoor bathing (Organised)	B	1. Total Coliform Organism MPN/100 ml: 500 or less 2. pH: between 6.5 and 8.5 3. Dissolved Oxygen: 5mg/1 or more

S.No	Designated-Best-Use	Class of Water	Criteria
			4. Biochemical Oxygen Demand 5 days 20°C: 3mg/1 or less
3	Drinking water source after conventional treatment and disinfection	C	1. Total Coliform Organism MPN/100 ml: 5000 or less 2. pH: between 6 to 9 3. Dissolved Oxygen: 4mg/1 or more 4. Biochemical Oxygen Demand 5 days 20°C: 3mg/1 or less
4	Propagation of Wild life and Fisheries	D	1. pH: between 6.5 to 8.5 2. Dissolved Oxygen: 4mg/1 or more
5	Irrigation, Industrial Cooling, Controlled waste disposal	E	1. pH: between 6.0 to 8.5 2. Electrical Conductivity at 25OC micro mhos/cm: Max 2250 3. Sodium Absorption Ratio Max.: 26 4. Boron Max.: 2mg/1

C) Drinking water standard at consumer end is under revision and the draft version is given in the following Table

Indian Standards for Drinking Water - Specification (BIS 10500: 1991) revised draft 2009

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
1. Organoleptic and physical parameters						
i)	Colour, Hazen units, Max	5	Above 5 consumer acceptance decreases	15	3025 (Part 5)	
ii).	Odour	Agreeable	-	Agreeable	3025 (Part 5)	a)Test cold when heated b)Test at several dilutions
iii)	Taste	Agreeable	-	Agreeable	3025 (Part 7 & 8)	Test to be conducted only after safety has been established
iv)	Turbidity, NTU, Max	1	Above 5 consumer acceptance decreases	5	3025 (Part 10)	-
v)	Dissolved solids, mg/l, Max	500	Beyond this palatability decreases and may cause gastrointestinal irritation	2000	3025 (Part 16)	-
vi)	pH Value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and/or water supply system	No Relaxation	3025 (Part 11)	-
vii)	Total hardness (as CaCO ₃), mg/l., Max	200	Encrustation in water supply structure and adverse effects on domestic use	600	3025 (Part 21)	
Note 1: It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under the water not acceptable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under permissible limit in the absence of alternate source in col (5), above which the sources will have to be rejected.						
General parameters concerning substances undesirable in excessive amounts						
i)	Iron (as Fe) mg/l, Max	0.3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria	No relaxation	3025 (Part 53)	Total concentration of Manganese (as Mn) and Iron (as Fe) shall not exceed 0.3 mg/l
ii)	Aluminium (as Al), mg/l, Max	0.1	Beyond this limit taste/appearance are	0.3	IS 3025 (Part 59)	-

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
			affected, has adverse effect on domestic uses and water supply structures			
iii)	Copper (as Cu), mg/l, Max	0.05	Astringent taste, discoloration and corrosion of pipes, fittings and utensils will be caused beyond this	1.5	IS 3025 (Part 42)	-
iv)	Manganese (as Mn), mg/l, Max	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures	0.3	IS 3025 (Part 59)	Total concentration of Manganese (as Mn) and Iron (as Fe) shall not exceed 0.3 mg/l
v)	Zinc (as Zn), mg/l, Max	5	Beyond this limit it can cause astringent taste and an opalescence in water	15	IS 3025 (Part 49)	-
vi)	Magnesium (as Mg), mg/l, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	No relaxation	IS 3025 (Part 46)	-
vii)	Barium (as Ba), mg/l, Max	0.7	May lead to cardiovascular problem	No relaxation	Annex F of IS 13428*/ S 15302	-
viii)	Calcium (as Ca) mg/l, Max	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 40)	-
ix)	Silver (as Ag), mg/l, Max	0.1	-	No relaxation	Annex J of IS 13428	-
x)	Selenium (as Se), mg/l, Max	0.01	Beyond this the water becomes toxic	No relaxation	3025 (Part 56) or IS 15303*	-
xi)	Molybdenum (as Mo), mg/l, Max	0.07	Beyond this it may cause osteoporosis/bone disorders	No relaxation	3025 (Part 2; 2002)/ ISO 11885: 1996	-
xii)	Boron (as B), mg/l, Max	0.5	-	1.0	3025 (Part 57)	-
xiii)	Nitrate (as NO ₃) mg/l, Max	45	Beyond this methaemoglobinamia takes place/may be indicative of pollution	No relaxation	3025 (Part 34)	
xiv)	Sulfate (as SO ₄) mg/l, Max	200	Beyond this causes gastro intestinal irritation when magnesium or sodium is present	400	3025 (Part 24)	May be extended to 400 provided that Mg does not exceed 30
xv)	Sulphide (as H ₂ S), mg/l, Max	Below detectable limit	Beyond this it may cause objectionable taste and odour	No relaxation	3025 (Part 29)	-
xvi)	Fluoride (as F) mg/l, Max	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	3025 (Part 60)	-
xvii)	Chlorides (as Cl) mg/l, Max.	250	Beyond this taste corrosion and palatability are affected	1000	3025 (Part 32)	-
xviii)	Ammonia (as	0.5	Toxicological effect	No	3025 (Part	-

