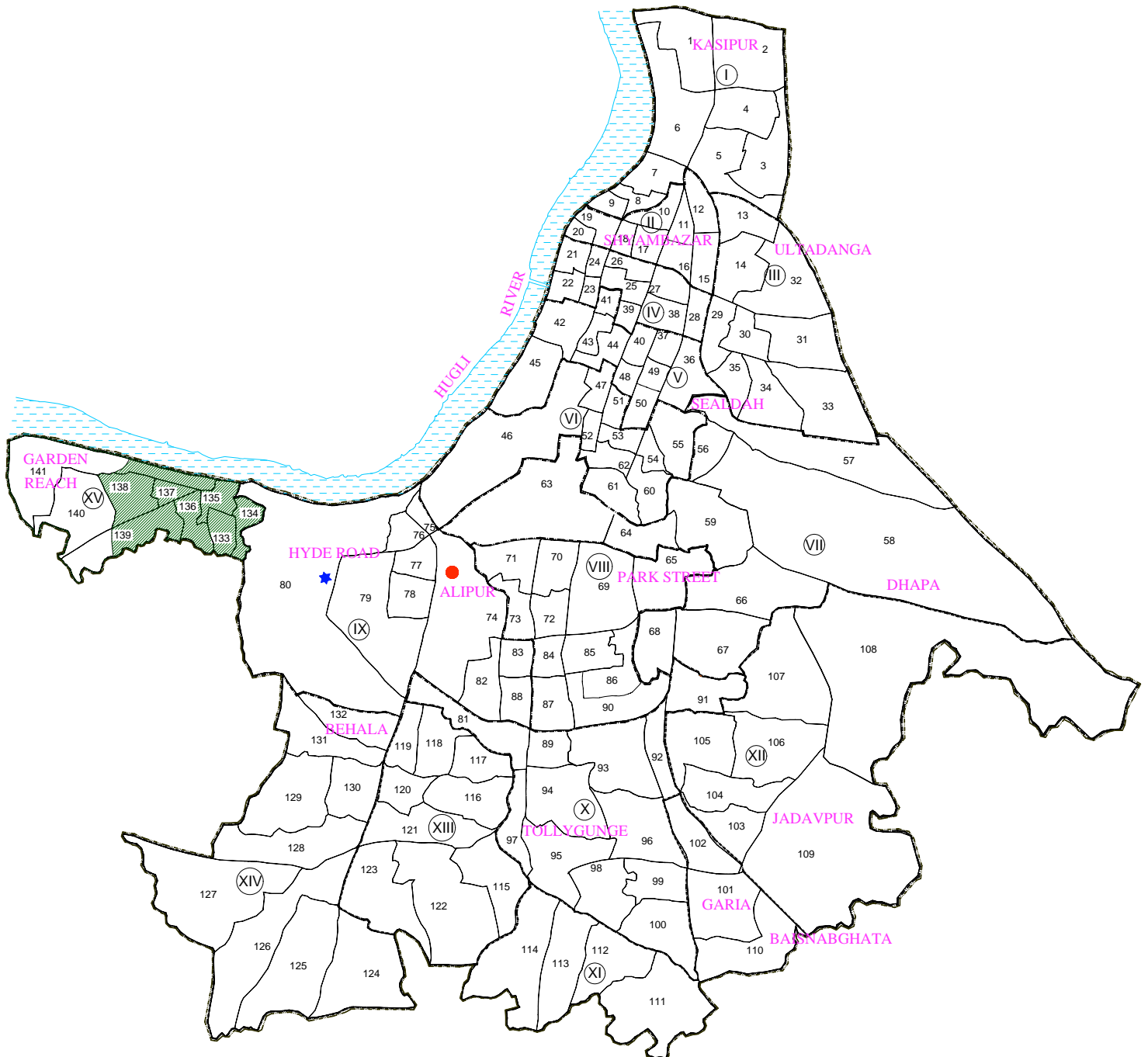


Initial environmental examination report on Sewerage and Drainage project of Borough XV



CONTENTS

- 1.0 Introduction**
- 2.0 Description of the project**
- 3.0 Description of the environment**
- 4.0 Potential environmental impacts and mitigation measures**
- 5.0 Monitoring**
- 6.0 Public consultation**
- 7.0 Findings and conclusion**

LIST OF TABLES

- 1.0 Coverage of S&D project of Borough XV**
- 2.0 Details of the proposed S&D scheme of Borough XV**
- 3.0 Ambient air quality statistics of Hyde Road station of WBPCB in KMC area based on daily 24-hourly data from April, 2005 to March, 2006.**
- 4.0 Quality of ground water from large-diameter tube wells**
- 5.0 Surface water quality**
- 6.0 Environmental checklist of S&D project of Borough XV**
- 7.0 Summary of environmental monitoring programme of S&D project of Borough xv**
- 8.0 Public consultations undertaken in S&D project of Borough XV**
- 9.0 Matrix of environmental impacts of S&D project of Borough XV**

1.0 INTRODUCTION

The Kolkata Municipal Corporation (KMC), with assistance from the Asian Development Bank (ADB) has embarked upon Kolkata Environmental Improvement Project (KEIP). The project is aimed at achieving a sustainable improvement in the environment of Kolkata through implementation of an urban infrastructure and environmental management investment programme.

Sewerage and Drainage (S & D) Project, a key sub project of KEIP, is being implemented to provide comprehensive drainage and sewerage coverage in part of borough I (Ward 1 to 6) and in identified priority areas of the 'added areas' of KMC encompassing boroughs XI, XII, XIII, XIV and XV covering ward 101 – 141. The existing drainage and sewerage network in boroughs is inadequate and needs augmentation and/or improvements considering the development of the area and anticipated growth.

This Initial Environmental Examination (IEE) study pertains to the sewerage and drainage scheme proposed for Borough XV.

Feasibility Study of KEIP conducted by EGIS Consulting Australia PTY Limited, in accordance with the ADB guidelines, has determined the project to be a Category B Project. All Category B projects are judged to have some adverse environmental impacts, but of lesser degree and significance than those of Category A projects. Category B project requires preparation of IEE to determine if the project would require a detailed Environmental Impact Assessment (EIA). If EIA is not warranted then the IEE is considered as the final environmental assessment report of the project.

1.1 Purpose

The purpose of IEE is to document screening of the environmental consequences of the subproject in accordance with the ADB guidelines, to identify potential adverse and beneficial environmental impacts, and to document the mitigation and monitoring measures that would be incorporated in the project to eliminate or minimise the adverse impacts.

1.2 Scope

The components of this subproject include (i) installation of new sewer lines where drainage and sewerage network does not exist and (ii) renovation of existing sewers & drains as required along with their desilting (iii) construction of new pumping stations and (iv) Augmentation of existing pumping stations

The IEE study is based on available secondary data, reports and design data.

