Initial Environmental Examination

August 2017

IND: Delhi Water Supply Improvement Investment Program – Project 1
Subproject for Improvements to the Clear Water Pumping Stations and Transmission Mains (Package DWSIIP/04)

Prepared by Delhi Jal Board for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 27 February 2017)

Currency Unit	–	Indian Rupees (INR)
INR1.00	=	$0.01494
$1.00	=	INR66.9065

ABBREVIATIONS

ADB	–	Asian Development Bank
AP	–	Affected Persons
ASI	–	Archeological Survey of India
CAPP	–	Community Awareness and Public Participation
CFE	–	Consent for Establishment
CFO	–	Consent for Operation
CMRC	–	Community Mobilization and Resettlement Consultant
DJB	–	Delhi Jal Board
DoF	–	Department of Forest
DoL	–	Department of Labour
DPCC	–	Delhi Pollution Control Committee
DWSIIP	–	Delhi Water Supply Improvement Investment Program
EA	–	Executing Agency
EAC	–	Expert Appraisal Committee
EARF	–	Environmental Assessment and Review Framework
EC	–	Environmental Clearance
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
GNCTD	–	Government of the National Capital Territory of Delhi
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
LARRA	–	Land Acquisition, Rehabilitation and Resettlement Authority
MFF	–	Multitranche Financing Facility
MoEFCC	–	Ministry of Environment and Forest, Climate Change
NCTD	–	National Capital Territory of Delhi
NMA	–	National Monument Authority
NGT	–	National Green Tribunal
PIU	–	Program Implementation Unit
PMC	–	Project Management Consultancy
PMU	–	Program Management Unit
PPTA	–	Project Preparatory Technical Assistance
RF	–	Resettlement Framework
ROW	–	Right of Way
SO	–	Safeguards Officer
SPS	–	Safeguard Policy Statement
TOR	–	Terms of Reference
UGR	–	Underground Service Reservoir
WTP	–	Water Treatment Plant

NOTES

(i) The fiscal year (FY) of the Government of India and its agencies ends on 31 March.
(ii) In this report, "$" refers to US dollars.

CONTENTS

APPENDIXES

1. Rapid Environmental Assessment Checklist
2. National Ambient Air Quality Standards
3. Vehicle Exhaust Emission Norms
4. National Ambient Air Quality Standards in Respect of Noise
5. Construction & Demolition Waste Management Rules, 2016
6. Salient Features of Major Labor Laws Applicable to Establishments Engaged in Construction of Civil Works
7. Drinking Water Standards
8. Sample Outline Spoils (construction waste) Management Plan
9. Sample Outline Traffic Management Plan

EXECUTIVE SUMMARY

1. The Delhi Water Supply Improvement Investment Program (DWSIIP) will complement past and ongoing efforts of the Government of National Capital Territory of Delhi (NCTD) to improve water supply services to the residents of NCTD. DWSIIP targets a complete improvement to water treatment, transmission and distribution network improvements to Wazirabad Water Treatment Plant Command area located in northern part of Delhi to ensure the objective of improved water supply services. The MFF targets benefits to 2.64 million population in terms of 24x7 and quality supply of water. The DWSIIP will help achieve the National Capital Territory of Delhi (NCTD) Water Supply Master Plan objectives of reduced non-revenue water (NRW) and equitable access to water supply services. The investment program will include the rehabilitation, upgrading and/or replacement of key water supply infrastructure, improvements in the management of the infrastructure and improved customer-related services within the Wazirabad WTP command area. The DWSIIP will be implemented as a multi-tranche financing facility (MFF) having two tranches and with each tranche constituting a project loan.

2. Physical works include water treatment works, transmission, reservoirs, pumping system and distribution networks, which will be implemented in six packages (subprojects), two in tranche-1, and the rest in tranche-2. This IEE report is for the subproject of "Distribution system improvement in three underground service reservoir (UGR) command areas G-01 (Piragarhi), H-05 (Avantika) and H-06 (Pitampura)" proposed under the tranche-2.

3. **The Subproject**. Subproject is for Improvements to the clear water pumping stations and transmission mains, and located in the northern part of the National Capital Territory of Delhi, India's national capital. The proposed transmission system will transmit treated water from the Wazirabad Water Treatment Plant (WTP) on the northeastern part of Delhi to the 11 UGRs spread in the northern part of Delhi. Each UGR has its own command area for water supply, so this transmission system will improve water supply in the entire project area comprising 11 UGR command areas. These are spread over in the districts of West Delhi, North Delhi, Northeast Delhi and Northwest Delhi. As per the census 2011, the total population of the project area is 2.2 million and the total area is 129.6 sq. km. The subproject includes the following civil works: (i) laying of transmission main of length 54.4 km (ductile iron (DI) and mild steel (MS)) pipe of diameter 700 mm to 2000 mm, and (ii) installation of 9 new pumps (including 3 standby) of 950 HP each in the existing clear water pumping stations at Wazirabad WTP. Subproject will be implemented over a period of 24 months, under a single civil works contract package.

4. **Program Implementation Arrangements.** The DWSIIP will be carried out under the supervision of the GNCTD. The DJB is executing agency (EA) and will be responsible for the management, coordination and execution of all the activities through a. Program Management Unit (PMU), headed by Member (Water Supply). Program Implementation Unit (PIU), established under the PMU, will be implementing agency (IA). Program Director (PD) will head the PIU, and will be assisted by Program Manager (PM). The Chief Engineer (Projects-Water) will be PD, while an .Executive Engineer (Civil) rank officer will be PM. PM will be further supported by technical, financial, safeguards and administrative staff. The PIU will be assisted by a Program Management Consultant (PMC) and a Community Mobilization & Resettlement Consultant (CMRC). The PIU will appoint the contractors to build the infrastructure elements and will manage the construction and commissioning activities. Safeguard Officer (SO) in the PIU will oversee the environmental and social safeguard tasks, which will inter alia include preparation, implementation, monitoring and overall safeguard compliance in DWSSIP.

5. **Screening and assessment of potential impacts**. 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. As per the GoI EIA Notification, 2006, this subproject do not require EIA study or environmental clearance. The potential environmental impacts of the subproject have been assessed using ADB Rapid Environmental Assessment Checklist for Water Supply. The potential negative impacts were identified in relation to pre-construction, construction and operation.

6. **Categorization.** Based on results of the assessment and ADB SPS, the subproject is classified as environmental Category B, i.e., the subproject is judged to be unlikely to have significant adverse environmental impacts. An initial environmental examination (IEE) is required to determine whether significant environmental impacts warranting an environmental impact assessment are likely.

7. This IEE aims to (i) provide critical facts, significant findings, 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 indicative costs and who is responsible for carrying out the mitigation and monitoring measures.

8. **Description of the Environment**. The subproject components locations are in northern parts of Delhi, the capital city of India. The proposed transmission pipeline will be laid along the public roads – mostly main wider roads that can accommodate large diameter transmission pipes. Mostly of urban character, subproject area is devoid of any significant sensitive environmental features in the alignment of proposed pipelines. Delhi climate is a distinct humid subtropical, and semi-arid climate, with seasonal temperature variations. Extreme dryness with intensely hot summer, dust storms, and very cold winters are the characteristics. Due to dry dust weather condition, coupled with traffic and other activities, the ambient air quality of Delhi in general is poor with high levels of particulate matter. Roads in the subproject area are congested with traffic, pedestrians and activities. Alignment of transmission main at this feasibility stage is fixed only in outline, and it will be fine-tuned as the project progresses to detailed design phase.

9. Transmission Main starts from Wazirabad WTP and is aligned along the main arterial roads of Outer Ring Road (ORR), Banda Bahadur Marg, NH1, Mahatma Gandhi Road (Inner Ring Road – IRR), Rohtak Road, Azadpur road, Maharaja Nahar Singh Marg, Lawrence Road, Britannia Road, Guru Harkishan Marg, Vashisht Kumar Gulla Marg, S Manohar Singh Marg, Maharaja Nahar Singh Marg, Muni Maya Ram Jain Marg, Maharaja Agrasen Marg, Guru Gowalkar Marg, Saiyyad Nangloi Marg and Bhao Rao Devars MargSanti Swaroop Tyagi Marg, Grand Trunk Road (NH1), Bawana Road, Libaspur Road, etc., Except ORR, which is very wide and carry comparatively less traffic, all other roads carry high traffic, congested with pedestrian

and commercial activities abutting the roads. There are also several important traffic junctions along the pipeline alignment (eg, Mukbara chowk). On the NH1, IRR, and Rohtak roads pipe will be laid along the service roads, which again carry significant volumes of traffic. Where the service roads are available, the pipeline will be accommodated.

10. There are 2 Archeological Survey of India (ASI) protected monuments in the project area. Shal Alam Tomb is situated near Wazirabad WTP (this located along the road leading to WTP), and Sheesh Mahal in Shalimar Bagh area. The transmission line is likely to fall within the 300 m regulated zone of Shah Alam Tomb, and therefore the alignment needs to be finalized in discussion with the ASI. Prior permission of ASI is necessary for laying the pipelines. At Shalimar Bagh, the proposed alignment is about 1 km from the monument, therefore permission may not be required. This is to be rechecked during the finalization of alignments, and as far as possible pipelines will be avoided within 300 m regulated zone.

11. **Potential environmental impacts.** The subproject is unlikely to cause significant adverse impacts because: (i) the components will involve straightforward construction and operation, so impacts will be mainly localized; (ii) there are no significant sensitive environmental features in the project sites and (iii) predicted impacts are site-specific and likely to be associated with the construction process and are produced because the process is invasive, involving excavation and earth movements.

12. Environmental impacts as being due to the project design or location are not significant. As the subproject activities are mainly located in an urban area congested with traffic, pedestrians and many of the roads carry heavy traffic and are abutted with busy commercial establishments frequented by people, necessary measures to align the pipelines along the wider roads to minimize the impacts are suggested.

13. During the construction phase, impacts mainly arise from the construction dust and noise; from the disturbance of businesses, traffic, residents and important buildings by the construction work, and from the need to dispose of large quantities of waste soil and import of construction material. The social impacts (access disruptions) due to construction activities are unavoidable, as the residential and commercial establishments exist along the roads where pipes will be laid. Impact of dust pollution is considered significant. As Delhi air already has high particulate matter content, and therefore any further increase due to dust from construction activities will deteriorate the situation, though temporarily. Trenchless technology is proposed for laying pipelines, this will therefore avoid / minimize the dust generation, traffic disruptions and other public inconveniences. However, this technology may not be suitable for all locations, open trenching may be required to certain extent. Appropriate measures are suggested to minimize the construction impacts. Also, to avoid impacts, 50% of the total pipelines are proposed to be laid by trenchless method. Trenchless method will have minimal impacts, and all standard construction practices and safety precautions will be undertaken to further reduce the impacts.

14. **Environmental Management Plan.** An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels. Locations and siting of the proposed infrastructures were considered to further reduce impacts. Pipelines are being laid in road right of way RoW alongside main/access roads, to reduce acquisition of land and impacts on livelihoods.

15. The EMP includes design and location related measures such as (i) energy efficient pumping equipment (ii) quick leak detection and rectification to save the resources, etc., (iii) measures to avoid water supply contamination from sewers and drains, (iv) fine tuning pipeline

alignments based on the type of roads, etc., During construction, the EMP includes mitigation measures such as (i) adoption of trenchless technology as far as possible for laying pipeline; (ii) use of barricading, dust screens, dust-suppression methods such as watering and/or covering of stockpiles to control dust (iii) implementation of traffic management plan in coordination with local traffic police to minimize traffic impacts; (iv) awareness campaigns and consultations to inform residents and businesses of potential disturbances; (v) provision of walkways and planks over trenches to ensure access will not be impeded; (vi) use of noise-dampening measures in areas with sensitive receptors such as hospitals, schools, places of worships and other silence-zones; and (vii) finding beneficial use of excavated materials to extent possible to reduce the quantity that will be disposed-off.

16. Subproject include improvement of distribution network, mainly focusing on enhancing efficiency and coverage of the system. Subproject do not include any supply side measures (like water source augmentation, treatment etc.,) and therefore there are no impacts during operation envisaged. In the IEE the discussion focused mainly on construction phase activities, as water pipelines are not generally associated with any significant impacts during operation. Public inconvenience, dust, and traffic disruptions are typical impacts that are envisaged for pipeline repair work during operation. These however will be rare and infrequent. The EMP includes mitigation measures and monitoring plan for O&M phase.

17. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between project management unit (PMU), project implementing unit (PIU), consultants and 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. The EMP includes a monitoring program to measure the environmental condition and effectiveness of implementation of the mitigation measures. It will include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

18. The contractor will be required to submit to PIU, for review and approval, a site environmental plan (SEP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring program as per SEP; and (iv) budget for SEP implementation. No works are allowed to commence prior to approval of SEP. A copy of the EMP/approved SEP will be kept on site during the construction period at all times. The EMP included in the bid and contract documents. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

19. **Consultation, disclosure and grievance redress mechanism.** The stakeholders were involved in developing the IEE through discussions on-site. A subproject level public consultation activity will be conducted during detailed design phase, after which views expressed will be incorporated into the IEE and also in the planning and development of the project. The IEE will be made available at public locations and will be disclosed to a wider audience via the ADB and DJB websites. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation. A grievance redress mechanism is described within the IEE to ensure any public grievances are addressed quickly.

20. **Monitoring and Reporting.** The PMU, PIU and PMC will be responsible for monitoring. The PMC will submit semi-annual monitoring reports to PIU, which will review and submit to ADB. ADB will post the environmental monitoring reports on its website.

21. **Conclusions and Recommendations.** Therefore, as per ADB SPS, the project is classified as environmental category B and does not require further environmental impact assessment. To comply with the government regulatory framework, subproject requires prior permission of ASI to construct pipelines in the regulated (300 m) zone of the protected monument (Shah Alam Tomb at Wazirabad). This IEE shall be updated during the detailed design stage by the PMC to reflect final alignment, construction technology and any other changes, amendments in the projects and will be reviewed and approved by ADB.

I. INTRODUCTION

A. Project Background & Context

1. The Delhi Water Supply Improvement Investment Program (DWSIIP) will complement past and ongoing efforts of the Government of National Capital Territory of Delhi (NCTD) to improve water supply services to the residents of NCTD.[1] DWSIIP targets a complete improvement to water treatment, transmission and distribution network improvements to Wazirabad Water Treatment Plant Command area located in northern part of Delhi (see **Figure 1**) to ensure the objective of improved water supply services.[2] The MFF targets benefits to 2.64 million population in terms of 24x7 and quality supply of water. The DWSIIP will help achieve the National Capital Territory of Delhi (NCTD) Water Supply Master Plan objectives of reduced non-revenue water (NRW) and equitable access to water supply services.[3]The investment program will include the rehabilitation, upgrading and/or replacement of key water supply infrastructure, improvements in the management of the infrastructure and improved customer-related services within the Wazirabad WTP command area. The DWSIIP will be implemented as a multi-tranche financing facility (MFF) having two tranches (project 1 & project 2) and with each tranche constituting a project loan.

2. Project 1 of the DWSIIP will include a PMC; civil works packages (DWSIIP/01 & 02) for distribution network improvement, including UGR, clear water pumping station, DMA feeder mains and distribution pipes, bulk flow meters and house service connections for UGR command areas C-02 (Chitranjan Das Park Jahangirpuri), C-03 (Model Town) G-02 (Punjabi Bagh), H-07 (Shakur Basti) and H-08 (Lawrence Road); and a civil works package (DWSIIP/04) for transmission mains and clear water pumping stations, and instrumentation and automation (SCADA). Project 2 will include civil works package (DWSIIP/03) for rehabilitation or construction of the Wazirabad WTP; civil works packages (DWSIIP/05 & 06) for distribution network improvement, including UGR, clear water pumping station, DMA feeder mains and distribution pipes, bulk flow meters and house service connections for UGR command areas G-01 (Piragarhi), H-05 (Avantika), H-06 (Pitampura), C-01 (Sanjay Gandhi Transport Nagar), P-09 (Burari-A) and P-10 (Burari Transport Planning Authority). Project 2 will also support a Project Development Facility (PDF) to enhance readiness of future investment projects by taking advance actions to prepare the projects.