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
	total ammonia – N), mg/l, Max		about 200 mg per kg of body weight	relaxation	34)	
xix)	Chloramines (as Cl ₂), mg/l, Max	0.2	Eyes, nose irritation, anaemia, stomach discomfort	No relaxation	3025 (Part 26) or APHA 4500-CIG	-
xx)	Residual, Free chlorine, mg/l, Min	0.2	-	-	3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l.
xxi)	Total alkalinity in Calcium carbonate, mg/l, Max	200	Beyond this limit taste becomes unpleasant	600	3025 (Part 23)	-
xxii)	Phenolic Compounds (as C ₆ H ₅ OH) mg/l, Max.	0.001	Beyond this may cause objectionable taste and odour	0.002	3025 (Part 43)	-
xxiii)	Mineral Oil mg/l, Max	Below detectable limit	Beyond this limit undesirable taste and odour after chlorination takes place	No relaxation	3025 (Part 39) Infra red partition method	-
xxiv)	Anionic detergents (as MBAS) mg/l, Max	0.2	Beyond this limit it can cause a light froth in water	1.0	Annex K to IS 13428-	-

Note 2: in case of dispute, the method by ** shall be referee method.

Note 3: It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under Acceptable render the water not acceptable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under permissible limit in the absence of alternate source in col (5), above which the sources will have to be rejected.

Parameters concerning toxic substances

i)	Total Chromium (as Cr ₆₊), mg/l, Max	0.05	May be carcinogenic above this limit	No relaxation	3025 (part 52)	-
ii)	Total Arsenic (as As) mg/l, Max	0.01	Beyond this the water becomes toxic	0.05	3025 (part 37)	
iii)	Mercury (as Hg) mg/l, Max	0.001	Beyond this the water becomes toxic	No relaxation	3025 (part 48)/Mercury Analyser	-
iv)	Cadmium (as Cd) mg/lit, Max	0.003	Beyond this the water becomes toxic	No relaxation	3025 (part 41)	
v)	Lead (as Pb) mg/l, Max	0.01	Beyond this the water becomes toxic	No relaxation	3025 (part 47)	
vi)	Nickel (as Ni), mg/l, Max	0.02	Beyond this the water becomes toxic	No relaxation	3025 (part 54)	
vii)	Cyanide (CN), mg/l, Max	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 27)	
viii)	Polynuclear	0.0001	May be carcinogenic	No	APHA 6440	-

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
	Aromatic Hydrocarbons (as PAH), mg/l, Max			relaxation		
ix)	Polychlorinated biphenyls, mg/l. Max	0.0005	May be carcinogenic	No relaxation	ASTM 5175/APHA 6630	-

Bacteriological quality of drinking water	
Organisms	Guidelines
E. coli or thermotolerant coliform bacteria	Must not be detectable in any 100 ml sample
Total coliform bacteria	Must not be detectable in any 100 ml sample

Appendix 2. Noise standards

A). Noise Pollution (Regulation and Control) Rules, 2002 as amended up to 2010

Rule 3. Ambient air quality standards in respect of noise for different areas/zones

(1) The ambient air quality standards in respect of noise for different areas/zones shall be such as specified below

(2) The State Government shall categorize the areas into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.

(5) An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area/zone for the purpose of these rules.

Area Code	Category of Area	Limit in dB(A) Leq	
		Day Time	Night Time
A.	Industrial area	75	70
B.	Commercial area	65	55
C.	Residential area	55	45
D.	Silence zone	50	40

Notes:

1. Day time is reckoned in between 6 a.m. and 10 p.m.

2. Night time is reckoned in between 10 PM and 6 AM.

3. Silence zone is an area comprising not less than 100 m around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority

4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq is an energy mean of the noise level over a specified period.