DESCRIPTION OF THE PROJECT

2.1 Need for Project

The proposed project will primarily provide sewerage and drainage system in borough XV of KMC along with construction of new pumping station as well as augmentation of existing pumping stations. The sewerage and drainage facilities available in the area are inadequate. Some of the areas do not have any organized sewerage or drainage network while in the remaining area, although a network of sewer lines exists, the system is not functioning properly due to inadequacies in capacity, lack of maintenance and other factors. As a result, several pockets in the borough are prone to flooding.

2.2 Location

In studying the existing drainage and sewerage network system, a basin-wise approach has been used. Eight drainage sub-basins in the priority area of borough XV are identified.

The area is located in the western part of KMC (Plate 1). The S&D scheme is proposed to be implemented in the priority area covering wards 133 to 139 which is surrounded by Garden Reach Road & Dr. A Khabir Road in the north, Kathal Beria Road and Railway line road (Santoshpur Road) in the west, Maheshtala Municipality in the south and Ramnagar Road & Dhankheti Khal in the east. Wards 140 and 141 are not considered as priority basins and works have not been included in this phase.

Part of Maheshtala municipality will also be served by the proposed project.

2.3 Coverage

In 2001, the total population of 7 wards of borough XV (ward 133 – 139) was 2,02,394 and that of part of Maheshtala municipality contributing to the system was 4206. The proposed sewerage and drainage scheme will cover a command area of about 478 hectares which includes part of Maheshtala Municipality also and is a projected population of about 3,08,000 in 2035 AD. Details of coverage of the proposed scheme are shown in Table 1.

Table 1 : COVERAGE OF S & D PROJECT IN BOROUGH XV

| Item | Total |
|----------------------|---|
| Coverage | Ward 133 to 139 (7 wards) and part of Maheshtala Municipality |
| Area (Ha.) | 478 |
| Projected Population | |
| (a) 2001 AD (Census) | 206,600 |

| Item | Total |
|-------------|---------|
| (b) 2005 AD | 214,000 |
| (c) 2015 AD | 244,000 |
| (d) 2021 AD | 262,000 |
| (e) 2035 AD | 308,000 |

2.4 Project Schedule

The preliminary construction work of the project is expected to commence in November, 2006.

2.5 Proposed Sewerage and Drainage Network

2.5.1 Drainage Sub-Basins Delineation

The proposed drainage sub-basins (total 8 Nos.) in project area have been delineated based on the existing topography and shown in Plate 2.

Sub-basin - 1 covers mainly parts of ward 134 & 135 and drains to river Hooghly. This covers an area of 34 Ha.

Sub-basin - 2 covers mainly parts of wards 133, 134 & 135 and drains to Dhankheti Khal. This covers an area of 33 Ha.

Sub-basin - 3 covers major part of wards 133 and drains to Dhankheti Khal. This covers a total area of 53 Ha.

Sub-basin - 4 covers major part of ward 136, part of ward 139 and Maheshtala Municipality. Storm water flow (SWF) will be taken through Mudiali drain to proposed Mudiali pumping station and discharged to Manikhali Khal (canal) by pumping. Area of this basin is 64 Ha.

Sub-basin - 5 covers parts of wards 136 & 133 and part of Maheshtala Municipality. SWF will be taken to proposed Mudiali pumping station and will be discharged to Manikhali Khal by pumping. Area of this basin is 18 Ha.

Sub-basin - 6 covers parts of wards 137 & 138 and drains to river Hooghly through open drains/channels. Area of this basin is 118 Ha.

Sub-basin - 7 covers parts of wards 138 & 140 and drains to river Hooghly through Sluice Gate No.1 of CIWTC adjacent to Rajabagan Dock Yard. Area of this basin is 47 Ha.

Sub-basin - 8 covers part of ward 139 & small parts of wards 137, 138 and Maheshtala Municipality and drains to Santoshpur Khal. Area of this basin is 111 Ha.

Mudiali drain and Santoshpur Khal extend to Maheshtala municipality. These two outfall drains to Manikhali Khal (canal), therefore improvement of these drainage channels has been considered in this package of drainage system. Proposed outfall structures will be constructed with proper gate operation system under the same package.

2.5.2 Sewerage and Drainage Zones

The proposed sewerage and drainage network in priority area have been divided in to three zones. Several sub-zones are considered according to collection and disposal system of SWF and dry weather flow (DWF). Sewerage and drainage zones are shown in Plate 3.

Sewerage and Drainage Zone - A

It covers wards 133,134 & parts of wards 135 & 136 carrying DWF for an area of 110Ha. DWF is proposed to be diverted through existing GAP sewerage system below Paharpur Road and Trenching Ground Road for treatment. Existing Dhankheti and Trenching Ground Sewage Lifting Stations will be utilised for collection and conveyance of DWF from this zone to Santoshpur Main Sewage Pumping Station (MSPS).

This zone covers drainage sub-basins 1, 2 and 3. SWF from this zone is proposed to be disposed off to Dhankheti Khal and river Hooghly. Outfall point is located approximately 500m d/s from the intake point of the Garden Reach Water Works (GRWW).

Sewerage and Drainage Zone – B

This zone covers parts of wards 135, 136 & 139 carrying DWF for an area of 150Ha. DWF is proposed to be diverted through a proposed sewer line below the Railway line Road - Santoshpur - Padirthati Road for treatment.

This zone covers drainage sub-basins 4 & 5. SWF from this zone is proposed to be taken through Mudiali drain and a trunk sewer to proposed Mudiali storm pumping station at Maheshtala Municipality area which is located within the premises of small scale industries and then through a pumping main to Manikhali Khal.

Sewerage and Drainage Zone - C

This zone covers parts of wards 136,137, 138 & 139 carrying DWF for an area of 218Ha. DWF is proposed to be diverted through existing GAP sewerage system below Santoshpur - Karbala Road for treatment.

This zone is covering drainage sub-basins 6, 7 & 8. SWF from this zone is proposed to be disposed off to river Hooghly and Santoshpur Khal.

DWF from the above 3 zones will be taken to existing Santoshpur MSPS and thereafter the same will be pumped to existing Garden Reach STP for treatment (existing capacity 47.5mld). Treated effluent will be discharged to Manikhali Khal. The Garden Reach STP will be suitably augmented.

Proposal for Improvement of Canals

Improvement of canal system in the borough is essential for smooth drainage from various basins. Unless the canals and major drains in the borough as well as Maheshtala Municipality are upgraded, the proposed sewerage and drainage system (combined and/or separate) will not function properly and the prevailing water-logging condition will remain.

Improvement of Dhankheti Khal, Mudiali Drain and Santoshpur Khal has already been considered under proposed sewerage zones. Therefore, the following existing drainage channels are proposed to be cleaned and renovated as required under the S&D package along with main works in the priority area.

- (a) Nalla adjacent to Kesoram Cotton Mill
- (b) Khaldhari Khal
- (c) Santoshpur Station Road Khal
- (d) Drain on both sides of Paharpur Road, Garden Reach Road, Railway line Road, Santoshpur –Karbala Road, Kathal Beria Road.
- (e) Renovation of existing outfall structure of CIWTC, Dhankheti, Khaldhari
- (f) Construction of proposed outfall structure for the above mentioned drains and drainage channels.