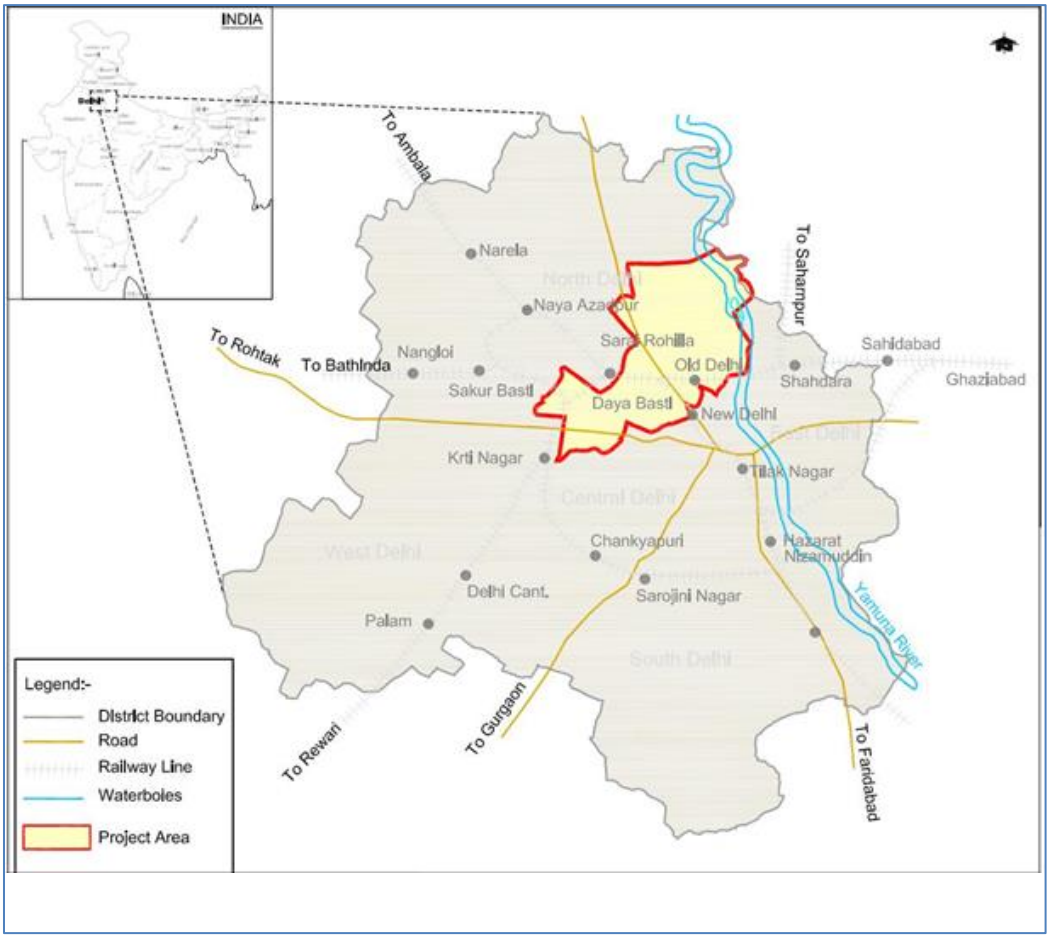
3. **Proposed Subproject.** The proposed subproject is for laying of clear water transmission main pipelines from the Wazirabad WTP to 11 UGRs spread in the northern part of Delhi. This transmission system will improve water supply in the entire project area comprising 11 UGR command areas. These are spread over in the districts of West Delhi, North Delhi, Northeast Delhi and Northwest Delhi. As per the census 2011, the total population of the project area is 2.2 million and the total area is 129.6 sq. km. The subproject includes the following civil works: (i) laying of transmission main 1 of length 10.8 km ductile iron (DI) pipe of diameter 700 mm to 1200 mm, (ii) laying of transmission main 2 of length 39.2 km ductile iron (DI) & mild steel (MS) pipes of diameter 700 mm to 2000 mm, and (iii) installation of 9 new pumps (including 3 standby) of 950 HP each in the existing clear water pumping stations at Wazirabad WTP.

4. The DWSIIP will be carried out under the oversight of the GNCTD. The DJB is the Executing Agency (EA) responsible for the management, coordination and execution of all the

[1] The Asian Development Bank (ADB) provided project preparatory technical assistance: ADB. 2013. *Technical Assistance to India for Preparing the Delhi Water Supply Improvement Investment Program.* Manila (TA 8415-IND).
[2] ADB, October 2013. *Country Partnership Strategy (2013-2017).*
[3] Japan International Cooperation Agency. 2011. *Study on Improvement of Water Supply System in Delhi in the Republic of India*. New Delhi.

activities funded under the MFF. DJB has established a PMU, chaired by the Member (Water Supply). A PIU has been established under the PMU to act as the Implementing Agency (IA). The Program Director will head the PIU and oversee the investment program, while the day-to-day management and implementation will be the responsibility of the Program Manager. The Chief Engineer (Projects) Water of the DJB will be the Program Director, and the Program Manager will be an Executive Engineer (Civil) rank officer. PIU will be assisted a Project Management Consultant (PMC).

Figure 1: Location of the Investment Program Area in the NCTD



B. Purpose of this IEE Report

5. 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. The potential environmental impacts of the subproject have been assessed using ADB Rapid Environmental Assessment Checklist for Water Supply (Appendix 1). Then potential negative impacts were identified in relation to pre-construction, construction and operation of the improved infrastructure, and results of the assessment show that the subproject is unlikely to cause significant adverse impacts. Thus, this initial environmental examination (IEE) has been prepared in accordance with ADB SPS's requirements for environment category B projects.

6. This IEE is based on the feasibility study report (prepared by PPTA team) and therefore certain details may change as the development of the subproject progresses, particularly in the detailed design stage. This IEE, therefore, will be required to be updated during the detailed design stage, to reflect any changes, or amendments to the subproject.

7. This IEE has been conducted mainly based on field reconnaissance surveys and secondary sources of information. No field monitoring (environmental) survey was conducted however, the environmental monitoring program developed as part of the environmental management plan (EMP) will require the contractors to establish the baseline environmental conditions prior to commencement of civil works. The results will be reported as part of the environmental monitoring report and will be the basis to ensure no degradation will happen during subproject implementation. Stakeholder consultation was an integral part of the IEE.

C. Report Structure

8. This Report contains the following ten (10) sections:

(i) Executive summary;
(ii) Introduction
(iii) Description of the project
(iv) Policy, legal and administrative framework
(v) Description of the environment;
(vi) Anticipated environmental impacts and mitigation measures;
(vii) Public consultation and information disclosure;
(viii) Grievance redress mechanism;
(ix) Environmental management plan, and,
(x) Conclusion and recommendation.

II. DESCRIPTION OF THE PROJECT

A. Project Area

9. Subproject is located in the northern part of the National Capital Territory of Delhi, India's national capital. The proposed transmission system will transmit treated water from the Wazirabad Water Treatment Plant (WTP) on the northeastern part of Delhi to the 11 UGRs spread in the northern part of Delhi. Each UGR has its own command area for water supply, so this transmission system will improve water supply in the entire project area comprising 11 UGR command areas. These are spread over in the districts of West Delhi, North Delhi, Northeast Delhi and Northwest Delhi. Project area comprises 56 municipal wards, some of which are partially covered. As per the census 2011, the total population of the project area is 2.2 million and the total area is 129.6 sq. km.

B. Existing Water Supply Situation

10. Delhi falls in the Yamuna sub basin of Ganga basin with Yamuna as the only river flowing through it. Along with sub surface water extracted through tube wells and Ranney wells, Delhi meets it demand through water received from the Western Jamuna Canal (WJC), River Yamuna and the Upper Ganga Canal. Supplies in WJC are supplemented by Delhi's share of the Ravi-Beas water transferred through the Narwana-Branch Link of the Bhakhra system. Delhi gets its share of Ganga water through the Upper Ganga Canal (UGC) system. Water supply services in Delhi are provided using treated water from 11 WTPs, and water from many tube wells and

several Ranney wells. The total capacity of these production facilities amounts to 925 MGD. Treated water is supplied to consumers via the transmission and distribution system.

11. In the existing system, the subproject area is supplied water from various water treatment plants. The Wazirabad Water works, with a total capacity of 131 MGD, supplies to 4 UGR command areas (C-02, C-03, G-02 and H-08) in the subproject jurisdiction. Under the reorganization of command areas it is proposed that Wazirabad WTP will supply to all 11 UGRs covered under the subproject area, besides it will also supply to additional UGRs and provides bulk water supply to New Delhi Municipal Corporation (NDMC) area.

C. Proposed Sub-Project

12. The existing transmission system from Wazirabad WTP comprises of six mains (of material two each from the three WTP units. Of this six, three mains are currently supplying to the 4 UGR command areas, which will continue to receive water from Wazirabad WTP, and the rest 3 are supplying to areas outside the subproject area. 7 new UGRs are added to the command area of Wazirabad WTP besides the existing 4 UGRs. Therefore new transmission lines are required to be laid to these UGRs, which is proposed under this subproject. Besides, the existing transmission lines will be replaced if required based on a field study to ascertain its condition as well as carrying capacity. The existing transmission mains consists mainly of cast iron (CI), DI and MS pipes. Adequate pumps will also be installed at the clear water pumping stations in the WTP.

13. Following Table shows the nature and size of the various components of the subproject. Subproject is presently in feasibility stage and therefore the alignments and pipe sizes may be changed as the project preparation progresses.

Table 1: Proposed Water Supply Subproject Components

<table>
<tr><th>Infrastructure</th><th>Function</th><th>Description</th><th>Location</th></tr>
<tr><td>New pumps</td><td>To transmit water under pressure from clear water reservoirs at WTP to underground reservoirs in 11 UGR command area</td><td>Installation of 9 new pumps including electro mechanical items
• 6 pumps of 950 HP each
• 3 pumps of 950 each (stand by)</td><td>New pumps will be installed within the existing pumping stations at the clear water reservoirs in the Wazirabad WTP campus. This is owned by DJB.</td></tr>
<tr><td>Transmission Main</td><td>To transmit water from WTP to UGRs in command areas of UGR C-03 (Model town), H-08 (Lawrence Road), H-07 (Shakur Basti), G-02 (Punjabi Bagh), H-06 (Pitampura), H-04 (Rohini), H-05 (Avantika),G-01 (Piragarhi), P-10 (Burari TPA); P-09 (Burari); C-01 (Sanjay Gandhi Transport Nagar) and P-05 (Siraspur)</td><td>54.4 km (500-2000 mm)
DI pipes
<table>
<tr><th>Dia</th><th>Length</th></tr>
<tr><td>Mm</td><td>m</td></tr>
<tr><td>500</td><td>2447</td></tr>
<tr><td>600</td><td>7355</td></tr>
<tr><td>700</td><td>6660</td></tr>
<tr><td>800</td><td>10391</td></tr>
<tr><td>900</td><td>2063</td></tr>
<tr><td>1000</td><td>5459</td></tr>
<tr><td>1100</td><td>332</td></tr>
<tr><td>1200</td><td>1067</td></tr>
<tr><td>Total</td><td>35774</td></tr>
</table></td><td>Pipes will be laid underground along the main roads such as Outer Ring Road (ORR), Banda Bahadur Marg, NH1, Mahatma Gandhi Road (Inner Ring Road – IRR), Rohtak Road, Maharaja Nahar Singh Marg, Lawrence Road, Britannia Road, Guru Harkishan Marg, Vashisht Kumar Gulla Marg, S Manohar Singh Marg, Maharaja Nahar Singh Marg, Muni Maya Ram Jain Marg, Maharaja Agrasen Marg, Guru Gowalkar Marg, Saiyyad Nangloi Marg and Bhao Rao Devars MargSanti Swaroop Tyagi Marg, Grand Trunk Road (NH1), Bawana Road, Libaspur Road, etc

Pipes will be aligned appropriately</td></tr>
</table>

<table>
<tr><th>Infrastructure</th><th>Function</th><th>Description</th><th>Location</th></tr>
<tr><td></td><td></td><td>MS pipes<table><tr><td>Dia</td><td>Length</td></tr><tr><td>Mm</td><td>m</td></tr><tr><td>1400</td><td></td></tr><tr><td>1600</td><td></td></tr><tr><td>1800</td><td></td></tr><tr><td>2000</td><td></td></tr><tr><td>Total</td><td>18638</td></tr></table></td><td>based on the availability of suitable land strip in the road right of way, considering existing utilities (drains, telephone lines and effect on traffic. In narrow roads, where there is no place, the pipeline will be laid within the tarmac; where the roads are very wide pipes will be main in the road shoulder, and if the roads have service roads, the pipes will be mostly laid in the service roads.</td></tr>
</table>

14. **Construction works (pipelines).** Civil works in the subproject include laying of water supply transmission pipes from diameters ranging from 700 mm to 2000 mm. These works will include linear excavation for laying pipes along the roads, placing pipes in the trench, jointing, hydro-testing and refilling with the excavated soil. Rhotak Road, GT Road (NH1), MG Road, ORR are the main transport corridors along which pipeline will be laid. Other important and busy roads include Santi Swaroop Tyagi Marg, Bawana Road, Libaspur Road, Banda Bahadur Marg, Maharaja Nahar Singh Marg, Vashisht Kumar Gulla Marg, Maharaja Nahar Singh Marg, Maharaja Agrasen Marg, Guru Gowalkar Marg, Saiyyad Nangloi Marg and Bhao Rao Devars Marg etc., All these roads carry heavy traffic. Subsequent to completion of works, road reinstatement will be undertaken immediately by the contractor as part of the civil works.

(i) Excavation: About 50% of the pipes will be laid by open cut trench type method while the rest 50% will be laid by adopting trenchless construction method. The open excavation will be carried out with excavators and where there is space constraints it will be done manually. Proper barricading will be done all around the excavated area for the safety and if required traffic diversion will be considered. Suitable trenchless technology will be adopted by the contractor such as modern micro tunneling with boring pipe jacking technique. Trenchless technology will be adopted at all locations, which are convenient/suitable to use such technology, with a purpose to avoid public inconvenience and safety, traffic disruptions, dust control, and avoid blocking access to properties. The exact trenchless technology to be adopted and selection of alignment/locations where it will be adopted once the contractor is appointed. However, the overall adoption of trenchless technology will be at least 50% of total pipeline to be laid under the subproject.

(ii) Barricading: To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, torches, red lanterns and guards, as required, will be placed and maintained during the progress of the work. The hard barricading will be done at all construction locations.

(iii) Temporary construction material storage: Due to space constraints and heavy traffic, the temporary construction of material storage at site will be limited. Material will be brought to the site as required. Material required for a day's work is only kept at the work site.

(iv) Temporary storage of excavated soil, refilling & disposal of surplus soil: All excavated material will be stacked in such a distance from the trench edge that it will not endanger the work or workmen and it will avoid obstructing footpaths, roads and drive ways. The excavated soil will be refilled on the same day. The surplus soil will be transported to the identified disposal sites.

(v) Traffic diversions: Traffic diversions may be required at some locations. Public will be informed in advance and approval of the competent authorities will be obtained. Traffic plan will however be prepared by the contractor

(vi) Testing and refilling: Pipe laying and testing activates will be planned meticulously. Excavation will be planned in such a way that, back filling will be done by the end of the day's activity. All smaller diameter pipes will be hydraulically tested before backfilling.

(vii) Pipes clean up prior to supply: Prior to supply of water through newly laid pipelines, ensure that pipes are properly cleaned and disinfected.

(viii) Road relaying Backfill material in the trench will be consolidated mechanically, and road restoration will be taken up taken up immediately. If it is not possible to take up the road restoration immediately for technical reasons of road construction, a plain concrete layer will be laid over the trench to make the surface smooth for driving and also to arrest the dust generation and erosion.

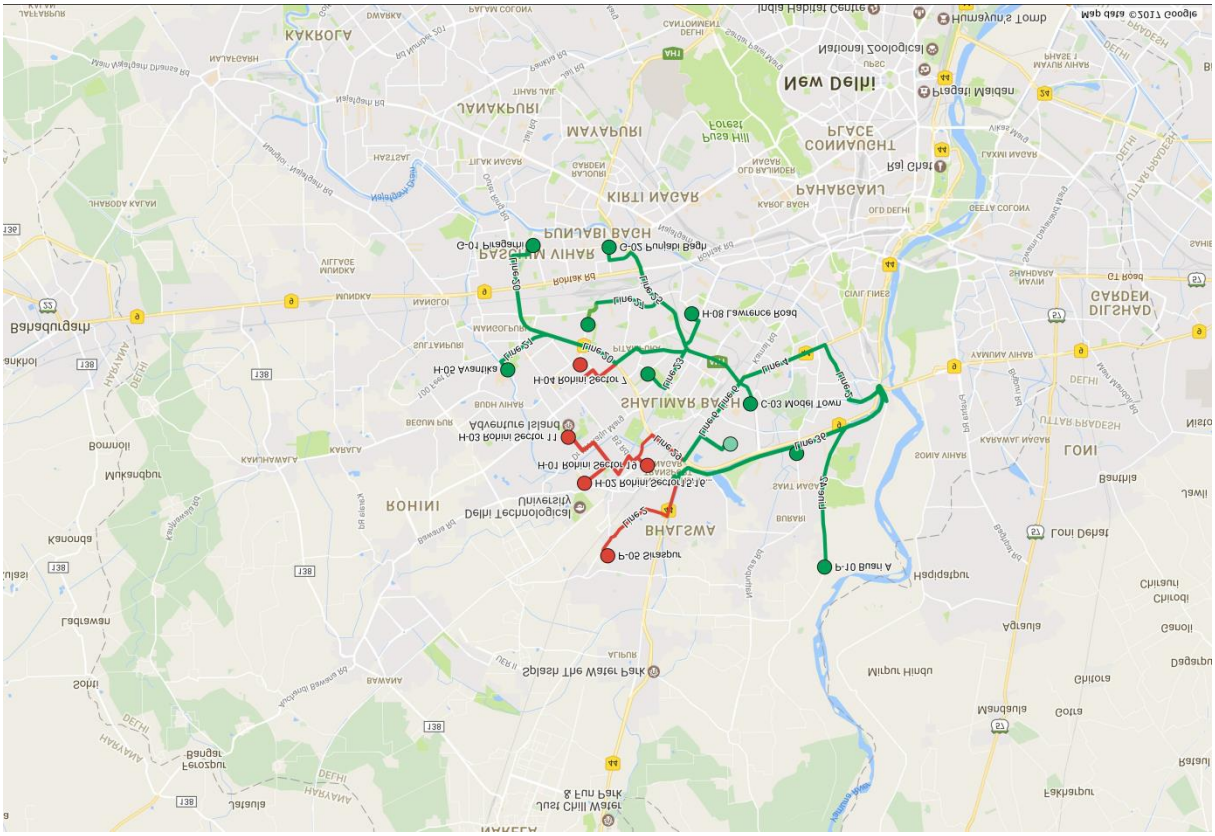
15. Contractor will prepare a method statement in detail for laying of pipeline. Approval of method statement by the Engineer is prerequisite for the start of work. Method statement will be specific to each site/road section as appropriate, and should clearly identify sections for trenchless technology and open trenching. The overall work shall be split into individual tasks (per say, site clearance, excavation, pipe laying and up to final road restoration), and each task shall be detailed out in the method statement. The method statement shall provide a activity-space-time graph along the alignment for each section, which should clearly show section-wise, for example, how many days the trench will be open kept open. All the works shall be taken as per the documented procedures only.

16. All the construction works will be carried out during day time. Only in case of emergency or site conditions (like crossing a main road) night work will be taken up with due permission from the civic agencies. Proper precautionary measures will also be followed.

D. Implementation Schedule

17. The subproject is currently at feasibility stage. Preparation of Detailed Project Report (DPR) will be taken up subsequently. Tenders may be invited in early 2018 once the Detailed Project Report (DPR) is approved by the competent authority. Works likely to take about 24 months for completion.