Rule 5. Restrictions on the use of Loud Speakers/Public Address system and sound producing instruments

(2) Any sound producing instrument shall not be used at night time except in closed premises for communication within, like auditoria, conference rooms, community halls, banquet halls or during a public emergency;

(4) The noise level at the boundary of the public place, where any noise source is being used shall not exceed 10 dB (A) above the ambient noise standards for the area or 75 dB (A) whichever is lower;

Rule 5A. Restrictions on the use of sound emitting construction equipments.

(3) Sound emitting construction equipments shall not be used or operated during night time in residential areas and silence zones.

B) Noise limit for generator sets run with petrol or kerosene

The noise limit for generator sets run with petrol or kerosene notified by Environment (Protection) (Amendment) Rules, 2000, vide G.S.R. 742 (E), dated 25th September, 2000, at serial no. 91, and as amended by Environment (Protection) (Amendment) Rules, 2001, vide G.S.R. 628 (E), dated 30th August, 2001 and Environment (Protection) (Amendment) Rules, 2011, vide G.S.R. 215 (E), dated 15th March, 2011, under the Environment (Protection) Act, 1986 is as follows:

	Noise Limit from	
	September 1, 2002	September 1, 2003
Sound Power Level LWA	90 dBA	86 dBA

C) Noise limit for generator sets run with diesel

Noise limit for Generator Sets run with Diesel notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17th May 2002 at serial no.94 and its amendments vide GSR No 520(E) dated 1st July 2003; GSR 448(E), dated 12th July 2004; GSR 315(E) dated 16th May 2005; GSR 464(E) dated 7th August 2006; GSR 566(E) dated 29th August 2007 and GSR 752(E) dated 24th October 2008; G.S.R. 215 (E), dated 15th March, 2011 under the Environment (Protection) Act, 1986) is as follows:

Para 50. Noise limit for diesel generator sets (up to 1000 KVA) manufactured on or after the 1st January, 2005

The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity up to 1000 KVA, manufactured on or after the 1st January, 2005 shall be 75 dB(A) at 1 metre from the enclosure surface. The diesel generator sets should be provided with integral acoustic enclosure at the manufacturing stage itself.

The implementation of noise limit for these diesel generator sets shall be regulated as given in paragraph 3 below.

2. Noise limit for DG sets not covered by paragraph 1.

Noise limits for diesel generator sets not covered by paragraph 1, shall be as follows:-

2.1 Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the users end.

2.2 The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction up to actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure/ room, then averaged.

2.3 The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).

2.5 Guidelines for the manufacturers/ users of Diesel Generator sets shall be as under:-

01. The manufacturer shall offer to the user a standard acoustic enclosure of 25 dB (A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB(A).

02. The user shall make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper citing and control measures.

03. Installation of DG set must be strictly in compliance with the recommendations of the DG set manufacturer.

04. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

GSR.7 dated 22 December 1998 amendment to Environment Protection Rules 1986

83. Standards/guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) Sets.

(i) Noise Standards for DG Sets (15-500 KVA)

The total sound power level, L_w , of a DG set should be less than, $94 + 10 \log_{10} (KVA)$, dB(A), at the manufacturing stage, where, KVA is the nominal power rating of a DG set.

This level should fall by 5 dB(A) every five years, till 2007, i.e. in 2002 and then in 2007.

(ii) Mandatory acoustic enclosure/acoustic treatment of room for stationary DG sets (5 KVA and above)

Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the room acoustically.

The acoustic enclosure/acoustic treatment of the room should be designed for minimum 25 dB(A) Insertion Loss or for meeting the ambient noise standards, which ever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction up to actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5m from the acoustic enclosure/room, and then averaged.

The DG set should also be provide with proper exhaust muffler with Insertion Loss of minimum 25 dB(A).

(iii) Guidelines for the manufacturers/users of DG sets (5KVA and above)

01 The manufacturer should offer to the user a standard acoustic enclosure of 25 dB(A) insertion Loss and also a suitable exhaust muffler, with insertion loss of 25dB(A).

02. The user should make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise

03 The manufacturer should furnish noise power levels of the unsilenced DG sets as per standards prescribed under (A).

04. The total sound power level of a DG set, at the user's end, shall be within 2 dB(a) of the total sound power level of the DG set, at the manufacturing stage as prescribed under (A).