The proposed drainage and sewerage network will retain approximately 37 km of existing sewers and drains which would be desilted and would include laying of approximately 92.4 km of new pipe lines. Details of the proposed scheme are provided in Table 2.

Table 2 : SALIENT DETAILS OF THE PROPOSED S & D SCHEME IN BOROUGH XV

| Component | Total |
|---|--------------|
| Estimated approximate volume of soil to be excavated from new and replaced pipes and manholes (m ³) | 1,89,000 |
| Estimated approximate volume of excess excavated soil to be disposed (m ³) | 1,38,000 |
| Estimated approximate volume of silt to be removed and disposed from cleaning of existing pipes (m ³) | 2,610 |
| Estimated approximate volume of silt to be removed from cleaning of existing drainage channels (m ³) | 21,000 |
| Estimated approximate volume of road crust to be removed (m ³) | 19,000 |
| Approximate Length of existing drainage and sewerage line to be utilized (km) | 37.00 |
| Approximate Length of proposed combined sewer line (km) | 90.60 |
| Approximate Length of proposed DWF sewer line (km) | 1.80 |
| Approximate Length of existing drain to be renovated (km) | 4.70 |

| Component | Total |
|---|------------|
| Approximate Length of proposed storm drain (km) | 4.40 |
| Proposed pumping main (km) | 2.50 |
| Diameter of new pipes (mm) | 300 - 2000 |
| Depth of trench (m) | 1.2 – 5.5 |
| Road Width (m) | 0.9 – 14 |

Sewer lines will be constructed beneath the existing roads. Due to very narrow roads and lanes in the area, which hamper laying of separate sewers and drains, a combined sewerage system has been proposed along most of the roads. The combined system catering both dry weather flow and storm water flow, has been so designed with diversion arrangement that the DWF is diverted to Garden Reach STP for treatment through pumping arrangement and the storm runoff overflows to drainage channels/river Hooghly. Treated effluent is discharged to Monikhali Khal (Canal).

2.0 DESCRIPTION OF THE ENVIRONMENT

3.1 Physical Resources

Geology and Soil: Geological Survey of India (GSI bulletin, 1964) has classified the area as that of quaternary age formed out of deposits of alluvial and deltaic sediments of the river Ganga and its tributaries. Lithologically, the alluvial fill consists of clay, silt, fine to coarse sand and sand mixed with fine pebbles. The thickness of the upper clay bed varies between 10 to 40 m while the basal clay bed exists at depths of 250 to 650 m below the land surface. Between these layers, confined aquifer occur which is being tapped as a ground water resource. The linear area along the Tolly's Nullah represents a palaeo-channel of one of the tributaries of Hooghly river.

The soil of the project area is primarily entisols, younger alluvial type and can be characterised as predominantly clayey type.

Climate: The climate of the study area is humid and tropical. The weather is typically warm and humid during summer from March to May, sultry during monsoon or rainy season from June to September and comfortable during winter from October to February.

Climatological data of the Alipur observatory reported by India Meteorological Department (IMD) for the period 1990-1999 indicates the following: the maximum temperatures were recorded in May (mean maximum 35.2 °C) while the minimum temperatures occurred during January (mean maximum 14.14 °C). The relative humidity ranged between 86.2% in August to 53.7% in March. The average annual rainfall was about 1919.0 mm. A long term average is about 1650 mm. The winds were predominantly southwesterly during the summer and monsoon season and northerly during the winter months. The wind speed is highest during

summer months with average speed of 6.0 km/hr while during the winter months the average wind speed is 2.63 km/hr.

Air Quality: There is no ambient air quality monitoring stations within the project area. The air quality monitored by the West Bengal Pollution Control Board (WBPCB) at Hyde Road, which is approximately 2.5 km away from the project area (Plate 1), can provide some indication of the air quality within the project area.

The levels of various pollutants measured at this location during the months from April, 2005 to March, 2006 are presented in Table 3.

TABLE 3: AMBIENT AIR QUALITY STATISTICS OF HYDE ROAD STATION OF WBPCB IN KMC AREA BASED ON DAILY 24-HOURLY DATA FROM APRIL, 2005 TO MARCH, 2006.

A = Average concentration in microgram per cubic metre from 24-hourly data

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

| Station Name | Month with Year | SPM | | RPM | | SO ₂ | | NO _x | |
|-------------------------------|-------------------|-----------|------|------------|------|-----------------|------|-----------------|------|
| | | A | B | A | B | A | B | A | B |
| 1. Hyde Road | Apr., 2005 | 247 | 8/8 | 89 | 1/8 | 6 | 0/8 | 37 | 0/8 |
| | May, 2005 | 196 | 4/9 | 68 | 0/9 | 5 | 0/9 | 39 | 0/9 |
| | Jun., 2005 | 168 | 1/7 | 61 | 0/7 | 4 | 0/7 | 35 | 0/7 |
| | July, 2005 | 113 | 0/8 | 52 | 0/8 | 4 | 0/8 | 37 | 0/8 |
| | Aug., 2005 | 137 | 0/8 | 56 | 0/8 | 5 | 0/8 | 42 | 0/8 |
| | Sep., 2005 | 138 | 0/9 | 54 | 0/9 | 4 | 0/9 | 40 | 0/9 |
| | Oct., 2005 | 135 | 0/10 | 53 | 0/10 | 6 | 0/10 | 54 | 0/10 |
| | Nov., 2005 | 243 | 7/8 | 120 | 6/8 | 11 | 0/8 | 76 | 2/8 |
| | Dec., 2005 | 357 | 9/9 | 214 | 9/9 | 20 | 0/9 | 103 | 9/9 |
| | Jan. 2006 | 365 | 9/9 | 219 | 9/9 | 20 | 0/9 | 100 | 9/9 |
| | Feb., 2006 | 283 | 8/8 | 164 | 8/8 | 13 | 0/8 | 78 | 4/8 |
| | Mar., 2006 | 239 | 9/4 | 128 | 9/9 | 8 | 0/9 | 62 | 0/8 |
| | Average : | 21 | | 107 | | 9 | | 59 | |
| Apr., 2005 -Mar., 2006 | 8 | | | | | | | | |

Source : www.wbpcb.gov.in

Based on the above data it appears that the pollutant levels of SPM, RPM, SO₂ and NO_x in the project area are likely to remain below the limiting ambient air quality standards of residential area during the typical summer (May) and the typical monsoon (July-August) months. During the typical winter months and part of summer (December-February and March - April) levels of SPM and RPM are likely to exceed the standard. NO_x concentrations in these months are variable exceeding the standard in some of the days.

Ground Water: Kolkata city receives its supply of water from both surface (80 per cent) and sub surface (20 per cent) sources. In some areas of Kolkata the uncontrolled pumping of groundwater by heavy-duty pumps has lowered the level of the ground-water by 10 m in the last thirty-five years. Intrusion of brackish water in the southern part of the city has gained momentum due to over-pumping of water from the aquifers. A further threat arises from the industries generating toxic effluents. These effluents contaminate the ground water considerably. (CMDA Report. 1997).