Figure 2: Transmission Main 1 Alignment



III. POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

A. ADB Policy

18. 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 ADB investments.

19. **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 impacts, 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.

20. **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.

21. **Public disclosure**. ADB will post the safeguard documents on its website as well as disclose relevant information in accessible manner in local communities:

(i) for environmental category A projects, 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 implementing agency during project implementation upon receipt.

22. **ADB SPS Additional Requirements on Pollution Control, Health & Safety**. During the design, construction, and operation of the project the PMU and PIUs will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.[4] These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Government of India regulations differ from these levels and measures, the PMU and PIUs will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the PMU and PIUs will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

[4] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

Table 2: WHO Ambient Air Quality Guidelines

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]		
	Averaging Period	Guideline value in µg/m³
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Table 3: World Bank Group's EHS Noise Level Guidelines

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

B. National Environmental Laws

23. **Environmental assessment.** The GoI EIA Notification of 2006 (replacing the EIA Notification of 1994), sets out the requirement for Environmental Assessment in India. This states that Environmental Clearance (EC) is required for specified 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.

24. Category A projects require EC from the central Ministry of Environment and Forests (MoEF). The proponent is required to provide preliminary details of the project in the prescribed

manner with all requisite details, after which an Expert Appraisal Committee (EAC) of the MoEF prepares comprehensive Terms of Reference (ToR) for the EIA study. On completion of the study and review of the report by the EAC, MoEF considers the recommendation of the EAC and provides the EC if appropriate.

25. Category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The State level EAC categorizes the project as either B1 (requiring EIA study) or B2 (no EIA study), and prepares ToR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the EC based on the EAC recommendation. The Notification also provides that any project or activity classified as category B will be treated as category A if it is located in whole or in part within 10 km from the boundary of protected areas, notified areas or inter-state or international boundaries.

26. None of the components of this water supply subproject falls under the ambit of the EIA Notification 2006, and, therefore EC is thus not required for the subproject.

27. **Applicable environmental regulations.** Besides EIA Notification 2006, there are various other acts, rules, policies and regulations currently in force in India that deal with environmental issues that could apply to infrastructure development. The specific regulatory compliance requirements of the subproject are shown in Table 4.

Table 4: Applicable Environmental Regulations

S. No	Legislation	Requirements for the Investment Program
A	**Policies**	
1.	National Environment Policy, 2006.	-Government of India policy at national level, and is a general guidance document - Subproject design shall overall be in line with the Policy principles, the most relevant policy principle for this subproject is the principle of “enhancing and conservation of environmental resources and abatement of pollution”. - Designing the pumping and distribution system with optimal energy use, and overall resource conservation through minimizing loss of water and overall load on the system
2	Delhi Climate Change Agenda.	- Under the water component, the Agenda suggests alternative water supply source development; - energy efficiency design.
B	**Acts, Rules**	
1.	EIA Notification, 2006.	- specifies requirements for EIA and environmental clearance (EC) - Not applicable to the subproject
2.	Air (Prevention and Control of Pollution) Act, 1981, amended 1987 and its Rules, 1982.	- Subproject do not include components that attract this Act - Act provisions will be applicable during construction works (emissions from equipment, machinery, vehicles shall confirm to emission norms) (including but not limited to diesel generators and vehicles) Appendix 2 & 3 presents the ambient air quality standards and vehicle emission norms
3	EIA Guidance Manual for Building, Construction, Townships & Area Development Projects, Ministry of Environment & Forests, 2010.	- this is manual is applicable to construction projects requiring environmental clearance (EC) - Considering high air pollution, especially dust, in ambient air, the National Green Tribunal has given a ruling in 2015 that all construction projects (irrespective of EC requirement) shall follow the dust control norms - Follow the dust & noise control measures as suggested in the manual
4.	Environmental (Protection) Act, 1986 amended 1991 and the following	

S. No	Legislation	Requirements for the Investment Program
	rules/notifications:	
4a.	Environment (Protection) Rules, 1986 including amendments.	- WTPs should be designed and operated with appropriate wastewater and sludge treatment and disposal facilities; - compliance with emission and disposal standards during construction.
4d.	Noise Pollution (Regulation and Control) Rules, 2000.	- Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones (Appendix 4) - Compliance with noise standards
4b	Municipal Solid Wastes Management Rules, 2016	- Rules to manage municipal solid waste generated; provides rules for segregation, storage, collection, processing and disposal. - Solid waste generated at proposed facilities shall be managed and disposed in accordance with the MSWM Rules
4c	Construction & Demolition Waste Management Rules, 2016	- Rules to manage construction & to waste resulting from construction, remodeling, repair and demolition of any civil structure. Rules define C&D waste as waste comprising of building materials, debris resulting from construction, re-modeling, repair and demolition of any civil structure. - Construction & demolition waste generated from the project construction shall be managed and disposed as per the rules (Appendix 5)
5.	Ancient Monuments and Archaeological Sites and Remains Acts, 1958, its Rules,1959 and notification, 1992.	- The Act designates areas within 100 m of the protected monument as “prohibited area” and 100-300 m as “regulated area”. -Any construction activity within these areas require prior permission of the National Monuments Authority (NMA). -a protected monument is located in the subproject area; and some residential areas (eg, Shalimarbagh north) are falling within the 300 m regulated boundary of the monument and therefore requires permission of NMA for laying pipelines -Application in the prescribed format for permission shall be submitted to ASI Delhi Circle, which after scrutiny and site visit, will be forwarded to NMA for grant of permission.
6.	Delhi Ancient and Historical Monuments and Archaeological Sites and Remains Act, 2004.	- An Act to provide for the preservation, protection, upkeep, maintenance, acquisition and regulation of, and control over, ancient and historical monuments and archaeological sites in Delhi; - Under the Act, State Government declares various monuments, sites etc. as protected monument/sites; - Requires prior permission of the Department of Archeology if the construction work is situated within 100m of any monument or if the site is declared as protected by the Government of NCTD under this Act; - Department provides conditional permission, including time for completion, procedures to be followed during the work and for chance finds etc.
7.	The Delhi Preservation of Trees Act, 1994.	-Imposes restrictions on the felling and removal of trees on any land in NCTD irrespective of land ownership; -Prior permission is required from the Tree Officer to cut/prune trees -Plant trees as per the direction of the Tree Officer.
8.	Labour laws (Appendix 6 provides labor laws applicable to establishments engaged in construction of civil works).	Applicable to construction works and some of the provisions are as follows: - Contractors to obtain license from the designated Labour Officer and shall register with Department of Labour, if Inter-state migrant workmen are engaged; - Adequate and appropriate amenities and facilities shall be provided to workers including housing, medical aid, traveling expenses to/from home etc. - The employer is required to provide safety measures at construction work and other welfare measures, such as canteens,

S. No	Legislation	Requirements for the Investment Program
		first-aid facilities, ambulance, housing accommodation for workers near the workplace etc.; - Rules stipulates hours of work, night work, welfare, payment of wages, registers and records, facilities to be provided, and safety and health - No child labour shall be employed. - All construction workers be paid not less than the prescribed minimum wage.[a] - Compensation for workers in case of injury by accident shall be provided as per the provisions of the Acts - Equal wages for work of equal nature to male and female workers; there shall be no discrimination in terms of gender

[a] http://www.delhi.gov.in/wps/wcm/connect/doit_labour/Labour/Home/Minimum+Wages/

Table 5: Indicative Statutory Clearance Requirements

S. No	Subproject Component	Statutory Requirements	Time required for obtaining clearance
1	Tree cutting for laying of pipelines / UGR rehabilitatio	- prior permission from Tree Officer, Department of Environment and Forest, GNCTD -Application form and procedure is available at the following web link; http://delhi.gov.in/wps/wcm/connect/9288ae004f06d0c8aeb4bee1feedd58c/Procedure+for+obtaining+tree+cutting+permission.pdf?MOD=AJPERES&lmod=-1526989464&CACHEID=9288ae004f06d0c8aeb4bee1feedd58c	60 days
3	Pipelines to be laid within in the regulated zone of ASI protected monuments	-Prior permission from National Monument Authority (NMA) -Application available at following weblink http://www.nma.gov.in:8080/documents/10157/bdfcc912-4c2c-4d48-b612-712c20e400c4	90 days
4	Other clearances required for pipelines based on the alignment location	- Permission from National Highway Authority of India, Municipal Corporation of Delhi, Public Works Department, Delhi Metro Rail Corporation, Irrigation & Flood Control Department etc., as the case may be.	-

C. Administrative Framework, Enforcement & Grievance Redress

28. **Environmental Clearance**. Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, governs and enforces the environmental clearance requirements in India. Clearances are handled at two levels –clearance to Category A projects is issued at central level by MoEFCC, and for Category B projects, clearance process is decentralized at state-level, and clearance is issued by the respective State-level EIA Authorities set up under the EIA Notification, 2006. This subproject do not fall under the ambit of EIA Notification, therefore this is not applicable.

29. **Enforcement of Pollution Control Laws.** Delhi Pollution Control Committee (DPCC) enforce the pollution control laws and regulations (water pollution, air pollution, solid waste, hazardous waste and biomedical waste management, etc.,) in NCT Delhi. DPCC enforces the pollution control law through issuance of consent for establishment and operation of industries and activities with pollution potential – notified by as Red, Orange and Green categories. The activities/projects that are not notified do not need to go through the consent process. Consent for establishment (CFE) is issued to an activity based on review of project proposal, pollution control measures and visit to proposed site. Consent for operation (CFO) is issued after the

construction is completed. The consent specifies the conditions to be complied with pertaining to emissions, effluents, and solid waste. The consent must be renewed annually or as specified by DPCC. The standards for discharge and other regulations to be followed are established by the Central Pollution Control Board, while at state level, DPCC can further strengthen the standards, but cannot relax.

30. DPCC monitors the pollution levels and regulates environmental protection related activities in Delhi. The involvement of DPCC in subproject implementation and monitoring, will be limited, as none of the components require consent of DPCC. However, as per the recent NGT's (National Green Tribunal) direction, DPCC monitors the construction activities to check pollution and control activities (especially dust and air emissions) irrespective of scale and size, and whether or not a project requires environmental clearance from MOEFFCC or consent from DPCC. NGT ruling also provides for levying of penalty (INR 50,000) for non-implementation of dust-control norms as per the Manual on Construction Projects published by MoEFCC. The subproject construction activities shall also comply with the dust control measures.

31. **Grievance Redress**. Complaints on pollution and waste management is handled by the DPCC. Public can approach the DPCC which will review, and take necessary steps to redress, and if requires takes punitive actions including closure of such polluting industry/activity. A grievance redress mechanism is established at MoEFCC on all matters related to environment, forest, wildlife etc. This system accepts, acknowledges and acts on the complaints in a time bound manner, with the help of regional offices as required.

32. Established under the National Green Tribunal Act, 2010, the National Green Tribunal (NGT) provides an effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith. NGT has jurisdiction over matters related to Water Act, 1974; Water Cess Act, 1977; Forest (Conservation) Act, 1980; Air Act, 1981; Environment (Protection) Act, 1986; Public Liability Insurance Act, 1991; and Biodiversity Act, 2002. Consequently, no other court will have jurisdiction over the matters related to environment, falling under the above referred Acts. Being a dedicated tribunal for environmental matters with the necessary expertise to handle environmental disputes, NGT provides speedy justice (within 6 months). If not satisfied with the NGT decision, aggrieved party can approach the Supreme Court within the specified period of time. Matters relating to the Wildlife (Protection) Act, 1972 do not fall under the jurisdiction of NGT.

IV. DESCRIPTION OF ENVIRONMENT

A. Methodology Used for Baseline Study

33. **Data collection and stakeholder consultations.** Data for this study has been primarily collected through comprehensive literature survey, discussion with stakeholder agencies, and field visits to the proposed subproject sites.

34. The literature survey broadly covered the following:

(i) Project details, reports, maps, and other documents prepared by technical experts of the ADB PPTA Team
(ii) Discussions with Technical experts of the PPTA team, DJB authorities, relevant government agencies like ASI, DPCC, etc.

(iii) Secondary data from previous project reports and published articles, and
(iv) Literature on land use, soil, geology, hydrology, climate, socioeconomic profiles, and other planning documents collected from Government agencies and websites.

35. **Ocular inspection.** Several visits to the project sites were made during IEE preparation period in 2016 to assess the existing environment (physical, biological, and socioeconomic) and gather information with regard to the proposed sites and scale of the proposed project. A separate socioeconomic study was conducted to determine the demographic information, existing service levels, stakeholder needs and priorities.

B. Physical Resources

1. Location, Area & Connectivity

36. The Project area is situated in National Capital Territory (NCT) Delhi, the Capital of India. Spread over 1,483 sq. km on the banks of River Yamuna, Delhi is geographically located in northern part of India, between $28^{O}24'15"$ and $25^{O}53'00"$ North latitude and $76^{O}50'24"$ and $77^{O}20'30"$ East Longitude. It is bordered by Uttar Pradesh in the east, and the remaining three sides by the State of Haryana. The population of NCT Delhi as per the census 2011 was 16.8 million, grew from 13.9 million in 2001. The subproject area falls in north, northeast, northwest and west districts. Area is 129.56 sq. km and inhabiting a population of 2.2 million (2011 census).

37. Delhi, being national capital, and an important trade, commerce and educational centre in north India, enjoys best connectivity with the rest of the world and within the country. It is connected by highways and railways, and it has a world-class airport.

2. Topography, Soils & Geology

38. Delhi is located between the mountain ranges of the Great Himalayas and Aravallis. River Yamuna flows in the eastern part of Delhi. The topography of Delhi is defined by three distinct features: the plains, Yamuna flood plains and the Aravali ridge. Delhi is in the western fringes of Gangetic plans, and the Yamuna flood plains are covered with fertile alluvium. The ridge, the extension of Aravali mountain ranges extends into Delhi in south from Rajasthan, and spreads further to west, northwest and northeastern parts, and is a distinct feature in the otherwise plain topography. Average elevation is about 215 m above the mean sea level (MSL), within a range of 200 m to 300 m above MSL. The highest point on the ridge is at 317 m above the MSL. Subproject areas is spread from the west bank of Yamuna in northern part of Delhi. The topography if flat, and slopes very gently and ultimately drains into Yamuna River.

39. The Delhi ridge which is the northernmost extension of Aravalli mountain consists of quartzite rocks and extends from southern parts of the territory to western bank of Yamuna for about 35 km. The alluvial formations overlying the quartizitic bedrock have different nature on either side of the ridge. The Yamuna flood plain contain a distinct river deposit. The areas near the ridge are occupied by alluvium derived from the adjacent quartzite ridge.

40. Subproject area, in the Yamuna alluvial plains, comprises of the newer alluvium made up of fine to medium sand, silts, gravel, clay and kankar. The surface layers made up of wind-blown sediments or recent age. These alluvial sediments are underlined by hard formations of Delhi system of rocks. Following is the general sequence of formations:

(i) Recent to Sub – Recent : Alluvium

(ii) Post-Delhi Intrusive : Pegmatic and basic intrusive
(iii) Algonkian (Delhi System) : Alwar Quartzites

41. The soils of the Delhi area are mostly light with subordinate amount of medium texture soils. The light texture soils are represented by sandy, loamy, sand and sany loam, while medium texture soils are represented by loam silty loam.

3. Seismology

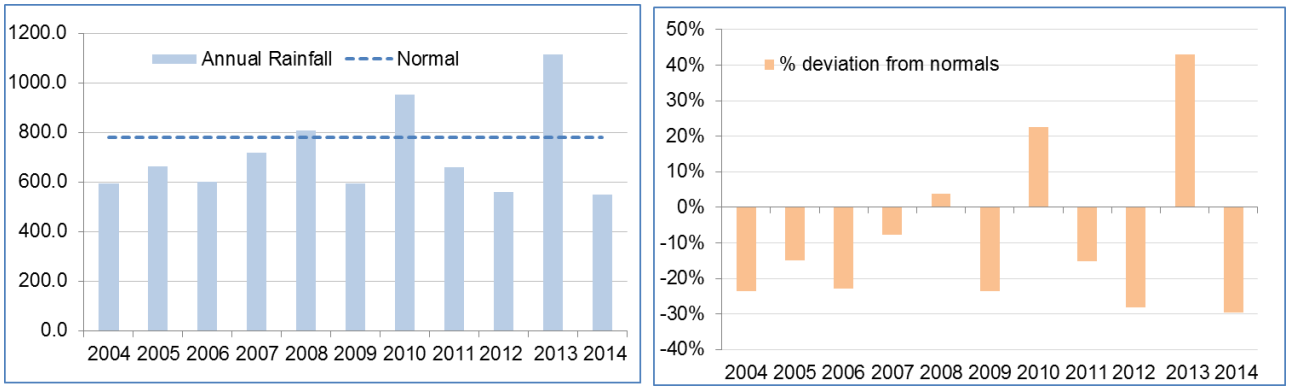
42. As per the seismic zoning map of India, project area falls under Zone IV, which is termed as “high damage risk zone”. A micro zonation seismic zoning map of Delhi classified Delhi into low, medium and high hazard areas. The subproject areas, located in the trans Yamuna, fall under high hazard zone.

4. Climatic Conditions

43. Influenced by its proximity to Himalayan range and Thar desert in the west, Delhi climate is a distinct humid subtropical, and semi-arid climate, with seasonal temperature variations. Extreme dryness with intensely hot summer, dust storms, and very cold winters are the characteristic of Delhi climate. There are predominantly three seasons: summers, from the beginning of April to late June until the arrival of southwest monsoon, and May being the hottest month; monsoon season from late June to mid-September, followed by a post monsoon season up to October end. Winter starts in late November / December and extends up middle of February. January experiences peak winters. Winter temperatures are often influenced by cold waves, chill winds due to its proximity with Himalayan ranges. Heavy fogs are common feature in Delhi, during which visibility falls drastically, which always leads to disruption of road, rail and air traffic. Winter is followed by spring season up to the beginning of summer in April.