05. Installation of a DG set must be strictly in compliance with the recommendations of the DG set manufacturer.

06. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

D) GSR 742(E) dated 30.08.1990 amended GSR 422 (E) dated 19 May, 1993

Noise limits for domestic appliances and construction equipments at the manufacturing stage in dB(A)

Window air conditioners of 1 -1.5 tonne	68
Air coolers	60
Refrigerators	46
Compactors (rollers), front loaders, concentrate mixers, cranes (movable), vibrators and saws	75

Appendix 3. Occupational noise exposure
National Institute of Occupational Safety and Health
Criteria for a recommended standard: occupational noise exposure
NIOSH Publication no. 98-126

Combination of noise exposure levels and duration that no worker exposure shall equal or exceed

Exposure Level (dBA)	Duration		
	Hours	Minutes	Seconds
80	25	24	-
81	20	10	-
82	16	-	-
83	12	42	-
84	10	5	-
85	8	-	-
86	6	21	-
87	5	2	-
88	4	-	-
89	3	10	-
90	2	31	-
91	2	-	-
92	1	35	-
93	1	16	-
94	1	-	-
95	-	47	37
96	-	37	48
97	-	30	-
98	-	23	49
99	-	18	59
100	-	15	-
103	-	7	30
105	-	4	43
110	-	1	29

**Appendix 4. Hazardous Wastes
(Management Handling and Transboundary Movement) Rules, 2008**

S.O. 2265 (E) dated 24 September, 2008

Rule 3. Hazardous waste means waste which by reasons of any of its physical, chemical, reactive, toxic, inflammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include wastes having constituents specified in Schedule II if their concentration is equal to or more than the limit indicated in the said schedule.

5. Grant of authorization for handling hazardous wastes

(a) Every person who is engaged in generation, processing, treatment, packaging, storage, transportation, use, collection, destruction, conversion offering for sale, transfer or the like of the hazardous waste shall require to obtain an authorization from the WBPCB.

(b) The hazardous waste shall be collected, treated, re-cycled, re-processed, stored or disposed of only in only in such facilities as may be authorized by the WBPCB for the purpose

Schedule 2

List of Waste Constituents with Concentration Limits*

Class A

Concentration limit: □ 50 mg/kg

- A1 Antimony and antimony compounds
- A2 Arsenic and arsenic compounds
- A3 Beryllium and beryllium compounds
- A4 Cadmium and cadmium compounds
- A5 Chromium (VI) compounds
- A6 Mercury and mercury compounds
- A7 Selenium and selenium compounds
- A8 Tellurium and tellurium compounds
- A9 Thallium and thallium compounds
- A10 Inorganic cyanide compounds
- A11 Metal carbonyls
- A12 Naphthalene
- A13 Anthracene
- A14 Phenanthrene
- A15 Chrysene, benzo (a) anthracene, fluoranthene, benzo (a) pyrene, benzo (K) fluoranthene, indeno (1, 2, 3-cd) pyrene and benzo (ghi) perylene
- A16 halogenated compounds of aromatic rings, e.g. polychlorinated biphenyls, polychloroterphenyls and their derivatives
- A17 Halogenated aromatic compounds
- A18 Benzene
- A19 Organo-chlorine pesticides
- A20 Organo-tin Compounds

Class B

Concentration limit: □ 5,000 mg/kg

- B1 Chromium (III) compounds
- B2 Cobalt compounds
- B3 Copper compounds
- B4 Lead and lead compounds
- B5 Molybdenum compounds
- B6 Nickel compounds
- B7 Inorganic Tin compounds
- B8 Vanadium compounds
- B9 Tungsten compounds
- B10 Silver compounds
- B11 Halogenated aliphatic compounds
- B12 Organo phosphorus compounds

- B13 Organic peroxides
- B14 Organic nitro-and nitroso-compounds
- B15 Organic azo-and azoxy compounds
- B16 Nitriles
- B17 Amines
- B18 (Iso-and thio-) cyanates
- B19 Phenol and phenolic compounds
- B20 Mercaptans
- B21 Asbestos
- B22 Halogen-silanes
- B23 Hydrazine (s)
- B24 Fluorine
- B25 Chlorine
- B26 Bromine
- B27 White and red phosphorus
- B28 Ferro-silicate and alloys
- B29 Manganese-silicate
- B30 Halogen-containing compounds which produce acidic vapours on contact with humid air or water, e.g. silicon tetrachloride, aluminium chloride, titanium tetrachloride