A study conducted by Geological Survey of India reveals that Kolkata is underlain by quaternary sediments consisting of clay, silt, various grades of sand, gravel and a few beds of pebble. Lithological logs show the presence of a clay bed at the top of the geological succession from Tribeni in the north to Bansdrani with a varying thickness from 10 m to 40 m.

There is another clay bed between depths of 254 and 614 m below ground level. Between these two clay beds there is a group of granular aquifers and intervening clay lenses. Between 60 – 180 m occur the main aquifers that tube wells tap. The Central Ground Water Board study indicates depletion of water table due to the unplanned way of drawing the ground water. (Biswas A K & Saha. A K. 1986).

The ground water quality from deep tube wells (Table 4) showed high concentrations of chlorides and the chemical composition is not satisfactory, but free of bacterial contamination. Hardness and the concentrations of Fe, Cl, SO₄ increase from north to south.

TABLE 4 : QUALITY OF GROUND WATER FROM LARGE-DIAMETER TUBE WELLS

| Location | Depth of aquifer trapped | PH | Iron Fe | Chloride Cl | Sulphate SO ₄ | Total hardness CaCO ₃ |
|-------------------------|--------------------------|-----|---------|-------------|--------------------------|----------------------------------|
| | | | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| North Calcutta | | | | | | |
| North Calcutta | 114 - 138 | 7.6 | 0.1 | 180 | - | 588 |
| Central Calcutta | | | | | | |
| Convent lane | 106 – 137 | 7.4 | 0.6 | 446.1 | NIL | 831 |

| | | | | | | |
|-------------------------------|-----------|-----|-------|---------|------|-------|
| Roy Charan Pal lane | 108 – 138 | 7.8 | 0.5 | 439.7 | NIL | 801 |
| East Calcutta | | | | | | |
| Pagla danga | 103 – 134 | – | 0.5 | 321.6 | NIL | 581 |
| West Calcutta | | | | | | |
| Watgunge Street Sahebpukur | – | – | 1.1 | 931.0 | NIL | 763 |
| South Calcutta | | | | | | |
| Kankulia | 109 – 139 | 7.4 | 0.6 | 802.7 | NIL | 593 |
| Dhakuria | 117 – 147 | 7.5 | Trace | 310.0 | - | 280 |
| Bijoygarh | 107 – 137 | – | 0.8 | 891.1 | NIL | 586 |
| Naktala | 107 – 137 | 7.8 | 1.3 | 1,258.7 | 31.6 | 1,009 |

Source: *Calcutta's Urban Future, Government of West Bengal, 1991*

Unplanned activities for abstraction of ground water from subsoil of Calcutta have changed the flow direction substantially in the last 40 years. It has been reversed from southward flowing in 1956 to northward flowing in 1996 (CMDA Report. 1997). Considering the above information the ground water should be properly utilised.

Surface Water: Monikhali, Jinjhira and Begore are the three major surface water bodies close to the project site. Heavy siltation and continued disposal of municipal waste have deteriorated the water quality of these canals. As per study conducted in April 2005, DO level in canal water ranges between 0-2 mg/l, BOD 27-299 mg/l, COD 84-590 mg/l, Ammoniacal N 4.5-6 mg/l, NO₃ 0.4 – 0.8 mg/l, Ortho Phosphate 0.8 – 1.3 mg/l, E. Coli 5-12/100 ml and total salinity between 156 – 226 mg/l (Table 5).

Table 5 : SURFACE WATER QUALITY

| Sl No | Test Parameters | Unit | Monikhali Canal | Jinjhira canal | Begore Canal |
|-------|---|------|-----------------|----------------|--------------|
| 1 | Dissolved Oxygen | Mg/l | 2.09 | Nil | Nil |
| 2 | Chemical Oxygen Demand | Mg/l | 84.04 | 590.52 | 470.62 |
| 3 | Biochemical Oxygen Demand for 3 days at 27° C | Mg/l | 27.00 | 299.00 | 241.00 |
| 4 | Ammoniacal Nitrogen as N | Mg/l | 4.40 | 6.78 | 5.95 |
| 5 | Nitrate as NO ₃ | Mg/l | 0.77 | 0.44 | 0.87 |
| 6 | Ortho Phosphate as P | Mg/l | 1.35 | 0.95 | 0.83 |
| 7 | E. Coli / 100 ml | CFU | 5 | 12 | 10 |
| 8 | Total Salinity | Mg/l | 225.90 | 167.37 | 155.98 |

Noise: Like any other major cities Kolkata is also very noisy. Vehicular traffic is the main source of noise pollution. Specially along and around the main traffic routes including Garden Reach Road, Paharpur Road and S. A. Farooquie Road range from 65 to 70 dB(A) during day time and 55 to 64 dB (A) during night time.

3.2 Ecological Resources

As the project area is highly urbanised, presence of wild life or endangered species is very unlikely. In addition, within the project area there are no forests, protected areas, coastal resources or fisheries.

3.3 Economic Development

Land Use: Predominant land use within the project area is residential and mixed residential and commercial.

Industries: There are only few large-scale industry in the project area such as Hindusthan Lever, Garden Reach Ship Builders & Engg, Kesoram Rayon etc. There are also some small scale industries in the project area. Treated effluent from these industries is discharged to the river.

Water Supply: KMC's water supply system relies on both surface water (River Hooghly) and ground water. Water supply in this borough is catered from Garden Reach water treatment plant (WTP) operated by KMWSA. Garden Reach water treatment plant has a rated capacity of 270 MLD but actual production is about 225 MLD of which 180 MLD is supplied to KMC service areas (mainly Garden Reach & South Suburban area) and 45 MLD to adjacent Maheshtala municipality.

Sewerage and Drainage: The borough is partially covered by underground sewerage system implemented under GAP scheme which also caters for some wards of Maheshtala municipality.

One trunk sewer has been laid under Paharpur Road and Trenching Ground under GAP scheme, which mainly carries discharge by intercepting DWF from Dhankheti Khal at the confluence of Dhankheti Khal and River Hooghly. The intercepted DWF at Dhankheti Sewage Pumping Station (SPS) is conveyed to gravity sewer located at Paharpur Road & Garden Reach Road crossing. DWF through the gravity sewer is then conveyed to Trenching Ground sewage lifting station. From Trenching Ground SPS, DWF is conveyed to Santoshpur Main Sewage Pumping Station (MSPS). There are few sewerage connections to this GAP sewer and the existing GAP sewer is not fully utilised.

Another GAP trunk sewer starting from Garden Reach and Railway Line Road - Santoshpur Road leading to Santoshpur Main pumping station has been laid. Due to several connections of drainage system with this GAP sewer line, presently the sewer line is working as a combined system. Catchment of this GAP sewer line covers portion of wards 138, 139 and 140 in borough-XV and part of Santoshpur area in Maheshtala municipality. This GAP sewer is under utilised as lateral sewer connections are very few. Moreover as open surface drains carrying solid waste are connected to the sewer, the sewer line is blocked in many places and does not function effectively requiring cleaning and maintenance.