44. Annual average rainfall (long term normal rainfall) is 778.4 mm. As presented in the following figures, rainfall data from 2004-2014 indicated erratic nature rainfall, with large deviations from the long term normal rainfall. Highest rainfall was received in 2013 (43% higher), while 2014 was the lowest rainfall year (-30% below).

Figure 3: Annual Rainfall in Delhi 2004-2014 & Deviation from Normal



45. Delhi receives its rainfall under the influence of southwest monsoon in the period of late June to mid-September. Over 82% of rainfall is received during this period. About 4-5% rainfall is received during the follow on post monsoon period, i.e. October – November. As depicted in the

following figure, there are large deviations observed from normal in the monthly rainfall, though the overall pattern of southwest monsoon is followed.

Figure 4: Monthly Rainfall in Delhi 2004-2014

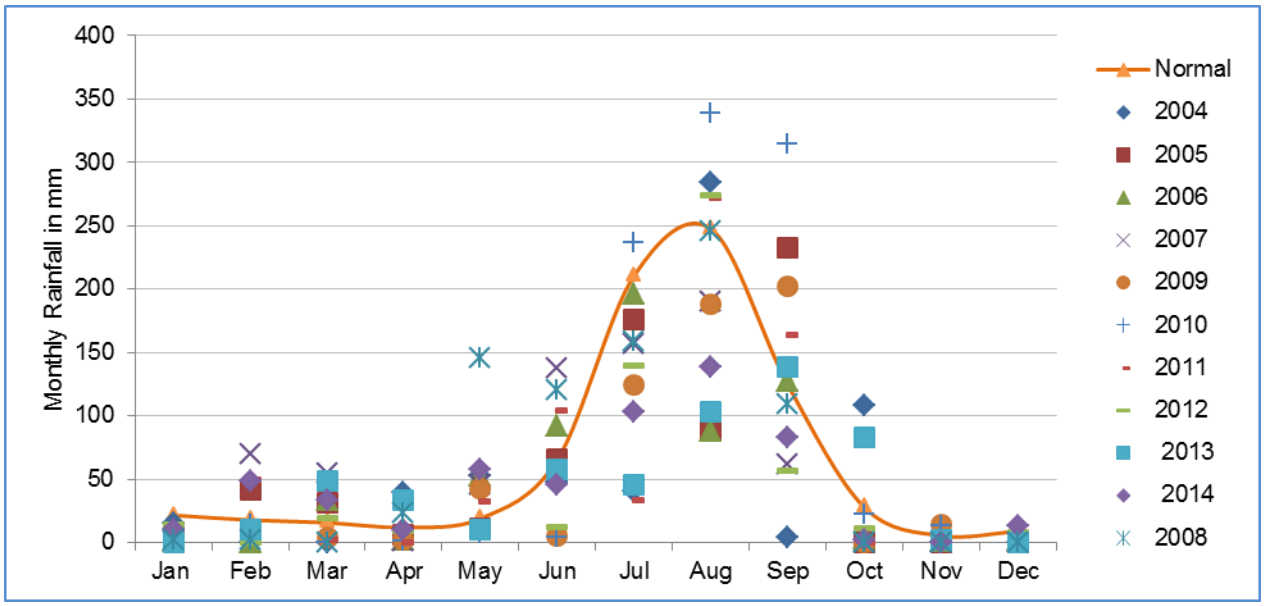
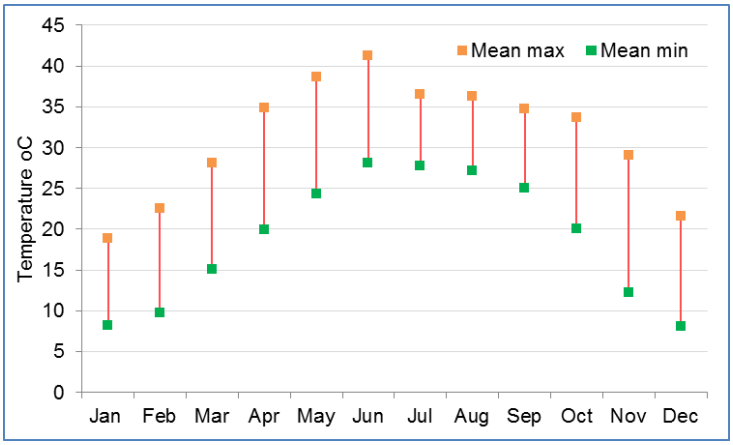


Figure 5: Monthly Mean Max & Minimum Temperature 2014



46. Delhi experiences very high seasonal temperature variation. The summer temperatures peak in May, and the maximum temperature can go as high as 46ºC or even more especially during the heat wave conditions. Hot conditions continue in June until the onset of monsoon by the end, after which the temperature gradually drops. Average maximum and minimum temperature recorded in 2014 summer were 41.3 ºC and 24.3 ºC respectively, while in winter the figures were 18.8 ºC and 8.1 ºC. The extreme maximum and minimum temperatures recorded in Delhi were 48.4 °C and −2.2 °C respectively. Occasional dust storms occur during summer, and are accompanied by strong waver, which can be severe and destructive.

47. Winds are generally light to moderate (0.9 to 4.9 m/sec) but increases in April-May-June. Wind direction is mostly from North, North East; and North West. Two most important wind

patterns influencing Delhi's climate are the Western Disturbance and the South-West Winds. As can be seen, the air is generally dry. The relative humidity peaks during the monsoon, and after which reduces drastically. Summers have very low humidity.

5. Surface Water

48. Delhi is developed on the western banks of Yamuna River. Originating in lower Himalayan glacier Yamunotri, Yamuna is one of the longest and most important rivers of India. River is a tributary of the Ganga. After travelling 1,376 km Yamuna joins the Ganga at Allahabad in Uttar Pradesh. The river enters Delhi at Palla village, 15 k upstream of Wazirabad barrage, which is a main source of water for Delhi. After travelling for nearly 45 km, the river exits Delhi at Okhla barrage, and enters Uttar Pradesh. Naini Lake and a canal is in the study area. Najafgarh drain passes through the boundary in the south.

49. Yamuna water quality, in Delhi stretch particularly, is very poor. Besides the pesticide-laden agricultural runoff from vast agricultural areas in the upper reaches of Wazirabad barrage, Shahadara drain and Najafgarh drain that join the river downstream of Wazirabad barrage carry most of the untreated / partially treated sewage and industrial effluents of Delhi. As there is no water release from Wazirabad barrage during the summers, the water downstream of the barrage throughout its course in Delhi compromise of only wastewater. This wastewater is flushed down the river during the monsoon heavy flows. Following table shows the water quality of Yamuna in Delhi from the entry at Palla village to the exit point at Agra canal from Okhla barrage. Water quality at the entry of Delhi is fairly good with low BOD and high DO, and as it runs through the Delhi, the quality is degraded, due to entry of wastewater.

Table 6: Yamuna Water Quality in Delhi – Annual Average 2015-16

S. No	Monitoring Location	pH			COD			BOD			DO		
		Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
1	Palla	7.1	7.4	7.7	8	10.4	12	1.8	2.19	2.9	7	8.9	10
2	Surghat	7.1	7.3	7.5	16	21.6	32	4.6	5.62	9.2	6	7.61	9
3	Khajuri Pantoor Pool	7.1	7.4	7.7	120	161.2	188	42	51.2	56	Nil	Nil	Nil
4	Kudesia Ghat	7.1	7.4	7.8	92	124.4	140	28	38.7	47	Nil	Nil	Nil
5	ITO Bridge	7.1	7.4	7.7	84	93.2	100	25	29.6	34	Nil	Nil	Nil
6	Nizamuddin Bridge	7.0	7.3	7.6	96	119.2	156	28	34.7	43	Nil	Nil	Nil
7	Agra canal Okhla	7.2	7.4	7.7	80	94.4	112	28	31.3	38	Nil	Nil	Nil
8	Shahdara (downstream)	6.3	7.2	7.6	100	128	172	37	44	53	Nil	Nil	Nil
9	Agra canal jaitpur	6.8	7.3	7.6	92	109.2	136	26	32.9	42	Nil	Nil	Nil

Source: DPCC

50. Najafgarh drain, the Delhi's most infamous polluted water body, flows through southern boundary of the study (G-01 UGR) area. This train is originally a river – River Sahibi, which is channelized in its course through Delhi, joins River Yamuna downstream side of Wazirabad barrage. Due to entry of untreated sewage and industrial effluents from industrial areas flows into the drain and it is one of highly polluted water bodies. Supplementary drain that carries mostly sewage except during the monsoon passes though the project area. Balswa lake is situated in the subproject area.

6. Ground Water

51. Delhi state is occupied by Quartzite interbedded with Mica-Schist belonging to Delhi Super Group, unconformably overlain by unconsolidated Quaternary to Recent sediments. The

ground water availability in the territory is controlled by the hydrogeological situation characterized by occurrence of alluvial formation and quartzite hard rocks. The hydrogeological set up and the following distinct physiographic units influence the ground water occurrence in Delhi: (i) Alluvial plain on eastern and western sides of the ridge (ii) Yamuna flood plain deposits, (iii) Isolated and nearly closed Chattarpur alluvial basin, and (iv) North-Northeast (NNE)-South-Southwest (SSW) trending Quartzitic Ridge. The alluvial deposits are of quaternary age. The newer alluvium belongs to recent age and consists of sediments deposited in the flood plains of Yamuna River. The older alluvium is of Pleistocene age and occurs extensively in the alluvial plains. In Chattarpur basin, the alluvial formation is derived from the weathered quartzite rocks. The hard rock formations in Delhi are mainly the Alwar quartzites of Delhi System belonging to Pre-Cambrian age.

Table 7: NCT Delhi Aquifer System

Sl.No.	Aquifer system	Depth (m)	Discharge (m^3/hr)	Drawdown (m)
1	Fractured Quartzite	50-150	2-18	8-30
2	Older Alluvium (kanker & fine sand)	30-115	18-135	2-24
3	Newer Alluvium (fine and medium sand)	40-50	100-200	1.5-3

52. The North-West district area characterized by unconsolidated quaternary alluvium deposits. Thick pile of alluvium over the basement rock possesses varied sediment strata in an alternate fashion of geological setting. Nearly fine to medium and silt grade of sediment are frequent up to the depth of 50 m along with buff coloured clayey bed admixed with Coarse kankars. On the other hand after the depth of 50 m, silty–clay and clay (Light yellow) beds with Kankars increases with depth. Clay beds are common at deeper depth i.e. 80 m.bgl to 250 m.bgl. In large part of the district the water levels are shallow ranging from 2 to 8 m.bgl, whereas in a limited area towards the northern border (Narela) the water levels are somewhat deeper ranging from 6 to 12 m.bgl.

53. The West district is occupied by unconsolidated Quaternary alluvium underlain by Precambrian meta-sediments of Delhi System. Quaternary alluvium comprises of sand, clay, silt, gravels/pebbles, kankars. The aquifer system include sand fine to coarse grained admixed with kankars with little amount of clay and silt. The depth of water level varies in the district, 2 m to 15 m. The depth of fresh saline interface also varies from 25 m to 50 m at different places. The depth of fresh water zone varies from 10 m to 45 m..

54. As per the CGWB, the depth to water level recorded in NCT Delhi during May-2014 ranges from 1.19 to 74.41 m.bgl (below ground level). South district has deeper groundwater levels, with more than half of the wells monitored showing water levels deeper than 40 m bgl. In New Delhi and South-West districts the water level is in the range of 10 to 20 m bgl, and in North East, East and North-West districts, the level is in the range of 5-10 m bgl. Lowest water levels are recorded in East, North, North-East, North-West, and West districts, in the range of 2 to 5m. The entire Yamuna flood plain falls in the 2 to 5m category. The fluctuation of water level between May-2013 and May-2014 shows rise in water level (in the range of 0.10 m to 4.53 m) in some parts, while there was a fall in water level (0.04 to 3.34 m) in the other part. Maximum fall in water level is recorded in South and South-West districts.

55. As per the CGWB Report[5] (July 2014), annual replenishable groundwater resource, and net groundwater availability in NCT Delhi is estimated as 0.31 billion cubic meter (bcm), and 0.29

[5] Dynamic Groundwater Resource of India (As of March 2011), Central Groundwater Board, Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India (July 2014).

bcm respectively. Annual groundwater draft is estimated as 0.39 bcm, which include 0.14 bcm for irrigation, and 0.25 bcm for domestic and industrial water supply. The stage of groundwater development thus is at 137% (over exploited category), which varies widely across the Delhi. In places such as Preet Vihar, Seema puri, Shahadra, Hauz Khas, Kalkaji, Delhi Cantonment, and Rajouri Garden, the groundwater resource is under severe pressure, as the water abstraction is over twice that of availability (over 200%). Of the total 22 tehsils in NCT Delhi as assessed by CGWB, 18 are in overexploited category.

56. **Groundwater Quality**. Groundwater quality varies widely across Delhi. Brackish ground water exists at shallow depths in Northwest, West and Southwest districts with minor patches in North and Central districts. Brackish / Saline water and fresh water interface is in the range of 30-40 m. As per the CGWB, high fluoride content in water (above 1.5 mg/l) is reported in East, New Delhi, North West, South, South West, North and West Delhi districts. Nitrate concentration more than the permissible limit (45 mg/l) is reported in East, Central, New Delhi, North, North West, South, South West and West Delhi districts. No arsenic (As) or iron (Fe) content reported above the permissible limits. In Heavy metals, lead is reported above permissible limits (0.01 mg/l) in some wells along Najafgarh drain in North, West and South-west districts, and Cadmium (above 0.003 mg/l) in some wells in Southwest district and Chromium (above 0.05 mg/l) in some wells in Northwest, South, New Delhi and East districts. The line of fresh-saline water interface also varies greatly in entire area of North West District; all along the western Yamuna Canal and along Yamuna Flood Plain it is between 40 to 70 m, whereas in rest of the area it is at 22 to 40 m deep. It was also observed from the exploratory well data in NW district that salinity of water increases with depth and there are no fresh water aquifers in between the saline zone.

7. Ambient Air Quality

57. Delhi, in terms of air quality, is considered one of the most polluted cities in the world. There are multiple sources of air pollution in Delhi: vehicles, industries, diesel generators, construction activities and road dust, burning of agricultural waste / solid waste etc. The ambient air quality monitoring is conducted regularly by Central Pollution Control Board and Delhi Pollution Control Committee. Following figures show the annual average concentration of carbon monoxide (CO), particulate matter (PM 10), and oxides of sulfur and nitrogen in ambient air of Delhi from 1997 to 2014. In comparison with National Ambient Air Quality Standards (NAAQS), particulate matter (PM10) is very high, 3 to 5 times higher than the standard. Very high CO values were recorded during 1997-2001 (2 times above the standard), and after which the concentration declined, and in 2014, the concentration was within the permissible limit. SO2 values during the monitored period were always well below the permissible limit, while NO2 concentration was higher than the concentration, by nearly 2 times in 2014.

Figure 6: Ambient Air Quality in Delhi - CO & PM10 (in µg/m3)

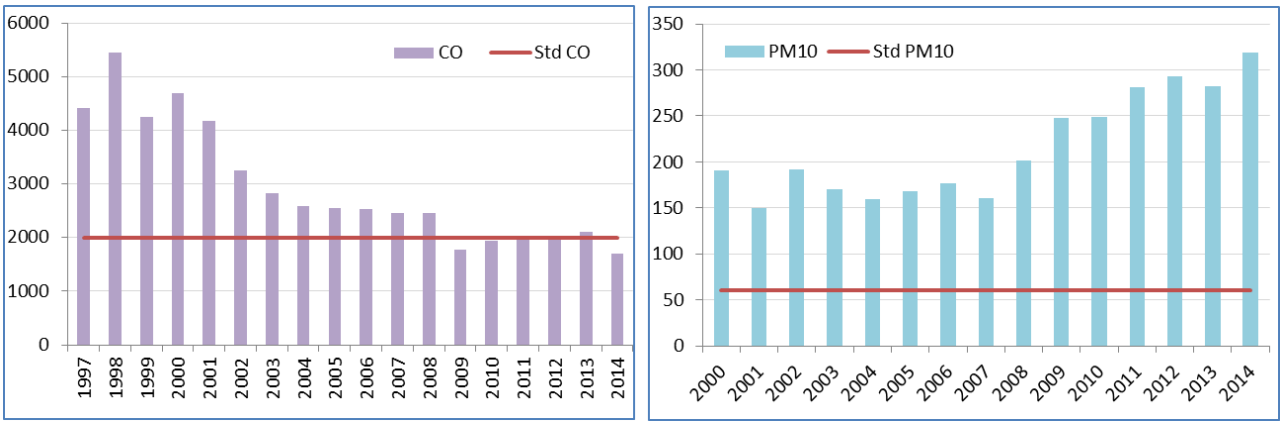
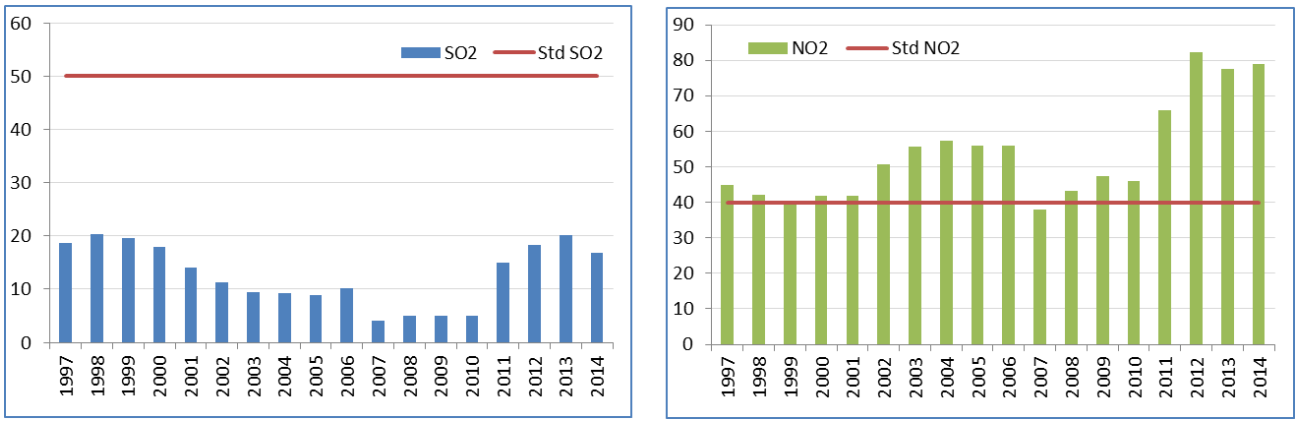


Figure 7: Ambient Air Quality in Delhi – SO2 & NO2 (in µg/m3)



58. Following table shows the annual average concentration of air pollutants (2014) at two monitoring stations located close to the subproject area. Particulate matter (both PM2.5 & PM10) and NO2 are several times higher than the limits, while SO2 is well within the limits at both the stations. CO levels are higher, while ozone levels are close to standard at civil lines.