Class C

Concentration limit: □ 20, 000 mg/kg

- C1 Ammonia and ammonium compounds
- C2 Inorganic peroxides
- C3 Barium compounds except barium sulphate
- C4 Fluorine compounds
- C5 Phosphate compounds except phosphates of aluminium, calcium and iron
- C6 Bromates, (hypo-bromites)
- C7 Chlorates, (hypo-chlorites)
- C8 Aromatic compounds other than those listed under A12 to A18
- C9 Organic silicone compounds
- C10 Organic sulphur compounds
- C11 Iodates
- C12 Nitrates, nitrites
- C13 Sulphides
- C14 Zinc compounds
- C15 Salts of per-acids
- C16 Acid amides
- C17 Acid anhydrides

Class D

Concentration limit: □ 50, 000 mg/kg

- D1 Total Sulphur
- D2 Inorganic acids

- D3 Metal hydrogen sulphates
- D4 Oxides and hydroxides except those of hydrogen, carbon, silicon, iron, aluminum, titanium, manganese, magnesium, calcium
- D5 Total hydrocarbons other than those listed under A12 to A18
- D6 Organic oxygen compounds
- D7 Organic nitrogen compounds expressed as nitrogen
- D8 Nitrides
- D9 Hydrides

Class E

Regardless of concentration limit, Classified as hazardous wastes if the waste exhibits any of the following Characteristics.

- E1 **Flammable**
Flammable wastes with flash point 65.6°C or below.
- E2 **Explosive**
Wastes which may explode under the effect of flame, heat or photochemical conditions. Any other waste of explosive materials included in the Indian Explosive Act.
- E3 **Corrosive**
Wastes which may be corrosive, by chemical action, will cause severe damage when in contact with living tissue.
- E4 **Toxic**
Wastes containing or contaminated with established toxic and or eco- toxic constituents.
- E5 **Carcinogenicity, Mutagenicity and Endocrine disruptivity**
Wastes contaminated or containing established carcinogens, mutagens and endocrine disruptors.

*Waste constituents and their concentration limits given in this list are based on erstwhile BAGA (the Netherlands Environment Protection Agency) List of Hazardous Substances. In order to decide whether specific wastes listed above is hazardous or not, following points be taken into consideration:

- (i) If a component of the waste appears in one of the five risk classes listed above (A,B,C,D or E) and the concentration of the component is equal to or more than the limit for the relevant risks class, the material is then classified as hazardous waste.
- (ii) If a chemical compound containing a hazardous constituent is present in the waste, the concentration limit does not apply to the compound, but only to the hazardous constituent itself.
- (iii) If multiple hazardous constituents from the same class are present in the waste, the concentrations are added together.
- (iv) If multiple hazardous constituents from different classes are present in the waste, the lowest concentration limit corresponding to the constituent(s) applies.
- (v) For determining the concentration of the hazardous constituents in the waste "Toxicity Characteristics Leaching Procedure (TCLP) as per ASTM-D5233-92 should be adopted.

Appendix 5. Rapid Environmental Assessment (REA) Checklist

(Water Supply)

Instructions:

This checklist is to be prepared to Support the environmental classification of a project It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Regional and Sustainable Development Department This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.

This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on (i) involuntary resettlement, (ii) indigenous peoples' planning, (iii)poverty reduction, (iv) participation, and (v) gender and development

Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts use the "remarks" section to discuss any anticipated mitigation measures.
Country/Project Title:

Sector Division:

Screening Questions	Yes/No		Remarks
A. Project Siting , Is the subproject area...			
Densely populated?'	+		Kolkata has a population of about 4.5 million residing within an area of about 185 sq.km and therefore densely populated
Heavy with development activities?		+	About 60% of Kolkata is residential area with industry occupying only about 5 % of the area. Infra structural development is however picking up
Adjacent to or within any environmentally sensitive areas?			
Cultural heritage; site		+	
Protected Area		+	
Wetland	+		East Kolkata Wetland (a Ramsar site) is on the eastern fringe of the city
Mangrove		+	
Estuarine		+	
Buffer zone of protected area		+	
Special area for protecting biodiversity		+	
Bay		+	
B. Potential Environmental Impacts Will the Project cause...			
pollution of raw water supply from upstream wastewater discharge from communities. industries, agriculture and soil erosion runoff?		+	The water supply source is Hooghly river, a distributary of Ganga river. The river water is already somewhat polluted from existing industrial and domestic pollution in the upstream. The project will not cause any additional pollution from waste water discharge
Impairment of historical/cultural monuments/areas and loss/damage to these sites?		+	
Hazard of land subsidence caused by excessive ground water pumping ?		+	No additional ground water extraction is envisaged
social conflicts arising from displacement of communities?		+	Displacement of communities will not be required. Small scale dislocation of business may be expected from water transmission pipe laying works for which RP will