The sewage is being pumped from Santoshpur Main Sewage Pumping Station (under GAP) to Garden Reach STP (under GAP) located on the southern side of the railway line between Santoshpur and Brace Bridge railway station. Past records show that the STP receives an average flow of about 17MLD while the installed capacity is 47.5 MLD. Treated effluent from STP is discharged to ManiKhali Khal.

Another diesel operated pumping station is under operation at the Kanthal Beria and Dr. Abdul Khabir Road junction, which is mainly collecting flow from Satghara area and discharging towards Nadial Road. There is some sewerage system in the Nadial area. Combined flow ultimately drains to river Hooghly through Sluice Gate No.2 without any treatment.

Another sewer network at Satghara and Nadial area covers a small portion of wards 138, 140 and 141. Sewer system in ward 134, adjacent to Dhankheti Lifting Station is now functional which discharges combined flow in Dhankheti Khal.

Functional Status of Existing System

Sewer line laid under GAP in this borough serve as a combined system though it is not functioning efficiently due to blockage etc.

There are few other sewer lines and covered drains in all wards and are functioning properly as combined system.

Surface drains carry storm water and septic tank effluent of the entire borough and disposed to main drainage channels. Southern portion of S A Farooque Road gets flooded due to inadequate outfall of Santoshpur Khal and Mudiali Drain. Water-logging in various places due to tidal effect of river Hooghly is also a problem.

The major drainage channels are not in good shape and condition due to dumping and accumulation of solid waste and weed growth. There are sluice gates at the outfall locations of few drainage channels but their conditions are not good.

Transportation: The main mode of transportation within the project area is by road. Approximately 60-70% of the roads are about 2.0 m wide. Due to narrowness of the roads and multi modal nature of traffic, frequent congestion occurs in densely populated

areas. Paharpur Road, Garden Reach Road, SAF Road, Sontoshpur Road, Fathepur Lane are the important Roads of the area.

Electrical Power: Project area falls inside the service area of Calcutta Electric Supply Corporation (CESC). Total demand of power in the KMC area exceeds 1200 MW. CESC generates about 800 MW at its 5 coal fired thermal power plants and purchases 300-400 MW from West Bengal State Electricity Board and Damodar Valley Corporation.

3.4 Environmental and other Significant Features

Environmental and other significant features present in the project area such as water bodies, schools, hospitals, markets etc were noted from field visits. Small number of these features considered to be affected by project activities during construction phase which are proposed to be protected by adequate environmental management measures.

3.0 POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Sewerage & Drainage

The proposed project would influence the environment in two distinct phases:

- i. During the construction phase which would be temporary and short term;
- ii. During the operation phase which would have long term effects

Checklist of potential environmental impacts of the project is presented in Table 6 and the impacts are discussed in the following sections.

Table 6– ENVIRONMENTAL CHECKLIST OF S & D PROJECT IN BOROUGH XV

| Actions Affecting Environmental Resources and values (A) | Damages to Environment (B) | Recommended Feasible Protection Measure (C) | IEE(D) | | | | Comments |
|---|--|---|----------------------------|---|--------------------------|------------|--|
| | | | No Significant Effect (D1) | Potential Significant Effect Small (D2) | Med (D3) | Major (D4) | |
| Problems related to siting for facilities | | | | | | | |
| Interference with other utilities | Nuisance/disturbances to public | Careful planning/design | | <input type="checkbox"/> | | | To the extent feasible existing utilities will be bypassed |
| Interference with street traffic/blocking of access to building | Nuisance/disturbances to public | Careful planning/design | | | <input type="checkbox"/> | | Due to narrow roads some traffic congestion is likely |
| Inadequate resettlement provision | Social inequities | Adequate resettlement planning and budgeting | <input type="checkbox"/> | | | | None expected, minor encroachment will be bypassed |
| Impairment of historical/cultural monuments / areas | Loss of impairment of these values | Careful planning/design, plus offsetting measures | <input type="checkbox"/> | | | | None expected |
| Problems Relating to Design Phase | | | | | | | |
| Overflow/bypassing hazard | Contamination of environment plus flooding | Proper design/O&M plus operations monitoring | | <input type="checkbox"/> | | | Adequate design measures have been incorporated |

| Actions Affecting Environmental Resources and values (A) | Damages to Environment (B) | Recommended Feasible Protection Measure (C) | IEE(D) | | | | Comments |
|--|---|---|----------------------------|---|--|--|---|
| | | | No Significant Effect (D1) | Potential Significant Effect Small Med Major (D2) (D3) (D4) | | | |
| s | | | | | | | |
| Hazardous materials illegally in sewer | Damage to sewer system plus danger to workmen, downstream contamination | Do | | <input type="checkbox"/> | | | Monitoring by KMC and WBPCB will prevent this |
| Inadequate management of industrial wastes discharge to sewers | Damage to pipes, down stream contamination | Do | | <input type="checkbox"/> | | | Do |
| Hazards of sulfide corrosion | Damage to sewer system | Do | | <input type="checkbox"/> | | | |
| Problems During Construction Stage | | | | | | | |
| Silt runoff from construction operation or exposed | Soil erosion plus damage to water quality and aesthetics | Do | | <input type="checkbox"/> | | | |

| Actions Affecting Environmental Resources and values (A) | Damages to Environment (B) | Recommended Feasible Protection Measure (C) | IEE(D) | | | | Comments |
|---|--|---|----------------------------|------------------------------|----------|------------|----------|
| | | | No Significant Effect (D1) | Potential Significant Effect | | | |
| | | | | Small (D2) | Med (D3) | Major (D4) | |
| surface | | | | | | | |
| Local flooding from dewatering of excavation sites, flushing of pipes and hydraulic testing | Hazard and nuisance to workers and public | Do | | <input type="checkbox"/> | | | |
| Dumping of silt and construction spoils | Soil and groundwater contamination | Do | | <input type="checkbox"/> | | | |
| Construction accidents and hazardous materials contacts or spills | Injuries and health safety of workers and public | Do | | <input type="checkbox"/> | | | |
| Dust/odour /fumes/noise/vibration from construction | Health hazard/nuisance to workers and public | Careful planning, control and monitoring | | <input type="checkbox"/> | | | |

| Actions Affecting Environmental Resources and values (A) | Damages to Environment (B) | Recommended Feasible Protection Measure (C) | IEE(D) | | | | Comments |
|---|--|--|----------------------------|------------------------------|--------------------------|-------|--|
| | | | No Significant Effect (D1) | Potential Significant Effect | | | |
| | | | | Small | Med | Major | |
| | | | | (D2) | (D3) | (D4) | |
| Accidental damage to utilities | Public inconvenience due to disruption of services | Appropriate planning plus prompt repair | | <input type="checkbox"/> | | | |
| Traffic congestion and blockage of access | Accidents/nuisance to public | Appropriate traffic and access control measures | | | <input type="checkbox"/> | | In consultation with Kolkata Police traffic management plan will be prepared |
| Problems During Operation Stage | | | | | | | |
| Water logging and/or overflowing of sewer due to clogged sewer lines/gully pits | Health hazard and public nuisance | Proper design construction, O&M, plus monitoring | | | <input type="checkbox"/> | | KMC will undertake periodic cleaning of sewer lines and gully pits |
| Workers exposed to toxic gases in sewers and hazardous materials in sewage | Serious/health/safety hazards | Proper design construction and O&M, including handling of emergencies plus operations stage monitoring | | <input type="checkbox"/> | | | |