Table 8: Ambient Air Quality in Delhi, 2014

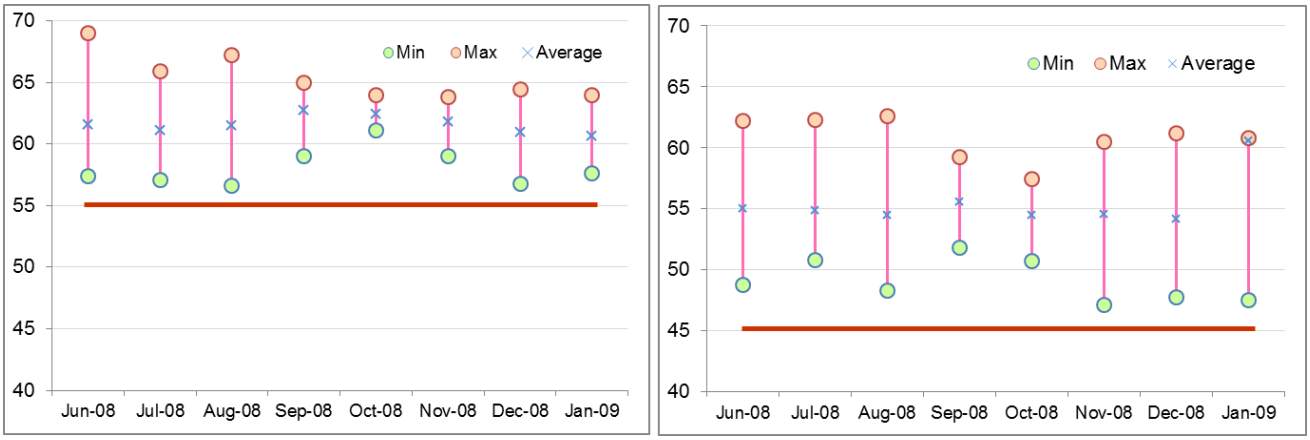
Monitoring Location	SO2	NO2	PM10	PM2.5	O3	CO
Punjabi Bagh	17.3	106.4	248	139	39	1.86
Civil Lines	19.7	79.4	318	141	96	2.64
NAAQ Standard	*50*	*40*	*60*	*40*	*100*	*2.00*

All values in µg/m^3 except CO in mg/m^3.

8. Ambient Noise Levels

59. Ambient noise levels in Delhi is always on high due to various urban activities, transport, generator sets, construction works, social and religious gatherings, etc. Following tables shows the minimum, maximum and average day-time and night-time ambient noise levels based on the noise level monitoring at 41 locations in Delhi in the year 2008-09. All the values recorded are higher than the day and night time noise standards (55 dBA & 45 dBA).

Figure 8: Day & Night-time Noise Levels in Delhi (in dBA)



C. Ecological Resources

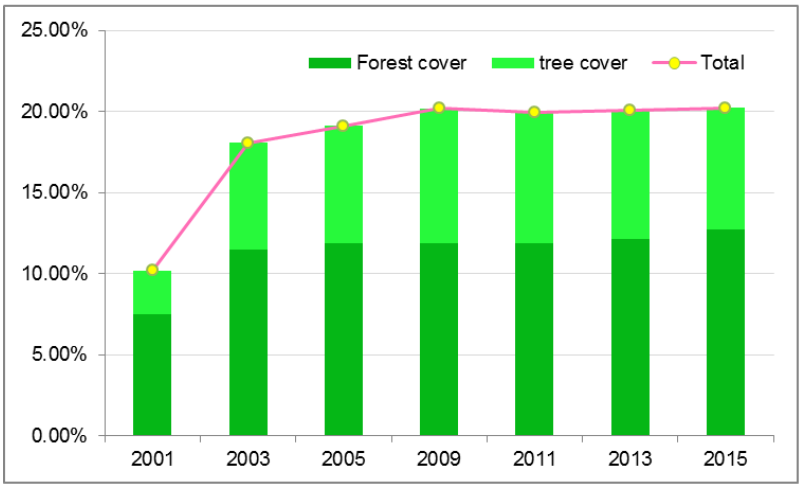
60. The vegetation of Delhi is thorny scrub typical of arid and semi-arid zones. The Delhi ridge, extension of Aravali hills, traversing heart of Delhi in northeast to southwest direction, is a most important ecological resource in Delhi. Ridge mostly comprises of tropical ravine thorn forest.

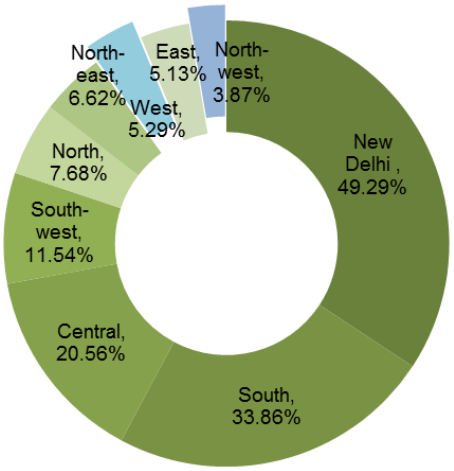
61. As per the India State of Forest Report (ISFR), 2015, the forest and tree cover in Delhi, is 20.22% of total geographical area, which constitute 12.74% of forest cover, and 7.48% of tree cover. This was 20.08% in ISFR 2013 Report. The recorded forest area, that comprise reserved and protected forest is 6.88% of total area. Though the development in Delhi has been significant, the efforts of various agencies, have ensured that green cover is maintained. In fact, there has been significant increase in forest and tree cover over the period. As per the Forest Survey of India, the forest and tree cover increased from 10.20% in 2001 to 20.2% in 2015. 61.

62. As per ISFR 2015, New Delhi District has nearly half of its geographic area under forest, followed by south, and central. The subproject districts of west and north west have a forest cover of 5.29% and 3.87% respectively. There are 42 city forests in Delhi, of which 10 are in northwest district, 1 is in west district, 3 are in north district, and 5 are in northeast district.

63. **Protected areas in Delhi**. Asola Bhatti wildlife sanctuary in South Delhi is the only protected wildlife area in Delhi, spread over 19.6 sq.km in Southern Ridge area. This wildlife sanctuary is unique as the ridge merges into Indo-Gangetic plains, and provides a distinctive habitat. There are trees along the roads and in general in project areas. The common tree species of Delhi include: Amaltas, Saherwa, Kadam, Bakul, Gauva, Peepal, Banyan, Ashoka, Mango, Champa, Mahua, Neem, Anar, Babool, Sisam, Imli etc.,

Figure 9: Forest & Tree Cover in Delhi





D. Economic Development

1. Land Use

64. The total geographical area of Delhi is 1,483 sq. km, of which 47.3% is covered with built up areas comprising of residential, commercial, industrial, institutional, etc., premises, and 13.26% is occupied by natural features like forests, wildlife sanctuary, ridge, Yamuna River and other water bodies (lakes, canals, drains etc.,). 20.9% of the land is for (either existing or proposed for future) utilities, metro, and agricultural activities. The remaining land (18.6%) is currently vacant and will be developed into built up areas in future.

2. Economy, Industry and Agriculture

65. Delhi is a node of political, administrative, commercial and economic centre of India, and there are wide range of industries in Delhi, that have flourished due to good infrastructure, connectivity, and availability of manpower. Delhi plays an important role in the Indian economy. Delhi has been growing at a rate of over 15% annually. The per capital income of Delhi is more than twice of national average. Delhi is the most urbanized state, and the economy is mostly dominated by service sector. The contribution of primary sector (agricultural, farm & forest related and mining) to the overall economy of Delhi is negligible at less than 1% (declined from 1.09% in 2004-05 to 0.65% in 2014-15, constant prices). Secondary sector (industries, manufacturing), contribution is at 9.65% (in 2014-15), which has declined from 18.45% in 2004-05. Prohibition on large, heavy, and hazardous industries in NCR, and also discouragement for medium scale industries in NCT Delhi, lack of suitable land, etc., and at the same time increase in service sector owing to good infrastructure and amenities, have also contributed in decline of manufacturing sector. The tertiary (service sector) contribution has always been high in Delhi, and it has been increasing at a rapid phase. It has increased from 80.46% in 2004-05 to 89.70% in 2014-15.

66. As per the Census 2011, the workforce participation ratio in Delhi was 33.28%, lower than the all India average of 39.79%. As the service sector most dominant, it is the principle employment generator. Primary (cultivators & agricultural workers), and secondary (household industrial workers) workers are 1.31% and 3.25% respectively, while the other workers (mostly service sector) constitute over 95%.

67. As per the Annual Survey of Industries 2011-12, In Delhi there are 2,976 organized industries establishments (factories), engaged in manufacturing of food products, beverages, tobacco, textile, apparels, leather and related, wood and cork products, chemicals, pharmaceuticals, plastic, rubber, metals, plant & machinery, computers, electronics & electrical goods, transport vehicles, equipment, etc. There are four thermal power stations (3 coal based and 1 gas based). There are 190,277 units in unorganized sector, which are mostly small scale and dealing with variety of activities. Units manufacturing wearing apparels, dressing and dying of fur constitute 27.4%, followed by fabricated metal, equipment, machinery (14%) and furniture (10.8%).

68. Industries in Delhi are located mostly in west, south and eastern parts of the city. However, there are several other industries and small units spread over others parts of the city as well in an unorganized manner. Most of the industrial areas are set up in 1970's.

69. **Agriculture**. Given the rapid phase of urbanization and limited land resources, agricultural activities have been declining over a period. Number of villages (rural settlements) have decreased from 214 in 1981 to 112 in 2011, and about 2% of the total land area is under agriculture. Land holding size is very small, and most of the farmers are small and marginal formers (with less than 2 ha of land holding). Predominant crops are Paddy, Jowar and Bajra during Kharif season, and wheat and mustard during Rabi season. Irrigation is by groundwater, canals, and treated wastewater from sewage treatment plants.

3. Infrastructure

70. **Water Supply**. Water supply and wastewater infrastructure in Delhi is developed and managed by Delhi Jal Board (DJB). DJB is responsible for supply of water to consumers in East, South and North Delhi municipal areas, and it is also responsible for provisional of bulk water supply to New Delhi Municipal Corporation (NDMC) and Delhi Cantonment areas. Main source of water for Delhi is Yamuna River. At present there are 9 water treatment plants, with rated capacity of 925 MGD and operating at 900 MGD. The water distribution system consists of 14,000 km pipelines and 107 underground reservoirs. DJB also has 407 mobile water tankers for supply to various areas as per the demand. At present 900 MGD of water is supplied in Delhi at a rate of 53 gallons per day (gross supply). About 81% of the households are connected with piped water supply system, 14% are dependent on tube wells, hand pumps, public stand posts, tankers and the remaining 5% are dependent on canals, lakes, tanks etc. Water supply is not continuous, and is supplied for few hours every day. Duration of supply and pressure varies widely across the city, and the water supply is unequal. Due to old pipe network in most of the places, leakage and loss of water is considerable.

71. **Sewerage.** Underground sewerage system covers planned colonies, regularized colonies, urban villages, authorized slums (known as JJ clusters) and urban villages. Sewerage system is not provided in rural villages and unauthorized colonies. The total sewerage network is the city is about 7,000 km, and 192 km of trunk sewer network. At present there are 22 sewage treatment plants, with a rated capacity of 614 MGD, but the current utilization is at 394 MGD (64%). Total sewage generation, at the rate of 0.80% of water supply, is about 720 MGD, of which only 394 MGD, which is 54% of total sewage generation, is treated and disposed. The remaining sewage flows directly into River Yamuna, mostly via Najafgarh drain. Though availability of sewage treatment capacity is 85% of generation, due to low utilization of rate of existing plants, most of the sewage flows directly into rivers without treatment. The main reason for low utilization is due to low volumes of sewage reaching the plants, due to lack of proper sewerage collection, pumping transmission infrastructure.

72. **Solid Waste Management**. Municipal solid waste management is the responsibility of urban local bodies in India. In Delhi, in all, there are 5 municipal authorities – North, South, East Delhi Municipal corporations, New Delhi Municipal Corporation, and Delhi Cantonment Board. The total waste generation is nearly 8,500 tons per day, of which nearly 80% of waste is collected and disposed. There are three disposal places – Ghazipur, Okhla, Bhalswa, where the solid waste is dumped. These landfills are however not designed as per the MSWM Rules, and therefore the disposal method is not scientific. Besides there are there are 3 Waste to Energy Plants in Delhi, of which two at Timarpur – Okhla and Ghazipur are functional and Narela is likely to start operation soon.

73. **Transportation.** Delhi has the best road and transportation infrastructure in India. Various government agencies – Public Works Department, Municipal Corporations, Delhi Development Authority, etc., are responsible for the construction and maintenance of road infrastructure in Delhi. The public transportation system is managed by Transport Department, while Delhi Metro is management Delhi Metro Rail Corporation. The total road network in Delhi is nearly 29,000 km, and it has highest road density in India. There are five national highways through Delhi: NH1 (GT Karnal Road), NH2 (Kolkata) NH8 (Gurgoan Road), NH 10 (Fazika) and NH24 (Ghaziabad). There are several other important arterial roads – Lal Bhadur Shastri Marg, Aurobindo Marg, Rao Tula Ram Marg, Patel road, Shankar road, Rohtak Road, Loni road, Shahadra road. Mahatma Gandhi Road (Ring Road), Outer Ring road, Noida road- Bund road form the ring roads. These are wide (four lane to six lane) and carry most of the traffic and are the main arterial roads. Public transport system mainly consists of bus, metro, auto and cycle rickshaws. Minor arterial, and collector roads, and most of the roads in old parts of Delhi are very narrow and highly congested with traffic, pedestrian and commercial activities. Construction activities are also considerable.

74. **Power and Gas supply**. Thermal power is the main source of energy in Delhi, there are three coal based, and one gas-based power generation plants. Power is supplied from sub-stations located at various places, via a distribution system consists of overhead cables on pylons along the roads and as well as underground cables in some places. Currently about 4.5 lakh households are connected with piped natural gas (PNG) network in Delhi, and there are 350 compressed natural gas (CNG) filling stations. The gaps pipelines are laid underground along the roads.

E. Socio Cultural Resources

1. Demography

75. According to the census, the population of NCT Delhi was 16.79 million grew from 13.9 million in 2001, recording a decadal growth rate of 21.2%. Of the total population, only 2.5% are rural and the rest 97.5% are classified as urban population. The rural population has been continuously declining in Delhi as the villages are converted into urban areas, that gave rise to urban population. In 2001-11, the rural population of Delhi declined by 55.6% while the urban population increased by 26.8%. Overall population density is 11,320 persons per sq.km. Of the total population, 16.7% belong to scheduled castes (SC), and there are no scheduled tribes. Sex ratio was 868 (females per 1000 males) increased significantly from 821 in 2001. Overall literacy rate 86.2 percent, comprising 90.9% for males, and 80.8% for females. Main languages spoken are Hindi, Punjabi, Urdu, and English. Demographic details of subproject districts are given in the following Table:

Table 9: Demographic Details 2011

District	Population	Density (/sq km)	Growth rate (2001-11)	Sex Ratio	SC population	Literacy		
						Total	Male	Female
Northwest	3,656,539	8,254	27.80%	865	19.10%	84.40%	89.70%	78.40%
West	2,543,243	19,563	19.50%	875	14.80%	87.00%	91.0%	82.40%
North	887,978	14,557	13.6%	869	18.70%	86.90%	90.90%	82.20%
Northeast	2,241,624	36,155	26.8%	886	16.70%	83.10%	88.80%	76.70%
NCT Delhi	16,787,941	11,320	21.2%	868	16.80%	86.20%	90.90%	80.80%

Source: Census 2011

2. History, Culture & Tourism

76. Delhi has a long and great history, and it is a longest serving capital city and one of the oldest inhabited in the world. Delhi has been the capital for several empires, kingdoms, and till today, it maintains its status as the capital of India. According to legends, during Mahabharata times, the city was known as Indraprastha, the capital city of *Pandavas*. It is believed that Delhi was site for several different cities between 3000 BC and 17th Century AD, most of which are located in what is called as Delhi Triangle, bounded by Delhi Ridge in south and west, and Yamuna River in east. Dilli as it is referred locally, and the modern Delhi, is said to be derived historical name Dhili. Following are the historical cities with distinct identities and indigenous heritage in Delhi: Qila Rai Pithora, Mehrauli, Siri, Tughlaqabad, Ferozabad, Dinpanah and Shahjahanabad.

77. With its long and glorious past, Delhi has rich heritage and culture. There are numerous heritage, religious and archeological structures, sites and living areas like walled city, monuments, historic gardens, institutions, the planned city of New Delhi (popularly known as Luteyn's Delhi) etc., There are 174 monuments identified as nationally important and protected by ASI, and there are 20 monuments under the protection of Department of Archeology, GNCTD. Three sites (Humayun's Tomb, Qutb Minar and Red Fort Compex) are notified as World Heritage Sites by UNESCO, Besides there are several hundreds of heritage structures.

78. Delhi is a world famous tourist destination, being a very old city with rich heritage and history there are several points of tourism and it is also a central connecting point to various tourist destinations in India. As per the 2014 Tourism Statistics Report, Delhi accounted for most foreign tourist arrivals (FTA) in India (30.2%). October to March is considered to be the peak tourist season, although Delhi receives tourists year-long.