			be in place
conflicts in abstraction of raw water for Water supply with other beneficial water uses for surface and ground waters?		+	No new water intake arrangement is contemplated. There is no proposal to draw ground water. Present drawal of raw water from Hooghly river is small compared to the discharge
unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		+	The raw water is trefable to national standard
delivery of unsafe Water to distribution system?		+	
inadequate protection of intake works or wells, leading to pollution of water supply?		+	The intake will be refurbished to make them secure
over pumping of ground water, leading to salinization and ground subsidence?		+	Raw water is being sourced from river water
excessive algal growth in storage reservoir?		+	Not anticipated although there are reports of algal growths in filter beds during winter months
increase in production of sewage beyond capabilities of community facilities?		+	Sewage system development is a part of the Invst Program
inadequate disposal of sludge from water treatment plants?		+	Sludge management is being refurbished under the Subproject
inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		+	No new pumping stations are being established; pumps are being replaced with sets conforming to noise standards
. impairments associated with transmission lines and access roads?	+		Expected only during the construction stage; mitigation measures will be in place
health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		+	Chlorine dosing through chlorinator will be continued; separate storing areas exist for the chemicals
health and safety hazards to workers from the management of chlorine used for disinfection and other contaminants?		+	Personal Protective Equipments will continue to be provided to workers; a standard O and M procedure will be introduced
dislocation or involuntary resettlement of people		+	Not expected
social conflicts between construction workers from other areas and community workers?		+	Not expected
. noise and dust from construction activities?	+		During construction stage only; will be suitably mitigated
increased road traffic due to interference of construction activities?	+		Expected during construction stage only; will be suitably mitigated
continuing soil erosion/silt runoff from construction operations?		+	The construction areas are all flat lands; soil erosion and silt run-off are least expected except during monsoon months
delivery of unsafe water due to poor O and M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?		+	O and M manual include schedule for regular maintenance and chemical dosing
delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		+	Not expected
accidental leakage of chlorine gas?		+	Not expected as chlorine gas will not be used
excessive abstraction of water affecting downstream water users?		+	Not anticipated.
competing uses of water?		+	Not anticipated
. increased sewage flow due to increased water supply		+	Not anticipated; Invest Program includes additional development
increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant		+	Not anticipated
Large population influx during project construction and operation that causes increased burden on social infrastructure and services		+	Priority in employment will be given to local residents. Water supply and sanitation at work camps will be provided by the contractor

Social conflicts if workers from other regions or countries are hired		+	Only local people will be employed by the contractor
Risk to community health and safety due to the transport, storage and use of explosives, fuels and other chemicals		+	Not applicable. Construction will not involve use of explosives and chemicals. Bentonite slurry to be used in micro-tunnel will be recycled
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		+	Operational area will be clearly demarcated and access will be controlled. Only worker and project members will be allowed to visit the operational areas
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)?	+		Low lying areas of Kolkata is subject to flooding during heavy rainfall in monsoon
Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?	+		Short term changes are not expected
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)?	+		Canal bank dwellers are vulnerable during flooding
Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		+	On the other hand treatment surface water will negate the increased salinity of raw water from Hooghly river

Appendix 6. Consultation and Participation Plan Of Water Supply Subproject

Consultation and Participation Activity	Target Stakeholders	Type of Participation	Objectives of the C&P Activity	Responsible Unit/Persons	Time Frame	Cost Estimate INR
<p>1 Project Orientation Workshop for government officials (especially KMC & WBPCB officials, officers, and staff on the Investment program (half day)</p>	<p>50 government officials and staff per Project orientation workshop consisting of representatives from the officials and staff, especially the Municipal Corporations; and private contractors</p>	<p>Information sharing Consultation Shared responsibility Shared decision making</p>	<p>To introduce the Project To demonstrate the link between improved S & D and sewerage infrastructure and good health, women's empowerment, and environmental conservation (Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental & social awareness). To present Safeguards and Social Frameworks and Plans and disclosure requirements. To discuss roles and accountabilities of various government units. To discuss issues related to use of government lands /property for the Project, environmental risks. To mitigate potential problems e.g., citizens' use of government lands and property that will be lost to the Project such as hawking rights on streets, temporary occupation of public facilities, construction material storage on public facilities, environmental risks especially aquatic ecology of Hooghly river, Compilation and agreement on recommendations</p>	<p>PMU with assistance from Project Team</p>	<p>Year 1: One Project orientation workshop</p>	<p>Project Orientation Workshop for officials = 50,000</p>
<p>1 Project Orientation Seminar for household heads on the investment program (half day)</p> <p>1 Project Orientation Seminar for women only on the investment program</p>	<p>100 community members, preferably, household heads, with at least 30 women participating</p> <p>At least 50 women community members per Project Orientation Seminar</p>	<p>Information sharing Consultation Shared decision making</p>	<p>To introduce the Project, highlighting its importance and benefits to the community To demonstrate the link between improved S & D and sewerage infrastructure and good health, women's empowerment and environmental conservation. (Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental/ social awareness). To present safeguards and social frameworks and plans. Compilation of concerns and views related to S</p>	<p>PMU with assistance from Project Team</p>	<p>Years 1:</p>	<p>Project Orientation Seminar households = 50,000</p> <p>Project Orientation Seminar for women = 25000</p>