| Actions Affecting Environmental Resources and values (A) | Damages to Environment (B) | Recommended Feasible Protection Measure (C) | IEE(D) | | | | Comments |
|--|-------------------------------------|---|----------------------------|---|--|--|----------|
| | | | No Significant Effect (D1) | Potential Significant Effect Small Med Major (D2) (D3) (D4) | | | |
| during maintenance work | | | | | | | |
| Cave-in of sewer lines | Safety hazard to public and workers | Do | | <input type="checkbox"/> | | | |
| Inadequate operations stage monitoring | Nuisance/hazard to public | Proper O&M and monitoring | | <input type="checkbox"/> | | | |

4.1 Environmental Impacts - Construction Phase

During the construction phase there would be some impact on air, noise and water quality, and management of solid waste. Also there would be some impact on quality of life due to inconvenience caused to public as a result of construction activities.

Air quality impacts are likely from general construction activities including land clearing, trenching, laying of pipes, construction of foundations and superstructures, handling and transportation of construction and demolition materials, and from wind erosion of open sites and stock pile areas.

Noise pollution will occur from operation of construction equipment including earth moving and material handling equipment.

Water quality impacts may occur from runoff and waste and sewage generated from construction activities.

Within the road flanks there are unlikely to have trees, which would need to be removed as a result of construction. There are few small temples and some structures on the ROW. Design of the proposed network will ensure that these encroachments are bypassed.

The project would require disposal of approximately 1,80,500 m³ of excavated materials including road crust, precipitate removed from cleaning of open channels, excavated soil and silt removed from desilting of existing pipes. Disposal of excavated soil, roads crust, and precipitate from drainage channels will not pose a problem, however, disposal of silt may require adequate protection.

Since most of the roads in the project area are narrow there will be some traffic congestion during the construction phase. In the narrow sections of road construction activities may cause significant traffic disruption.

Some inconvenience to public may result from restricted access to building and structures and temporary dislocation of civic amenities like water supply, drainage and sewerage, electricity, telephone and cable TV connection due to relocation or replacement of these facilities.

Traffic dislocation, lack of access to buildings and air and noise pollution caused by construction activities could have some adverse impact on trade and commerce in the service area.

Unforeseen accidents could result in personal injury and/or damage to private or public property.

It will not be feasible to provide drainage and sewerage coverage in all the wards of Borough XV which may result in some discontent from public residing in the areas that will not be covered by the project. The awareness programme to be undertaken to address this issue and other public concerns are discussed in Section 6.0 - Public Consultation.

4.2 Mitigation Measures - Construction Phase

Following measures are recommended for mitigating or minimising the environmental impacts that are likely to occur during the construction phase of the proposed project. The contractor under supervision and direction of DSC shall implement these mitigation measures.

Prevention of erosion

1. Construction will be scheduled so that large areas of soil are not laid bare during the monsoon.
2. Ground disturbances will be phased so that it is limited to workable size.
3. Exposed surface will be resurfaced and stabilised as soon as possible.

4. Trenches will have adequate backfill to prevent subsequent street settlement. Upon completion of backfill the road surface shall be restored fully to the level at its original condition.

Prevention of dust nuisance

1. On exposed construction surfaces during dry/windy periods fugitive dust generation will be suppressed by spraying of water or other suitable means.
2. Workers working in dust prone areas will be provided with masks and goggles.
3. Excavated material transported by trucks will be covered and/or wetted to prevent dust nuisance.

Noise and emission from vehicles and construction activities

1. All construction vehicles will be properly maintained and will have valid "Pollution Under Control Certificate"
2. Noisy construction activities will be carried out only during normal working hours and local residents will be advised of any unusual or unavoidable noise.
3. Where feasible sound barrier will be provided in inhabited areas.

Relocation of utility services

1. Utility services such as telephone line, electric poles, and water lines etc. that will be impacted by project construction will be identified.
2. Concerned authorities will be informed and their assistance sought to remove, relocate and restore services of these utilities prior to commencement of construction.
3. It will be ensured that these utilities are not damaged due to construction activities.

Prevention of dust and noise during material handling operation

Dust and noise producing activities such as stone crushing, bitumen and cement batching plant etc. will be preferably located downwind and away from habitation settlement wherever practicable.

Prevention of soil, ground and/or surface water contamination

1. Silt after dewatering will be immediately disposed in approved disposal site.
2. Excess excavated soil and spoils will be disposed in approved disposal site.

Prevention of water logging/ flooding

1. De-watering during trenching and water testing of new lines will be regulated in a manner so that it does not lead to water logging of the nearby area.

Road safety and traffic management during construction

KMC in coordination with DSC will prepare a traffic management plan for approval of Kolkata Police. The plan will include:

1. Measures to be taken to prevent traffic congestion.
2. Provision of temporary safe access to buildings, which will be blocked due to construction.
3. Measures to be taken for safe passage of traffic including temporary diversions, and/or separation of motor vehicle traffic from non-motorized and pedestrian traffic where necessary.
4. Measures to be taken to ensure safety of traffic passing through the construction area including signs, marking flags, lights and flagmen as may be required.

Prevention of Accidents and Damage to Property

All necessary precautions will be taken to prevent accidents and/or damage to property. Measures taken by the contractor will include but not limited to:

1. Safe execution of construction work
2. Providing adequate health and safety protection to workers.
3. Sufficient insurance coverage covering all risks including property damage, third party liability, workmen compensation and transit insurance.

Health and safety of work force

1. All occupational and health and safety requirements for workforce will be adhered to.
2. Periodic health check up of workers will be provided
3. A physician's services will be retained to handle emergencies.
4. During sewer line cleaning operation the line will be adequately vented to ensure that no toxic or hazardous gases are present in the line and the gases present in the sewer line will be analysed for hazardous/toxic gases before commencing cleaning operation, if warranted.
5. Workers engaged in cleaning of sewer lines will be provided with proper protective cover including gumboots, rubber gloves and gas masks.

Environmental health and safety considerations at construction camp sites and construction worksites

1. Camps/compounds will be located so that they do not interfere with the existing drainage system.
2. Camps/compounds will be contained by surrounding the site with a bund or earth mound with controlled drainage outlet.
3. Campsites will have adequate provision of shelter, water supply, excreta and solid waste management as far as practicable.
4. Construction work-site will be properly barricaded and have adequate provision of drinking water, toilets and dispensing of first aid.
5. Appropriate control measures will be taken to prevent insect/vector diseases especially malaria by measures such as spraying and/or preventing creation of stagnant pool of water

Prevention of impacts on places of cultural importance

1. Routing of sewer/drain lines will avoid places of cultural importance including shrines, temples, maazars, mosques etc. to the extent feasible or they will be relocated.
2. Safe access to these places will be maintained.