79. Subproject area is just located outside the Delhi Triangle, and therefore it is not archeologically very sensitive. Two protected monuments of national importance are located in the subproject area: (i) "Sheesh Mahal" is situated near Shalimar Bagh in H-06 UGR command area. Built in 1653 AD by Shahjahan, this was a resting place for Mughals travelling to northern part of their empire. In 1658, Aurangzeb declared himself as the Emperor at this garden; and (ii) "Shah Alam Tomb" is located in Wazirabad along the road leading to WTP. The transmission line is likely to fall within the 300 m regulated zone of Shah Alam Tomb, and therefore the alignment needs to be finalized in discussion with the ASI. Prior permission from the National Monument Authority (NMA) is necessary for laying the pipelines. At Shalimar Bagh, the proposed alignment is about 1 km from the monument, therefore permission may not be required. This is to be rechecked during the finalization of alignments, and as far as possible pipelines will be avoided within 300 m regulated zone.

V. ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

80. Potential environmental impacts of the proposed infrastructure components are presented in this section. Mitigation measures to minimize/mitigate negative impacts, if any, are recommended along with the agency responsible for implementation. Monitoring actions to be conducted during the implementation phase is also recommended to reduce the impact.

81. Screening of potential environmental impacts are categorized into four categories considering subproject phases: location impacts and design impacts (pre-construction phase), construction phase impacts and operations and maintenance phase impacts.

(i) **Location impacts** include impacts associated with site selection and include loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their livelihood or any other structures by the development of that site.
(ii) **Design impacts** include impacts arising from Investment Program design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services.
(iii) **Construction impacts** include impacts caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.
(iv) **O&M impacts** include impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams, and occupational health and safety issues.

82. Screening of environmental impacts has been based on the impact magnitude (negligible/moderate/severe – in the order of increasing degree) and impact duration (temporary/permanent).

83. This section of the IEE reviews possible project-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the project's area of influence.

84. The ADB Rapid Environmental Assessment Checklist in http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.asp has been used to screen the project for environmental impacts and to determine the scope of the IEE.

85. In the case of this project (i) most of the individual elements involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements along the public roads (iii) being mostly located in an urban area, will not cause direct impact on biodiversity values. The project will be in properties held by the local government and access to the project location is through public rights-of-way and existing roads hence, land acquisition and encroachment on private property will not occur.

A. Pre-Construction Impacts – Design & Location

86. **Design of the Proposed Components.** Technical design of the (i) pumps and (ii) transmission main pipes follows the relevant national planning and design guidelines, focusing on

providing a robust system which is easy to operate, sustainable, efficient and economically viable. Subproject design include the following environmental considerations:

(i) Minimizing water losses from pipelines by perfect jointing and alignments using appropriate techniques
(ii) Designing the entire system to maintain optimal flow and pressure, and optimising the overall energy usage

87. **Energy Efficiency Measures included in the subproject.** Water supply distribution system is designed with utmost consideration to the energy efficiency. As the study area has flat topography, water from WTP will be required to supply under pressure to reach the UGRs. Pumping system is therefore part of the design. High efficiency pumps and motors will be used to reduce the energy loads. According to Manual for the Development of Municipal Energy Efficiency Projects, 2008, energy savings, at minimum, of 25% to 40% is possible with appropriate measures. The following measures will be incorporated into the designs:

(i) Installation of Energy Efficient Motors
(ii) Efficient Pumping system operation using SCADA
(iii) Installation of Variable Frequency Drives (VFDs)

88. **Contamination of treated water supplies**. There are sewers, surface drains carrying waste water, and canals in the study area. In appropriate location or inadequate clearance with these utilities may contaminate water supply. Following measures shall be implemented:

(i) Ensure adequate vertical and horizontal clearance with the sewer, surface water drains, etc., to avoid contamination of treated water supplies:
(ii) No sewer or surface drain or canal cross over a water pipe

89. **Utilities.** Proposed water transmission pipes will be buried along the public roads. Various utilities (telephone lines, electric poles and wires, sewers and gas pipelines) are already located along these roads. These may require to be shifted in few cases. To mitigate the adverse impacts due to relocation of the utilities, the contractor, in collaboration with DJB, shall:

(i) Identify the locations and operators of these utilities to prevent unnecessary disruption of services during construction phase
(ii) Conduct detailed site surveys with the construction drawings and discuss with the respective agencies before site clearance and start of excavation work; and
(iii) Instruct construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.

90. Replacement of existing transmission mains may disturb the existing water supply services temporarily if not managed well. Advance notice will be given to the consumers about the likely disruptions, and if the disruption extends over a day, then alternative arrangements will be provided. Following measures are to be implemented to minimize the inconvenience:

(i) provide prior information to public on likely disturbances, and
(ii) make temporary arrangements for water supply in the affected area (for example, through mobile tankers) if the water supply service is disrupted over 24 hours.

91. **Social and Cultural Resources.** Delhi is an historical town, and any work involving ground disturbance can uncover and damage archaeological and historical remains. For this

project, excavation will occur in project sites, which are situated in the northern part of the town outside the historic Delhi Triangle. So the risk of the sites containing any archeological and historical remains may be low, but not unlikely. Two protected monuments (Sheesh Mahal & Shah Alam Tomb) are situated in the study area. While Shah Alam Tomb is located along the road leading to Wazirabad WTP, while Sheesh Mahal is surrounded by a large green area in Shalimar Bagh away from the proposed alignment road. There are existing pipelines near Shah Alam Tomb, which are not located on the road adjoining the Tomb, but are placed away from the tomb. The proposed pipeline will also not be laid along the road close to the tomb, but will be aligned parallel to the existing pipelines over a canal. No direct impact / damage thus envisaged on the Tomb. Nevertheless, as it will be within 300 m regulated zone of the monument, it will require prior permission. Appropriate steps should be taken according to the nature of the risk as per the ASI clearance conditions. This should involve:

(i) Avoid pipeline alignments within the regulated zone (300 m) of the monuments at Wazirabad and Shalimar Bagh
(ii) If unavoidable, obtain permission for laying of pipelines within the regulated zone
(iii) Finalize the proposed construction technology and exact alignment in consultation with the ASI
(iv) Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved. This should involve:
- Conduct awareness training to contractor & supervision staff prior to start of excavation
- Stopping work immediately to allow further investigation if any finds are suspected;
- Calling in the ASI if a find is suspected, and taking any action they require to ensure its removal or protection in site

92. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas.** Consider sites that will not result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas shall not be considered for setting up camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near the forest, water bodies, swamps, or in areas which will inconvenience the community. All locations would be included in the design specifications and on plan drawings. Construction work camps shall be located at least 200 m from residential areas. Material stockpiles shall be protected by bunds during the monsoon to arrest the silt laden runoff into drains. The subproject is likely to generate soil from excavations, which needs to be disposed safely. Priority should be to minimize the quantity of waste to be disposed by using the excess soil for beneficial uses, and sending the debris (for eg, from road cutting) to the construction waste management facility at Bhawana.

93. Site selection of sources of materials. Significant quantities of coarse aggregate and fine aggregate will be required for construction works. Requirement of gravel is limited. Following measures are to be implemented:

(i) Contractor should procure these materials only from the quarries permitted/licensed by Mines and Geology Department.
(ii) Contractor should, to the maximum extent possible, procure material from existing quarries, and creation of new quarry areas should be avoid as far as possible.

(iii) It will be the construction contractor's responsibility to verify the suitability of all material sources and to obtain the approval of Department of Mines & Geology and local revenue administration.

(iv) Contractor should submit the details of sources and copies of approvals, permissions to PIU, and should start procurement only after the respective source is approved by PIU

B. Construction Impacts

94. **Pipeline laying works.** Civil works in the project mainly include linear pipe laying works for 340 km. As explained previously, 50% of pipes will be laid using trenchless technology, and the rest 50% will be laid by open cut method. Appropriate trenchless technology will be adopted by the contractor such as modern micro tunneling with boring pipe jacking technique. Trenchless technology will be adopted at all locations, which are convenient/suitable to use such technology, with a purpose to avoid public inconvenience, ensure safety, traffic disruptions, dust control, and avoid blocking access to properties, business and houses. Open cut trenching method of pipe laying involves excavation for laying pipes along the roads, placing pipes in the trench, jointing and testing, and refilling with the excavated soil. The trenches will be of 0.5 m – 1.5 m wide and 1 to 2.2 m depth. Subsequent to completion of works, road reinstatement will be undertaken by the contractor as part of the civil works. There are different type of roads in the subproject area.

95. Main transport corridors, with two way main road corridors plus service roads on both sides (Rohtak Road, NH1, MG Road), with metro on the central elevated corridor (Rohtak Road), carry very heavy traffic throughout most of the day. Service roads also carry considerable traffic, as much of the width is used for parking of vehicles. In these roads, pipeline will be laid in the service line, and wherever it is not feasible due to trees, tiled walkways, etc., pipeline will be laid in the edge of the main carriageway.

96. In the next level, there are other main roads providing connectivity, serving as main commercial areas, and also for through traffic to other neighbourhoods (Maharaja Nahar Singh Marg, Lawrence Road, outer ring road, Guru Harkishan Marg, Vashisht Kumar Gulla Marg, S Manohar Singh Marg, Maharaja Nahar Singh Marg, Muni Maya Ram Jain Marg, Maharaja Agrasen Marg, Guru Gowalkar Marg, Saiyyad Nangloi Marg and Bhao Rao Devars Marg, Santi Swaroop Tyagi Marg, Bawana Road, Libaspur Road). These roads, except Outer ring road, carry very heavy traffic and are congested with activities (commercial establishments are located all along), pedestrians and traffic. In most of the commercial areas, on-road vehicle parking is provided, which occupied a line, and footpaths are provided along the roads. In these roads, pipelines will be laid in the parking lane.

97. Earth work excavation will be undertaken by machine (backhoe excavator) and include danger lighting and using sight rails and barricades. At a time about 100 m stretch of work will be undertaken. A width of strip of 5 m will be barricaded and all the works and equipment, excavated material will be stocked within that area.

98. Pipe laying works will include laying pipes at required gradient, fixing collars, elbows, tees, bends and other fittings including conveying the material to work spot and testing for water tightness. Sufficient care will be taken while laying so that existing utilities and cables are not damaged and pipes are not thrown into the trenches or dragged, but carefully laid in the trenches. Trenches are a maximum of 3 m, the risk of collapse of trenches or risk to surrounding buildings is assessed by the contractor during the work and necessary precautions, like shoring, will be

undertaken. Shoring will also be provided where the trench excavation is to be restricted due to site conditions, shoring will be provided and vertical cut will be provided.

99. Once they are laid, pipes will be joined as per specification and then tested for any cracks of leakages. The minimum working hours will be 8 hours daily, the total duration of each stage depends on the soil condition and other local features. About 90% of the excavated soil will be used for refilling the trench after placing the pipe and therefore residual soil after pipe laying and refilling is not significant. This soil shall be used for construction for beneficial purposes such as construction or leveling ground.

100. Although construction of these project components involves quite simple techniques of civil work, the invasive nature of excavation and the project locations in the built-up areas, and public roads of the town where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as residents, businesses, and the community in general. These anticipated impacts are temporary and for short duration.

101. Appropriate and safe trenchless technology will be adopted by the contractor. Excavation will be required at entry and exit point of micro tunnel, and placing of tunneling equipment. About 50% of the pipes will be laid by adopting trenchless construction method. The exact trenchless technology to be adopted and selection of alignment/locations where it will be adopted once the contractor is appointed. However, the overall adoption of trenchless technology will be at least 50% of total pipeline to be laid under the subproject.

102. **Preparation of Method Statement**. Contractor will prepare a method statement for laying of pipelines. Approval of method statement by the Engineer is prerequisite for the start of work. Method statement will be specific to each site/road section as appropriate, and will specify the sections for trenchless technology. The overall work shall be split into individual tasks (per say, site clearance, excavation, pipe laying and up to final road restoration), and each task shall be detailed out in the method statement. The details shall include about the material, machinery, workforce, work process, waste disposal, clearances/approvals, etc. Separate method statement will be prepared for trenchless sections. The method statement shall provide a activity-space-time graph, which should clearly show section-wise. All the works shall be conducted as per the documented procedures of Method Statement only.

103. **Sources of Materials.** Significant amount of sand and coarse aggregate will be required for this project. Total quantity of earthwork excavation for the subproject has been estimated as xxx m3. The requirement of construction material is estimated as follows: sand xxx, gravel xxx stone aggregate m3. Construction materials will be sourced from quarries approved by the respective Mines & Geology Departments. Yamuna Nagar in Haryana about 200 km away is a known source for stone aggregate. Ghaghar (180 km) and Haridwar (160 km) are sources for sand.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

(i) Procurement of material only after the respective source is approved by PIU
(ii) Submit to PIU on a monthly basis documentation of sources of materials.

104. **Air Quality.** Construction work, coupled with dry and windy working conditions, traffic movement, has high potential to generate dust, especially from earthwork activities. Emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality in the construction sites. Anticipated impacts include dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons. Given that in the baseline situation, the particulate matter in the ambient air is very high. Therefore dust generation from construction activity will further deteriorate the air quality, and may have adverse impacts on people and environment.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		√
Moderate		
Negligible		

To mitigate the impacts, construction contractors will be required to:

(i) Employ trenchless technology to the maximum extent as open trenching will produce considerable dust
(ii) Barricade the construction area using hard barricades (of 2 m height) on both sides and provide dust/wind screen (such geo textile fabric) up to 3 m height (1m above the hard barricading)
(iii) Initiate site clearance and excavation work only after barricading of the site is done
(iv) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.,), to the barricaded area
(v) Damp down the soil and any stockpiled material on site by water sprinkling;
(vi) Apply water and maintain soils in a visible damp or crusted condition for temporary stabilization
(vii) Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process
(viii) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area
(ix) Cover the soil stocked at the sites with tarpaulins
(x) Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work areas; limiting soil disturbance will minimize dust generation
(xi) Undertake the work section wise: 100 – 200 m section should be demarcated and barricaded
(xii) Conduct work sequentially - excavation, pipe laying, backfilling; conduct pipe testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done.
(xiii) Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated soil for back filling, this will avoid stocking of material, and minimize the dust.
(xiv) Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will generate dust from backfilled section. Road restoration shall be undertaken immediately. If there should be time allowance for natural consolidation of backfill,

then the backfill shall at least covered by a layer of PCC so that there is no exposed soil surface.

(xv) Ensure that all the construction equipment, machinery are fitted with pollution control devises, which are operating correctly, and have a valid pollution under control (PUC) certificate

(xvi) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by trucks;

(xvii) Clean wheels and undercarriage of haul trucks prior to leaving construction site/quarry

(xviii) Control dust generation while unloading the loose material (particularly aggregate, soil) at the site by sprinkling water and unloading inside the barricaded area

(xix) Stabilize surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition

105. **Immediate road restoration after refilling the trench**. Excavation and refilling activities disturb the top soil, and under the influence of wind, traffic, pedestrians, and other activities etc., produces dust. There is large potential to generate significant quantities of dust after refilling the trench, and prior to road relaying. It is a common practice not to restore the road immediately after refilling the trench so as to allow sufficient time for the refilled material to stabilize naturally. Given the dry and windy conditions, and heavy traffic and other activities along the roads, the refilled trenches with loose top soil along the roads will generate maximum dust, and create very unhealthy conditions. Moreover, as the barricades/dust screens will removed after the trench is refilled, there will be absolutely nothing to control the dust generation. Dust control activities like wetting of top soil will not be effective given the site conditions. It is therefore necessary to restore/relay the road surface immediately or take suitable steps to arrest the dust. Soil consolidation technique shall be used so that road can be restored immediately. Necessary costs towards this shall be included in the project costs.

(i) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. Backfilled trench without any road restoration is a major source of dust.