(half day)			& D and sewerage. Compilation and agreements on recommendations			
One Consultation workshop (half day) with temporarily affected persons	50 hawkers/ vendors, and small shopkeepers affected per subproject	Information sharing Consultation	<p>To introduce the Project.</p> <p>To demonstrate the link between improved water supply and sewerage infrastructure and good health, women's empowerment and environmental conservation & social protection.</p> <p>To show possible livelihood/business opportunities/alternatives.</p> <p>(Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental awareness).</p> <p>To present social and resettlement framework and draft social and resettlement plans.</p> <p>To mitigate potential resistance to the Project</p> <p>Compilation of recommendations & agreements on remedial measures</p>	PMU with assistance from Project Team	Year 1: One consultation workshop	Consultation Workshop = 75,000
One Consultation workshop with the academe, NGOs, and other civil society organizations (1 whole day)	50 representatives of the academic field, NGOs, and other civil society organizations	Information sharing/knowledge generation. Consultation Shared responsibility	<p>To introduce the Project.</p> <p>To demonstrate the link between improved S & D and sewerage infrastructure and good health, women's empowerment, and environmental conservation and social protection.</p> <p>To show possible livelihood/business opportunities/alternatives.</p> <p>(Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental awareness)</p> <p>Compilation of views on proposed conservation and mitigation measures.</p>	PMU with assistance from Project Team	Year 1: One consultation workshop	Consultation Workshop = 50,000 Travel of participants = 25,000

			<p>To mitigate potential resistance to the Project. To discuss possible roles as watchdogs of the Project's implementation.</p> <p>To gather other relevant recommendation</p>			
<p>Strategic and Action Planning Workshop</p> <p>1 half day for Councillors and KMC officials & engineers</p> <p>1 half day for ADB Project Team</p>	<p>Councillors, KMC and KMC officials & engineers</p>	<p>Information sharing</p> <p>Shared responsibility.</p> <p>Shared decision making control</p>	<p>To develop strategic and action plans in accordance with the Project road map.</p> <p>To review compliance with social safeguards, environment, and gender frame works and plans.</p> <p>To discuss progress in implementation, including problems encountered and means to mitigate/address them.</p> <p>To regularly report on the progress of implementation.</p>	<p>PMU with assistance from Project Team</p>	<p>Annually</p>	<p>Councillors meetings 50,000 X 5 years = 250,000</p> <p>Project Team monitoring meetings: 15000 X 4 years = 60,000</p>
<p>Participatory Monitoring Meetings (half day) (for community watchdogs)</p>	<p>20 representatives (50% women) from the community and civil society (representatives of CBOs, NGOs, ward committees, poor/slum communities, private sector)</p>	<p>Information sharing.</p> <p>Shared responsibility</p>	<p>Discussion of issues and concerns during Project implementation.</p> <p>To discuss and recommend measures to mitigate/ address the problems.</p> <p>To monitor progress of Project implementation</p>	<p>PMU with assistance from Project Team</p>	<p>Participatory Monitoring Meetings: Semi-annually</p>	<p>15000 X 2 meetings X 4 years = 120,000</p>
<p>TOTAL COST OF CONSULTATION AND PARTICIPATION - INR ~ 705,000</p>						

Appendix 7. Sample Grievance Registration Form
(To be available also in Bengali, Hindi and Urdu)

The _____ Project welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing ***(CONFIDENTIAL)*** above your name. Thank you.