Protection of trees

Routing of sewer/drain lines will avoid impacting trees to the extent feasible. Prior approval of the Forest Department, GoWB will be obtained where trees have to be felled for laying the pipes.

4.3 Environmental Impacts - Operation Phase

During the operation phase the environmental impacts are likely to be mostly positive. These positive impacts have been discussed in Section 4.5. However, there could be some adverse impacts due to inadequate operation and maintenance or control.

Lack of proper operation and maintenance of the system could cause over flow of sewage and water logging during rainy season, which would be a nuisance and health hazard to public.

Due to lack of control there may be discharge of hazardous industrial effluents into sewer, which can damage the sewer system, or interfere with the downstream treatment process or pass through the treatment plant and cause damage to the environment.

There is a potential health hazard to workers engaged in sewer maintenance workers. These workers are likely to be exposed to toxic gases and hazardous materials present in the sewage and are likely to contract communicable diseases from exposure to pathogens present in the sewage.

4.4 Mitigation Measures - Operation Phase

1. Since a combined sewerage and drainage system has been proposed instead of a separate storm water drainage system due to space restriction it is likely that some silting will occur due to difficulty in achieving self cleansing velocity during DWF. To alleviate the siltation problem it would be necessary for KMC to undertake continual routine maintenance of the system. Periodic preventive maintenance carried out by KMC would prevent flooding or water logging caused by clogged drains.
2. KMC will ensure that the proper health and safety precautions are adhered to during sewer cleaning operation.

4.5 Positive Impacts of the project

Improvement in sewerage and drainage as a result of this project would minimise water logging and/or flooding in the service area and ensure better sanitation practices. This would lead to:

1. Abatement of nuisance and public health hazard in the service area. Improved sanitary conditions would result in reduction in incidence of parasitic infections, hepatitis and various gastrointestinal diseases including cholera and typhoid which occur either through direct contact with fecal material or contamination of water supply and food.
2. Fewer incidence of illness would lead to reduction in health care expenditure and lost workdays.
3. Fewer incidence of disruption of transportation.
4. Accelerate economic growth as a result of improved quality of life within the service area.

A significant population of the service area who are poor and live in slums would benefit the most from the proposed project as they suffer the most when there is flooding and/or water logging in the service area. Other benefits of the project would include:

1. Improvement of water quality of SWF channels as a result of interception of DWF from the service area into these canals.
2. Contamination of local ponds and canals as a result of sewage overflow and flooding will be prevented or minimised.
3. Employment generation during the construction phase
4. Transportation within the service area will improved due to improved road conditions as a result of resurfacing of roads sections damaged by the project.

B. Pumping Station :

Environmental Issues

The environmental issues that are relevant to the project are as follows:

- (i) Replacement of electrical & mechanical equipment at Trenching Ground Lifting Station. This may temporarily interrupt pumping of wastewater during construction activities.
- (ii) Augmentation of sewage pumping station in the premises of Sontoshpur MSPS
- (iii) Construction of new storm water PS at Mudiali
- (iv) Disposal of silt, soil and debris due to the construction of inlet and outlet channels and other civil works of the pump houses
- (v) Safety, security and occupational hazards during construction and operation phases.

Impact Assessment

Construction phase impacts

Construction activities will inflict short-term minor adverse impacts on soil, surface water, air, noise, ecology of the area and quality of life values of nearby habitants and work force.

Operation phase impacts

1. The proposed pumps have been designed to transmit DWF to Garden Reach STP for treatment of wastewater and SWF to be disposed off to Monikhali canal and will significantly reduce the incidence of pollution & inundation respectively of project area. This is a positive impact.

Mitigation Measures

Construction phase

- Construction phase activities related to earth work are to be scheduled in the dry season, so that chances of flooding, inundation, water logging, and surface erosion become minimum.
- Exposed construction sites to be adequately covered to reduce erosion, surface runoff and air pollution.
- Construction spoils are to be suitably disposed of.

- Most of the construction activities are to be carried out during the normal working hour and the local residents to be informed of any unavoidable noise pollution.
- All necessary precautionary measures are to be taken to prevent accidents and/or damage to property or life.
- Efforts are to be made to fulfill occupational, health and safety requirements

Operation phase

- Pump house has to be adequately operated and maintained with proper desiltation of silt
- Sewerage and Drainage project of KEIP will separate the DWF from SWF; therefore pollution load to river Hooghly & Monikhali canal will be reduced in the long run.

4.0 MONITORING PLAN

Effective implementation of the mitigation measures to mitigate or minimise the environmental impacts would require the project to undertake a comprehensive monitoring programme. The objective of the monitoring programme is to ensure that the construction and operation activities are carried out in an environmentally sensitive and responsible manner, and in accordance with the recommendations of IEE. Recommended monitoring activities of the proposed project is presented in Table 7

Table 7 --SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME OF S & D PROJECT IN BOROUGH XV

| Monitoring Category | Type of Monitoring | Minimal Frequency | Monitoring Agency |
|--|---|-------------------|-------------------|
| CONSTRUCTION PHASE | | | |
| Soils | | | |
| Excavation and back filling | Monitor adherence to contract specifications | Daily | Contractor/ DSC |
| Erosion | Monitor proper management of excavated soil/silt including timely removal of material from project site | Monthly | Contractor/ DSC |
| Surface and Ground Water Quality | | | |
| Surface runoff management | Monitor measures to chennelise surface runoff | Daily | Contractor/ DSC |
| Contamination from waste and sewage generated from | Monitor measures taken to prevent contamination of ground and/or surface water from waste | Daily | Contractor/ DSC |

| Monitoring Category | Type of Monitoring | Minimal Frequency | Monitoring Agency |
|---|--|--------------------------|--------------------------|
| construction activities | and sewage generated from construction activities | | |
| Air/Noise Pollution | | | |
| Dust emission during site preparation, excavation | Monitor adequacy of dust suppression measures undertaken | Daily | Contractor/ DSC |
| Storage and transportation of construction materials, excavated soil and silt | Monitor adequacy of measures undertaken to prevent fugitive dust | Daily | Contractor/ DSC |
| Noise and emissions from construction vehicles | Monitor 'Pollution under Control' certificate are current for construction vehicles | Quarterly | Contractor/ DSC |
| Noise pollution from construction activities | Monitor preventive measures being implemented to curb noise | Daily | Contractor/ DSC |
| Solid Waste | | | |
| Disposal of excavated soil and silt | Monitor to ensure excavated soil and silt are being disposed in approved sites | Daily | Contractor/ DSC |
| Flooding/Water logging | | | |
| Blockage of drainage due to construction activities | Monitor to ensure construction activities does not cause flooding or water logging at the project site. | Weekly | Contractor/ DSC |
| Health and safety of construction workforce | | | |
| Health and safety requirements | Monitor adherence to all occupational and safety requirements | Weekly | Contractor/ DSC |
| Health check up of workers | Monitor adequacy of health check up service provided including attendance of the physician retained and the extent to which the workforce is availing this service | Monthly | Contractor/ DSC/PMC |
| Provision of health and safety protection gear | Monitor availability of adequate number of protective gear equipment needed | Monthly | Contractor/ DSC |
| Maintenance of health | Review and monitor health and | Monthly | Contractor/ |