106. **Surface Water Quality.** Run-off from stockpiled materials and chemical contamination from fuels and lubricants during construction works can contaminate downstream surface water quality of the streams. As the rainfall in the project areas is mostly confined to monsoon, these potential impacts are short-term and temporary. However, to ensure that these are mitigated, construction contractor will be required to:

(i) All earthworks/tunnelling be conducted during the dry season to prevent the problem of soil run-off during monsoon season

(ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets;

(iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used;

(iv) Identify construction waste/excess disposal sites prior to start of work

(v) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;

(vi) Place storage areas for fuels and lubricants away from any drainage leading to water bodies;
(vii) Dispose any wastes generated by construction activities in designated sites; and
(viii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

107. **Noise and Vibration Levels.** Al the construction works will be conducted in built up areas and the roads in Delhi, where there are houses, schools and hospitals, religious places, industrial and business centers. The sensitive receptors are the general population in these areas. Increase in noise level may be caused by excavation, particularly breaking of cement concrete or bitumen roads, operation of construction equipment like tunnel boring equipment, concrete mixers, and the transportation of equipment, materials, and people. Vibration generated from construction activity, for instance from micro tunneling, from the use of pneumatic drills, will have impact on nearby buildings and monuments. This impact is negative but short-term, and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance
(ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimise sound impact to surrounding sensitive receptor
(iii) Utilising modern vehicles and machinery with the requisite adaptations to limit noise and exhaust emissions, and ensuring that these are maintained to manufacturers' specifications at all times.
(iv) Maintain maximum sound levels not exceeding 80 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s.
(v) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity
(vi) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

108. **Landscape & Aesthetics, .** Solid wastes generated from the construction activities are excess excavated earth (spoils), discarded construction materials, cement bags, wood, steel, oils, fuels and other similar items. Domestic solid wastes may also be generated from the workers' camp. Improper waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape. The following

mitigation measures to minimize impacts from waste generation shall be implemented by the contractor:

(i) Prepare and implement a Construction Waste Management Plan (CWMP), including identification of disposal site; work shall be initiated only after approval of CWMP by PIU
(ii) Stockpiles, lubricants, fuels, and other materials should be located away from slopes and water bodies;
(iii) Avoid stockpiling any excess spoils. Excess excavated soils should be dispose to approved designated areas immediately;
(iv) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site;
(v) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed in disposal sites/recyclers approved by DPCC;
(vi) Do not burn construction / domestic waste;
(vii) Ensure that wastes are not haphazardly dumped within the project site and adjacent areas.
(viii) Restore road immediately after backfilling or provide a PCC layer over the backfilled trench immediately to improve the aesthetics.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

109. **Surface and Groundwater Quality.** Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids. In subproject area, groundwater is deeper than the proposed excavation depths (~2 - 3 m), and rains are limited to short duration during monsoon. However, to ensure that water will not pond in pits and voids near project location, the construction contractor will be required to conduct excavation works in non-monsoon season to the maximum extent possible. Protect the material, soil stocks at the site properly so that soil, material do not wash into roads, drains.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		
Negligible		√

110. **Accessibility & Traffic Disruptions.** Excavation along the roads, hauling of construction materials and operation of equipment on-site can cause traffic problems. Highways and ring road carry very heavy traffic throughout the day. The other main roads providing connectivity, serving as main commercial areas, and also for through traffic to other neighborhoods. carry very heavy traffic and are congested with activities (commercial establishments are located all along), pedestrians and traffic. Transportation is the principal activity that will be impeded by this work, and the impact will be considerable if proper precautions and traffic management is not implemented. The following measures therefore shall be implemented to minimize the disturbance:

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		√
Moderate		
Negligible		

Type of roads and measures for fine tuning the alignment of pipelines:

(i) As far as possible, adopt trenchless technology at all locations where are likely disruptions to traffic
(ii) Finalize the alignment to have least disturbance to the traffic; in many main roads, one line on each side (either or main carriage way or on service roads) is used for parking; this location may be ideal if the parking is temporarily disallowed for the duration of work. Barricade and confine the work to parking lane. This will avoid any disturbance to traffic movement.
(iii) In roads where there is a road shoulder, align the pipeline in the shoulder
(iv) In roads where there is no parking lane or shoulder, pipe will have to be laid on the carriage way. As far as possible, align the pipeline into the edge of the road; if this requires closure of one traffic lane, take precautions to reduce the traffic (by informing people about the work, and alternative routes that can be taken etc.,)

Measures to minimize traffic and accessibility disruptions:

(i) As far as possible, adopt trenchless technology at all locations where are likely disruptions to traffic
(ii) Employ trenchless technology to the maximum extent
(iii) Barricade and confine the work area
(iv) Minimize the work area / barricaded area along the roads to the minimum possible width; adopt vertical trench cutting, where required, using shoring
(v) Confine all the activities within in the barricaded area, including material & waste/surplus soil stocking.
(vi) Avoid material/surplus soil stocking in congested areas – immediately remove from site/ or brought to the site as and when required
(vii) Transport material, waste etc., during low traffic periods (eg, before 8 AM)
(viii) Minimize access disruptions to adjacent properties; vehicle access may be controlled however, pedestrian access should always be available; if necessary provide temporary pedestrian access (eg, over the trench) using wooden planks/metal sheets
(ix) Plan transportation (for material and waste) routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites;
(x) Schedule transport and hauling activities during non-peak hours;
(xi) Locate entry and exit points in areas where there is low potential for traffic congestion;
(xii) Keep the site free from all unnecessary obstructions;
(xiii) Drive vehicles in a considerate manner;
(xiv) Coordinate with Traffic Police for temporary road diversions, where necessary, and for provision of traffic aids if transportation activities cannot be avoided during peak hours
(xv) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for

concerns/complaints. Provide information to the public through media – newspapers and local cable television (TV) services

(xvi) At work site, public information/caution boards shall be provided including contact for public complaints

(xvii) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored.

111. **Socio-Economic – Income.** The project components will be located in government owned land parcels or public roads and there is no requirement for land acquisition or any resettlement. Some shops and other premises along the roads may lose business income if the access will be impeded by excavation of trenches, the presence of heavy vehicles and machinery, etc. Access disruption to hospitals, socio cultural places etc., will inconvenience public. Implementation of the following best construction measures will avoid the disturbance reduce the inconvenience and disturbance to the public:

(i) Employ trenchless technology to the maximum extent

(ii) Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations;

(iii) Adopt trenchless technology to avoid any blockage of access

(iv) Do not block any access; leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches

(v) Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around

(vi) Control dust generation

(vii) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. This will also avoid any business loss due to dust and access inconvenience of construction work.

(viii) Employee best construction practices, including trenchless technology, speed up construction work with better equipment, increase workforce, etc in the areas with predominantly commercial, and with sensitive features like hospitals, and schools;

(ix) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and

(x) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

112. **Socio-Economic – Employment.** Manpower will be required during the 24-months construction stage. This can result in generation of temporary employment and increase in local

revenue. Thus potential impact is positive and long-term. The construction contractor will be required to:

(i) Employ local labour force, or to the maximum extent possible to increase local employment opportunities temporarily

113. **Occupational Health and Safety.** Workers need to be mindful of the occupational hazards which can arise from working in height and excavation works. Potential impacts are negative and long-term but reversible by mitigation measures. The construction contractor will be required to:

(i) Comply with all national, state and local labour laws (see Appendix 6);
(ii) Develop and implement site-specific occupational health and safety (OH&S) Plan which will include measures such as: (a) identification of potential hazards and safety issues (b) ensuring all workers are provided with and use personal protective equipment; (c) OH&S Training[6] for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents;
(iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the site
(iv) Adopt standard and safe practices for micro tunnelling
(v) Secure all installations from unauthorized intrusion and accident risks
(vi) Provide supplies of potable drinking water
(vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances
(viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers
(ix) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions may be present. Ensure also that visitor/s do not enter hazard areas unescorted
(x) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas
(xi) Ensure moving equipment is outfitted with audible back-up alarms
(xii) 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; and
(xiii) Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.

[6] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include (i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; and (v) legislation and responsibilities. Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

114. **Community Health and Safety.** Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. Potential impact is negative but short-term and reversible by mitigation measures. Another aspect of public health concern is that of degradation of air quality due to construction dust as ambient air in Delhi already has high particulate matter concentration, and any further increase will definitely have incremental impacts on public health, especially vulnerable sections like children, elders, and people suffering from ailments. The construction contractor will be required to:

(i) Restrict construction vehicle movements to defined access roads and demarcated working areas (unless in the event of an emergency)
(ii) Enforce strict speed limit (20-30 kmph) for playing on unpaved roads, construction tracks
(iii) Night-time driving will be by exception only, as approved by the PIU to
(iv) minimise driving risk and disturbance to communities
(v) Temporary traffic control (e.g. flagmen) and signs will be provided where necessary to improve safety and provide directions
(vi) Temporary traffic control measures will be employed at road crossings and to reduce the risk of traffic accidents
(vii) Where traffic is diverted around crossings, traffic control or careful selection of the exit from the working areas will be provided with the aim of ensuring that vehicles join the road in a safe manner.
(viii) At sensitive locations where particularly where there are schools and markets close to the road, awareness of safety issues will be raised through neighbourhood awareness meeting
(ix) All drivers will undergo safety and training
(x) Public access to all areas where construction works are on-going will be restricted through the use of barricading and security personnel
(xi) Warning signs, blinkers will be attached to the barricading to caution the public about the hazards associated with the works, and presence of deep excavation
(xii) The period of time when the pipeline trench are left open will be minimized through careful planning
(xiii) Control dust pollution – implement dust control measures as suggested under air quality section (*Para 104*)
(xiv) Ensure appropriate passage for pedestrians, provide a separate
(xv) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.
(xvi) Provide road signs and flag persons to warn of on-going trenching activities.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√

Negligible		

115. **Construction Camps.** Contract may require to set up construction camps – for temporary storage of construction material (pipes, cement, steel, fixtures, fuel, lubricants etc.,), and stocking of surplus soil, and may also include separate living areas for migrant workers. The contractor will however be encouraged to engage local workers as much as possible. Operation of work camps can cause temporary air, noise and water pollution, and may become a source of conflicts, and unhealthy environment if not operated properly. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Select a camp site away from residential areas (at least 50 m buffer shall be maintained) or locate the camp site within the existing facilities of DJB
(ii) Avoid tree cutting for setting up camp facilities
(iii) Ensure that a proper compound wall is provided, and erect a wind/dust screen around the site as per the DPCC guidelines (i.e. 3 m or 1/10th of plot length whichever is higher)
(iv) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas
(v) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit
(vi) Provide proper temporary accommodation with proper materials, adequate lighting and ventilation, appropriate facilities for winters and summers; ensure conditions of liveability at work camps are maintained at the highest standards possible at all times;
(vii) Provide drinking water, water for other uses, and sanitation facilities for employees
(viii) Provide cooking fuel (cooking gas) to workers
(ix) Wastewater shall be disposed into sewer system with DJB prior permission if no sewer systems are available in the area, contractor should be provide a package sewage treatment plant for treatment and disposal of wastewater generated at the camp site
(x) Train employees in the storage and handling of materials which can potentially cause soil contamination;
(xi) Recover used oil and lubricants and reuse or remove from the site;
(xii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;
(xiii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
(xiv) Confirm to PIU report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

Impact Classification		
Magnitude / Duration	Permanent	Temporary
Sever		
Moderate		√
Negligible		

C. Operation and Maintenance Impacts

116. Once the construction is over the operation and maintenance of the improved water supply system will be carried out by contractor/DJB. Prior to supply of water, it will be ensured that the newly laid pipes are properly cleaned and disinfected. In water supply distribution system project, the impacts are primarily due to construction phase activities, and are not generally

associated with any significant impacts as a result of activities during operation. During the system design life (15/30 years for mechanical/civil components) it shall not require major repairs or refurbishments and should operate with little maintenance beyond routine actions required to keep the equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any 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.

117. Recurrence of pipe bursting and leakage problems can be managed by the leak detection and water auditing surveys. The DJB will be required to ensure that the leak detection and rectification time is minimized. The use of DMA approach will help in minimizing the water losses, including physical leaks by way of early identification and rectification.

118. The citizens of the Delhi will be the major beneficiaries of the improved water supply system, as they will be provided with a constant supply of better quality water, piped into their homes at an appropriate pressure. The project will improve the over-all health condition of the town as water borne diseases will be reduced, so people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health. This should also improve the environment of these areas, should deliver major improvements in individual and community health and well-being.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Overview

119. The active participation of stakeholders including local community, NGOs/CBOs, and the media in all stages of project preparation and implementation is essential for successful implementation of the project. It will ensure that the subprojects are designed, constructed, and operated with utmost consideration to local needs, ensures community acceptance, and will bring maximum benefits to the people. Public consultation and information disclosure is a must as per the ADB policy.

120. Most of the main stakeholders have already been identified and consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders of the subproject are: residents, shopkeepers and businesspeople who live and work alongside the roads in which transmission lines will be provided, DJB, Archeological Survey of India, and Delhi Pollution Control Committee. Secondary stakeholder are: NGOs and CBOs working in the area, community representatives, beneficiary community in general, government agencies, and the ADB.

B. Public Consultation

121. Government regulatory agencies such as Delhi Pollution Control Committee, Archeology Survey of India, etc., were consulted during the project preparation. Discussions were held with DPCC regarding the consent requirements, and the dust control requirements as per the recent court orders. Detailed discussion held with the ASI Delhi Regional office about the clearance requirements for laying water pipelines in the regulated area of protected monuments. It is transpired that the permission will be issued by National Monument Authority (NMA) Delhi based on the site inspection and recommendation by the Regional Office.

122. A socio-economic household survey has been conducted in the study area, covering sample households, to understand the household characteristics, health status, and the

infrastructure service levels, and also the demand for infrastructure services. General public and the people residing along the project activity areas were consulted during preliminary design. A subproject-level public consultation and FGDs will be conducted during detailed design phase and relevant information will be shared with the stakeholders and affected persons.

123. **Consultation during construction**. Prior to start of construction, DJB / PIU with the assistance of PMC will conduct information dissemination sessions at various places and solicit the help of the local community, leaders/prominent for the project work. At each ward/neighborhood level, focus group meetings will be conducted to discuss and plan construction work with local communities to reduce disturbance and other impacts.

124. A constant communication will be established with the affected communities to redress the environmental issues likely to surface during construction phases and also regarding the grievance redress mechanism. PIU and PMC will organize public meetings and will appraise the communities about the progress on the implementation of EMP. Meeting will also be organized at the potential hotspots/sensitive locations before and during the construction.

C. Information Disclosure

125. Executive summary of the IEE will be translated in Hindi and made available at the offices of DJB local office in the subproject area, PIU, DJB head office, etc., and also displayed on their notice boards. Electronic version of the IEE in English and Executive Summary in Hindi will be placed in the official website of the DJB after approval of the IEE by Government and ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

126. Public information campaigns to explain the project details to a wider population will be conducted. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future plans. Prior to start of construction, the PIU will issue Notification on the start date of implementation in local newspapers A board showing the details of the project will be displayed at the construction site for the information of general public.

127. 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 signage, etc.

VII. GRIEVANCE REDRESS MECHANISM

A. Project Specific Grievance Redress Mechanism

128. A project-specific GRM will be established to receive, evaluate, and facilitate the resolution of AP's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social & environmental concerns linked to the project.

129. A common GRM will be in place for social, environmental, or any other grievances related to the investment program. The resettlement plans and IEEs will follow the GRM described below. The GRM will provide an accessible and trusted platform for receiving and facilitating the resolution of APs' grievances related to the investment program. The multi-tier GRM for the investment program is outlined below, each tier having time-bound schedules and with

responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required.

130. Investment program area-wide public awareness campaigns will ensure that knowledge of the grievance redress procedures is generated. The PIU will, through the PMC and the Community Mobilization and Resettlement Consultant (CMRC) will conduct awareness campaigns to ensure that poor and vulnerable households are made aware of the grievance redress procedures and their entitlements.

131. APs will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes to be installed by DJB or by e-mail, or by on the DJB website or by post, or by writing in a complaints register in the PIU office or at construction site offices. Careful documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and how the problem was resolved will be undertaken. The PIU SO will have the overall responsibility for timely grievance redressal on environmental and social safeguards issues and for registration of grievances, related disclosure, and communication with the aggrieved party.

132. **Exiting Grievance Redress Mechanism.** DJB currently has an established Public GRM and has established 25 complaint receiving cells called Water Emergencies. There is also a central control room for coordination. The concerned DJB engineers/officials contact details are publicized and made available to the public to register complaints. Alternatively, the public can 'call', 'send a message', 'register' a complaint through the DJB website or through GNCTD grievances websites. Complaints are forwarded to concerned engineers for their action. After taking feedback from concerned engineers on redress, an Action Taken Report will be posted on the website. If no action is taken in 21 days, then the complaint is taken *suo moto* by the Public Grievance Commission for hearing.

133. **Proposed DWSIIP Grievance Redress Process**. In case of grievances that are immediate and urgent in the perception of the complainant, the contractor, and supervision personnel from the PIU and the PMC on-site supervision staff will provide the most easily accessible or first level of contact for the quick resolution of grievances. Contact phone numbers and names of the concerned staff and contractors, will be posted at all construction sites in visible locations.

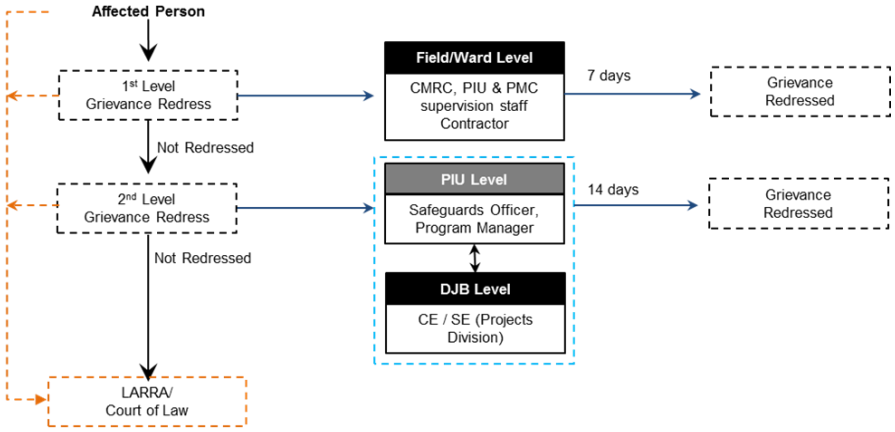
(i) **1st level grievance**. The CMRC or on-site Junior Engineer of the PIU will receive and record the complaint at the site. Alternatively, the complaint can be registered by phone call, message, email, or on website. The complaint will be reviewed and, if necessary, forwarded to the contractor and PMC supervision staff for immediate resolution of the issue on-site in consultation with the CMRC will be required to do so within 7 days of receipt of a complaint/grievance.

(ii) **2nd level grievance**. All grievances that cannot be redressed within 7 days at the field/ward level will be brought to the notice of the SO of the PIU, and the PMC Environmental Specialist. The PIU SO will resolve the grievance within 14 days of receipt of a complaint/grievance in discussion with the CMRC and under the direction of the PIU Program Manager. If the grievance is not resolved at Program Manager level, the grievance will be referred internally to the Superintending Engineer, and the Chief Engineer in the projects division of DJB. Notwithstanding the referral to Superintending Engineer/Chief Engineer, the grievance at this 2nd level should be resolved in 14 days of its receipt.

134. The program GRM notwithstanding, an aggrieved person shall have access to the country's legal system at any stage. This can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM. Alternatively, if the grievance is related to land acquisition or resettlement and rehabilitation,[7] the APs can approach the Land Acquisition, Rehabilitation and Resettlement Authority (LARRA). As per the recently implemented Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act, 2013, the GNCTD will establish the LARRA to address grievances during implementation.