Date		Place of registration			
Contact Information/Personal Details					
Name		Gender	* Male * Female	Age	
Home Address					
Village / Town					
District					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where and how) of your grievance below:					
If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of Official registering grievance)	
Mode of communication: Note/Letter E-mail Verbal/Telephonic	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	Yes No
Means of Disclosure:	

Appendix 8. Environmental Monitoring Format

A. Work Progress

Location	Work package	Work components	Physical progress

B. Status of environmental clearance

Work Package	Type of clearance	Agency applied for	Date of application	Date of receipt of clearance	Clearance reference number	Validity date

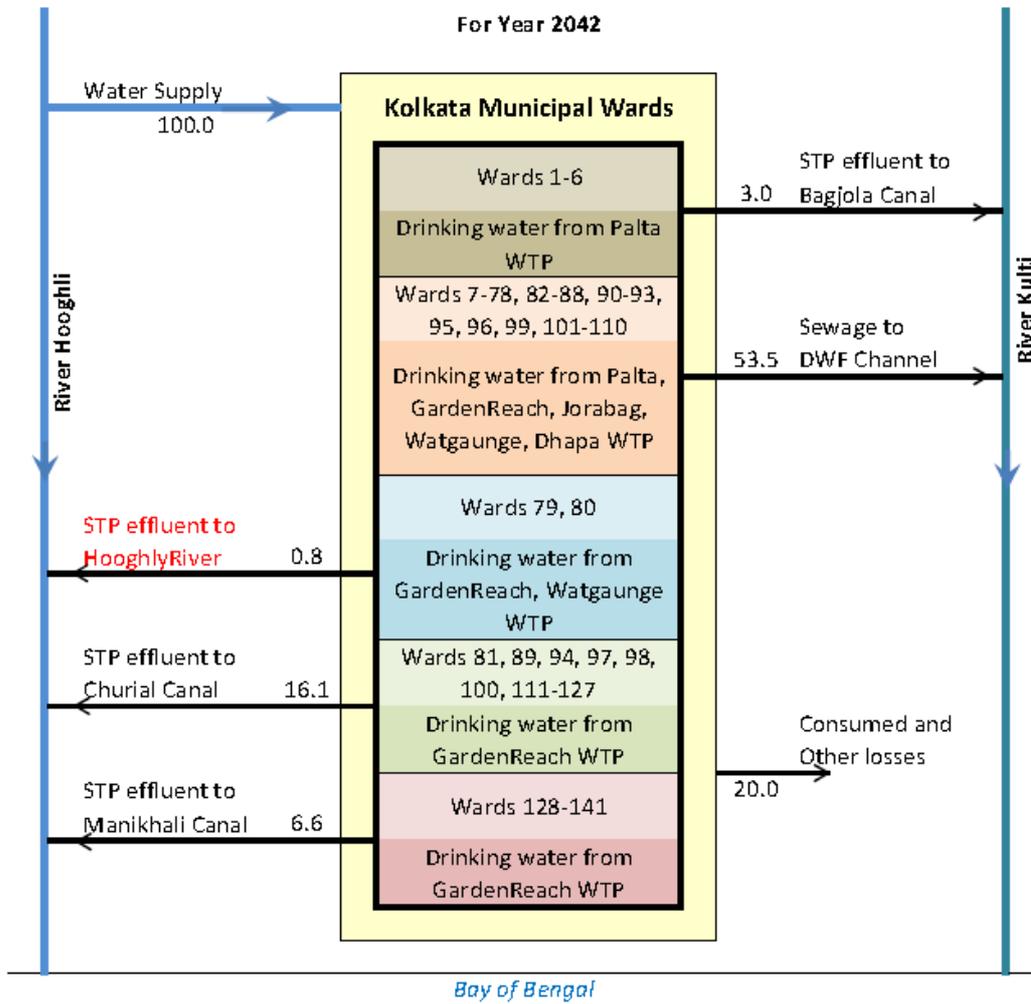
C. Compliance with EMP (Pre-construction/Construction/Operation stage)

Package	Impact description	Mitigation measures undertaken	Period	Date or Frequency	Monitoring remarks	Monitored by

D Measurement of pollutants

Components	Package/Location	Parameters/Pollutants	Sate of sampling	Monitoring result
Air quality				
Water quality				
Sludge quality				
Noise level				

Appendix 9 : Water Balance



Mass Balance		
Incoming to the system -		
Water to KMC	100	unit
Outgoing from the system -		
STP effluent to Bagjola canal	3.0	
STP effluent to DWF Channel	54	
STP effluent to Hooghly river	0.8	
STP effluent to Churial canal	16.1	
STP effluent to Manikhali canal	6.6	
Consumed and other losses	20.0	
	100	unit