| Monitoring Category | Type of Monitoring | Minimal Frequency | Monitoring Agency |
|---|--|--------------------------|--------------------------|
| and safety records of work force | safety records to ensure all project related accidents are being properly investigated and reported | | DSC |
| Sanitary conditions of construction campsite | Monitor provision of shelter, water supply, excreta and solid waste management at campsites | Monthly | Contractor/ DSC |
| Road Safety and Traffic Management | | | |
| Traffic management plan | Obtain approval to traffic management plan from Kolkata Police | | DSC/KMC/C ontractor |
| | Monitor adherence to the traffic management plan | Fortnightly | Contractor/ DSC/KMC |
| Review road safety record | Review and monitor road safety records to ensure all project related road accidents are being properly investigated and reported | Monthly | Contractor/ DSC/KMC |
| Community Life and Economic Activities | | | |
| Access to public and private properties | Monitoring impact of project on dwelling and business in the project area | Daily | Contractor/ DSC |
| Damage to public and private property | Monitor construction activities to ensure public and private property is not damaged | Weekly | Contractor/ DSC/KMC |
| | Review and monitor property damage report to ensure timely resolution of claims etc. | Monthly | Contractor/ DSC/KMC |
| Hardship and inconvenience to public and business | Monitor to ensure that communities and business face minimal hardship and inconvenience due to construction activities | Weekly | Contractor/ DSC |
| Public Awareness | | | |
| Awareness campaign highlighting the long term benefit of the project and public | Review and monitor effectiveness of the awareness campaigns conducted | Fortnightly | PRC/NGO/ DSC |

| Monitoring Category | Type of Monitoring | Minimal Frequency | Monitoring Agency |
|---|--|--------------------------------|--------------------------|
| cooperation to overcome short term construction phase inconveniences | | | |
| OPERATION PHASE | | | |
| Operation and Maintenance of the System | | | |
| Preventive and unscheduled maintenance as result of accidents or damage to the system Operation and maintenance of down stream equipment. Provision of adequate financial and human resources to carry out O&M activities | Monitor adequacy of implementation of preventive and all unscheduled maintenance work including periodic cleaning of the system, timely completion of work, health and safety of maintenance crew and allocation of human and financial resources to carry out the preventive and unscheduled maintenance work Monitor to ensure proper O&M of down stream equipment of the system including lifting and pumping stations and STP | Monthly Monthly | KMC |
| Discharge of Industrial Effluents | | | |
| Discharge of industrial effluent into the sewer | Monitor discharge of industrial effluent into the sewer including review of consent to operate forms submitted to the WBPCB and analysis of wastewater sample from industries discharging into the sewer system. | Ongoing Monthly | WBPCB |

6.0 PUBLIC CONSULTATION

Public consultation started prior to commencement of engineering design. Meetings were held with the Member Mayor in Council (MMIC) Drainage, Borough Chairman and Councillors to appraise them and solicit feedback on the KEIP projects and the proposed scheme. Several field visits were undertaken to identify problems with existing drainage and sewerage system in the project area through interactions with local ward Councillors, Borough Engineers and some primary stakeholders in areas where problems were noted. In addition, NGO Consultants

planned an awareness campaign to inform public about the various components of KEIP project and to highlight the benefits that the public would derive from these projects. Some of the public consultation undertaken is provided in Table 8

Table 8 : PUBLIC CONSULTATIONS UNDERTAKEN IN S & D PROJECT IN BOROUGH XV

| Date | Meeting/Activity | Participant | Purpose |
|------------------------|-------------------------------|--|---|
| 8-10-2002 | Consultation Meeting | Borough Chairman, Councillors of all Wards, Borough engineers, NGO Field Coordinators, DSC and PRC representatives | Project overview and to identify community needs |
| 23-10-2002 | Distribution of KEIP Leaflets | NGO Consultant | 200 copies of KEIP leaflets were given to all Ward Councillors for distribution to public |
| July 2004 – April 2005 | No of field Visits | Borough Chairman, Ward Councillors, KMC officials, DSC representatives and some local residents | Identify problems with the existing drainage and sewerage system |

During the construction phase of the project, ongoing dialogue will be maintained with the Borough Officials to keep them informed of the project status. Also, public awareness campaigns will be undertaken to seek public support and cooperation for the project. Public awareness initiatives will focus on public acceptance of short term inconvenience and hardship that are likely due to the construction activities and mandatory requirement of obtaining sewer connections and decommissioning and demolishing of all septic tanks upon completion of the project.

7.0 FINDINGS AND CONCLUSIONS

A matrix of environmental impacts, as shown below in Table 9, was developed from examination of potential environmental impacts and mitigation measures discussed in Section 4.0.

**Table 9 : MATRIX OF ENVIRONMENTAL IMPACTS S & D PROJECT OF
BOROUGH XV**

| | Physical Resources | | | Environmental Attributes | | | | | Human and Economic Development | | | | | | Quality of Life Values | | | | |
|----------------------------------|--------------------|---------------|-----------------------|--------------------------|--------------|-------------------|---------|----------|--------------------------------|-------------------|----------------|---------|----------------|---------------|------------------------|---------------|----------------|---------------------|------------|
| | Topography | Soils/Geology | Erosion/Sedimentation | Surface Water | Ground Water | Air Quality/Noise | Ecology | Land Use | Communities | Trade/Commerce/In | Infrastructure | Housing | Transportation | Socioeconomic | Resettlement | Public Health | Flooding/Water | Cultural/Historical | Aesthetics |
| Construction Phase | □ | ↓ | ↓ | ↓ | ↓ | ↓ | □ | □ | ↓ | ↓ | ↓ | □ | ↓ | □ | □ | ↓ | □ | ↓ | ↓ |
| Operation or Post Project | □ | □ | □ | ↑ | ↑ | □ | □ | □ | ↑ | ↑ | ↑ | ↑ | ↑ | □ | ↑ | ↑ | □ | ↑ | ↑ |

□ Insignificant impact, no change over existing conditions

↓ Minor short time negative impact ↓ Moderate short-term negative impact

↑ Positive impact ↑ Significant positive impact

As evidenced from the above matrix, the project is not expected to cause any long term irreversible environmental impact. Most of the environmental impacts that are likely will occur for a short duration during the construction phase of the project. Adequate preventive measures have been incorporated to mitigate or minimise these impacts. The project upon completion would realise several positive impacts, most significant of which being reduction of public health hazard as result of improved drainage and sewerage conditions in the service area. In consideration of the above, a detailed EIA is not warranted and this IEE may be considered as the final environmental assessment of the project.