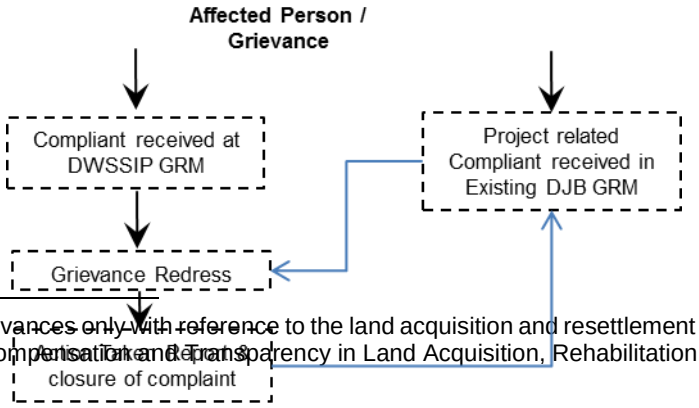
135. In the event that the established GRM is not in a position to resolve the issue, the APs can also use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer at ADB headquarters or the ADB India Resident Mission. The complaint can be submitted in any of the official languages of ADB's Developing Member Countries. The ADB Accountability Mechanism information will be included in the Project Information Document to be distributed to the affected communities, as part of the project GRM.

Figure 10: Grievance Redress Process



CMRC = community mobilization & resettlement consultant, CE = Chief Engineer, DJB = Delhi Jal Board, LARRA = Land Acquisition Rehabilitation and Resettlement Authority, NGO = non-governmental organization, PIU = Program Implementation Unit, PMC = Project Management Consultant, SE = Superintending Engineer

136. **Integration of the DWSIIP GRM with the Existing DJB GRM**. To facilitate quick and easy redress of grievances, both GRMs will be linked so that the affected persons have the flexibility to approach either of the channels to redress their grievances. Any complaints/ grievances regarding the project activities received at the general DJB GRM will be referred internally to DWSIIP GRM for redress. After redress, the Action Taken Report will be uploaded in the general system as per current procedures.



[7] LARRA admits grievances only with reference to the land acquisition and resettlement and rehabilitation issues under the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act

137. **Record-keeping.** The PIU will keep records of grievances received, including contact details of the complainant, the date the complaint was received, the nature of the grievance, agreed corrective actions and the date these were affected and the final outcome. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the PIU office, and on the DJB website, as well as reported in monitoring reports submitted to ADB on a semi-annual basis.

138. **Periodic review and documentation of lessons learned**. The PMU will periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the program's ability to prevent and address grievances.

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

VIII. ENVIRONMENTAL MANAGEMENT PLAN

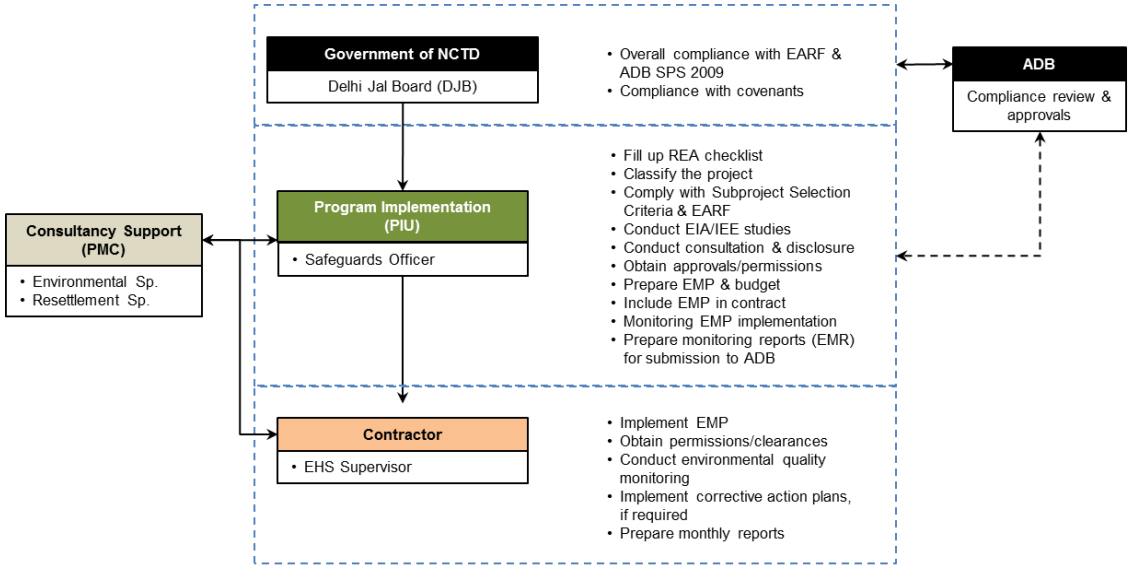
A. Implementation Arrangements

140. The DWSIIP will be carried out under the oversight of the GNCTD. The DJB has been appointed as the EA and will be responsible for the management, coordination and execution of all the activities funded under the MFF. DJB has established a PMU which will be chaired by the Member (Water Supply). A PIU has been established under the overall management of the PMU and will act as the IA. The Program Director will head the PIU and oversee the investment program, while the day-to-day management and implementation will be the responsibility of the Program Manager. The Chief Engineer (Projects) Water of the DJB will be the Program Director.

141. The Program Manager will be an Executive Engineer (Civil) rank officer and will be supported by technical, financial, safeguards and administrative staff. The PIU staff will mostly be drawn from DJB, and if required, will also be seconded from the other government departments on deputation. The PIU will be assisted by a PMC in the implementation, management and monitoring of the investment program. The PMC will design the infrastructure, manage the tendering of contracts, supervise the construction process, assure the technical quality of design and construction, and provide advice/assistance on institutional capacity development. The PIU will appoint the contractors to build the infrastructure elements and will manage the construction and commissioning activities.

142. The PIU staff will include a Safeguard Officer (SO), who will be an Assistant Engineer rank officer, and will be responsible for all environment, health and safety, social, and grievance redress tasks. The SO will be a qualified engineer (preferably an environmental engineer). The SO can also be deputed from other government organizations such as the DPCC. Environmental and Social Safeguard Specialists of the PMC will assist the SO.

Figure 11: Safeguard Implementation Arrangements



ADB – Asian Development Bank; DJB = Delhi Jal Board; EARF – Environmental Assessment and Review Framework; EHS – Environment, Health & Safety, EIA – Environmental Impact Assessment; EMP – Environmental Management Plan; IA – Implementing Agency; IEE – Initial Environmental Examination; NCT = National Capital Territory; PMC – Project Management Consultant; REA – Rapid Environmental Assessment; SPS – Safeguard Policy Statement, 2009,

B. Environmental Management Plan

143. An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels.

144. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between PMU, PIU, consultants and 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. The EMP includes a monitoring program to measure the environmental condition and effectiveness of implementation of the mitigation measures. It will include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

145. The contractor will be required to submit to PIU, for review and approval, a site environmental plan (SEP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring program as per SEP; and (iv) budget for SEP implementation. No works are allowed to commence prior to approval of SEP.

146. A copy of the EMP/approved SEP will be kept on site during the construction period at all times. The EMP included in the bid and contract documents. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

147. For civil works, the contractor will be required to (i) carry out all of the mitigation and monitoring measures set forth in the approved SEP; and (ii) implement any corrective or preventative actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of this IEE and SEP. The contractor shall allocate budget for compliance with these SEP measures, requirements and actions.

148. The following tables show the potential environmental impacts, proposed mitigation measures and responsible agencies for implementation and monitoring.

Table 10: Design Stage Environmental Management Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
Design of water supply system	Loss of water from the system	(i) Minimize water losses from pipelines by perfect jointing and alignments using appropriate techniques (HDPE pipes up to 150 mm dia joined by electro fusion couplers using on-site electro fusion welding, and all higher dia pipes by on site butt welding) (ii) Design the entire system to maintain optimal flow and terminal pressure, and optimising the overall energy usage	PIU	Part of civil works costs
Design of water supply system	Energy use	(i) Install Energy Efficient Motors (ii) Efficient Pumping system operation using SCADA (iii) Install of Variable Frequency Drives (VFDs)	PIU	Part of civil works costs
Design of water supply system	Contamination of water	(i) Ensure adequate vertical and horizontal clearance with the sewer, surface water drains, etc., to avoid contamination of treated water supplies. o No sewer or surface drain or canal cross over a water pipe o No sewer or surface drain or canal cross over a water pipe (ii) Ensure that newly laid pipes are properly cleaned and disinfected prior to supplying water to consumers	PIU	Part of civil works costs
Project siting	Loss of tree cover	(i) Aviod tree cutting thrugh amending the pipeline alignments (ii) Obtain prior permission from Tree Officer, Forest Department, if tree cutting is required (iii) Plant and maintain 10 trees for each tree that is removed	PIU	Part of civil works costs
Socio cultural resource	Chance finds	(i) Avoid pipeline alignments within the regulated zone (300 m) of the monuments at Wazirabad and Shalimar Bagh (ii) If unavoidable, obtain permission for laying of pipelines within the regulated zone (iii) Finalize the proposed construction technology and exact alignment in consultation with the ASI (iv) Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved. This should involve: o Conduct awareness training to contractor & supervision staff prior to start of excavation o Stopping work immediately to allow further investigation if any finds are suspected; o Calling in the ASI if a find is suspected, and taking any action they require to ensure its removal or protection in situ	PIU	Part of civil works costs
Easiness in pipe laying and repairs & maintenance	Public inconvenience, traffic disruptions, risk of accidents	Following guidelines may be taken into consideration while finalizing specific alignments on the sites (i) As far as possible, adopt trenchless technology at all locations where are likely disruptions to traffic	PIU in coordination with the Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
		(ii) Finalize the alignment to have least disturbance to the traffic; in many main roads, one line on each side (either or main carriage way or on service roads) is used for parking; this location may be ideal if the parking is temporarily disallowed for the duration of work. Barricade and confine the work to parking lane. This will avoid any disturbance to traffic movement. (iii) In roads where there is a road shoulder, align the pipeline in the shoulder (iv) In roads where there is no parking lane or shoulder, pipe will have to be laid on the carriage way. As far as possible, align the pipeline into the edge of the road; if this requires closure of one traffic lane, take precautions to reduce the traffic (by informing people about the work, and alternative routes that can be taken etc.,)		

Table 11: Environmental Management Plan of Anticipated Impacts during Pre-Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
Utilities	Telephone lines, electric poles and wires, within proposed project area	(i) Identify the locations and operators of these utilities to prevent unnecessary disruption of services during construction phase (ii) Conduct detailed site surveys with the construction drawings and discuss with the respective agencies before site clearance and start of excavation work; and (iii) Instruct construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.	Contractor in collaboration with PIU	Part of civil works costs
Construction work camps, stockpile areas, storage areas, and disposal areas.	Conflicts with local community; disruption to traffic flow and sensitive receptors	(i) Select a camp site away from residential areas (at least 50 m buffer shall be maintained) or locate the camp site within the existing facilities of DJB (ii) Avoid tree cutting for setting up camp facilities (iii) Ensure that a proper compound wall is provided, and erect a wind/dust screen around the site as per the DPCC guidelines (i.e. 3 m or 1/10th of plot length whichever is higher) (iv) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas	Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
		(v) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit		
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	(i) Contractor should procure these materials only from the quarries permitted/licensed by Mines and Geology Department. (ii) Contractor should, to the maximum extent possible, procure material from existing quarries, and creation of new quarry areas should be avoid as far as possible. (iii) It will be the construction contractor's responsibility to verify the suitability of all material sources and to obtain the approval of Department of Mines & Geology and local revenue administration. (iv) Contractor should submit the details of sources and copies of approvals, permissions to PIU, and should start procurement only after the respective source is approved by PIU	Construction Contractor	Part of civil works costs
Consents, permits, clearances, NOCs, etc.	Failure to obtain necessary consents, permits, NOCs, etc. can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, NOCs, etc. prior to award of civil works Ensure that all necessary approvals for construction to be obtained by contractor are in place before start of construction (ii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc. (iii) Include in detailed design drawings and documents all conditions and provisions if necessary	PIU	Part of project costs
Asbestos Cement Pipes	Health risk due to exposure to asbestos materials	(i) Obtain details from DJB on location of underground AC pipes (ii) Locate the new pipes carefully to avoid encountering AC pipes (iii) Leave the AC pipes undisturbed in the ground.	Contractor in coordination with PIU	Part of civil works costs

Table 12: Environmental Management Plan of Anticipated Impacts during Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
EMP Implementation Training	Irreversible impact to the environment, workers, and community	(i) Mobilize EHS Supervisor (ii) Project manager and all key workers will be required to undergo training on EMP implementation including spoils/waste management, Standard operating procedures (SOP) for construction works; occupational health and safety (OH&S), core labor laws, applicable environmental laws, etc. (iii) Prepare Site Environmental Plan based on the EMP measures (iv) Prepare method statement	Construction Contractor (Training to be conducted by PMC)	EHS supervisor costs (24 months x INR 75,000)
Sources of Materials	Extraction of materials can damage environment	(i) Procurement of material only after the respective source is approved by PIU (ii) Submit to PIU on a monthly basis documentation of sources of materials.	Construction Contractor	Part of civil works costs
Air Quality	Emissions from construction vehicles, equipment, and machinery used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons.	(i) Employ trenchless technology to the maximum extent as open trenching will produce considerable dust (ii) Barricade the construction area using hard barricades (of 2 m height in Mild Steel (MS) frame and 1 mm MS sheet) on both sides and provide dust/wind screen (such geo textile fabric) up to 3 m height (1m above the hard barricading) (iii) Initiate site clearance and excavation work only after barricading of the site is done (iv) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.,), to the barricaded area (v) Damp down the soil and any stockpiled material on site by water sprinkling; (vi) Apply water and maintain soils in a visible damp or crusted condition for temporary stabilization (vii) Apply water prior to leveling or any other earth moving activity to keep the soil moist throughout the process (viii) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area (ix) Cover the soil stocked at the sites with tarpaulins (x) Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work areas; limiting soil disturbance will minimize dust generation (xi) Undertake the work section wise: 100 – 200 m section should be demarcated and barricaded (xii) Conduct work sequentially - excavation, pipe laying, backfilling; conduct pipe testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done. (xiii) Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated	Construction Contractor	Part of civil works costs Additional costs for hard barricading: provision for 2000 m length cost @ INR 350 per running meter

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		soil for back filling, this will avoid stocking of material, and minimize the dust. (xiv) Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will generate dust from backfilled section. Road restoration shall be undertaken immediately. If there should be time allowance for natural consolidation of backfill, then the backfill shall at least covered by a layer of PCC so that there is no exposed soil surface. (xv) Ensure that all the construction equipment, machinery are fitted with pollution control devises, which are operating correctly, and have a valid pollution under control (PUC) certificate (xvi) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by trucks; (xvii) Clean wheels and undercarriage of haul trucks prior to leaving construction site/quarry (xviii) Control dust generation while unloading the loose material (particularly aggregate, soil) at the site by sprinkling water and unloading inside the barricaded area (xix) Stabilize surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition (xx) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. Backfilled trench without any road restoration is a major source of dust.		
Surface water quality	Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water quality.	(i) All earthworks be conducted during the dry season to prevent the problem of soil run-off during monsoon season (ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; (iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used; (iv) Identify construction waste/excess disposal sites prior to start of work (v) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies; (vi) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; (vii) Dispose any wastes generated by construction activities in designated sites; and (viii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).	Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Noise Levels	Increase in noise level due to earth-moving and excavation equipment, and the transportation of equipment, materials, and people	(i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance (ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimize sound impact to surrounding sensitive receptors (iii) Utilizing modern vehicles and machinery with the requisite adaptations to limit noise and exhaust emissions, and ensuring that these are maintained to manufacturers' specifications at all times. (iv) Maintain maximum sound levels not exceeding 80 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s. (v) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity (vi) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach	Construction Contractor	Part of civil works contract
Landscape, aesthetics and creation of filthy conditions	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers, spoils, oils, lubricants, and other similar items.	(i) Prepare and implement Construction Waste (spoils) Management Plan (CWMP), including identification of disposal site; work shall be initiated only after approval of CWMP by PIU. Appendix 8 provide a template for CWMP (ii) (ii) Stockpiles, lubricants, fuels, and other materials should be located away from slopes and water bodies; (iii) Avoid stockpiling any excess spoils. Excess excavated soils should be dispose to approved designated areas immediately; (iv) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; (v) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed in disposal sites/recyclers approved by DPCC; (vi) Do not burn construction / domestic waste (vii) Ensure that wastes are not haphazardly dumped in and around project areas (viii) Ensure that site is maintained well and tidy (ix) Restore road immediately after backfilling or provide a PCC layer over the backfilled trench immediately to improve the aesthetics.	Construction Contractor	Part of civil works contract
Accessibility & traffic disruptions	Traffic problems and conflicts near project locations and haul road	(i) Prepare Traffic Management Plan (TMP) in consultation with the Traffic Police – a generic plan to be prepared, and it shall be made specific to meet the conditions at each section/road taking into consideration diameter of pipe, work area and road width.(Appendix 9 provides a template for TMP) **Type of roads and measures for fine tuning the alignment of pipelines:**	Construction Contractor	Part of civil works contract

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(ii) As far as possible, adopt trenchless technology at all locations where are likely disruptions to traffic (iii) Finalize the alignment to have least disturbance to the traffic; in many main roads, one line on each side (either or main carriage way or on service roads) is used for parking; this location may be ideal if the parking is temporarily disallowed for the duration of work. Barricade and confine the work to parking lane. This will avoid any disturbance to traffic movement. (iv) In roads where there is a road shoulder, align the pipeline in the shoulder **(v)** In roads where there is no parking lane or shoulder, pipe will have to be laid on the carriage way. As far as possible, align the pipeline into the edge of the road; if this requires closure of one traffic lane, take precautions to reduce the traffic (by informing people about the work, and alternative routes that can be taken etc.,) **Measures to minimize traffic and accessibility disruptions:** (vi) As far as possible, adopt trenchless technology at all locations where are likely disruptions to traffic (vii) Employ trenchless technology to the maximum extent (viii) Barricade and confine the work area (ix) Minimize the work area / barricaded area along the roads to the minimum possible width; adopt vertical trench cutting, where required, using shoring (x) Confine all the activities within in the barricaded area, including material & waste/surplus soil stocking. (xi) Avoid material/surplus soil stocking in congested areas – immediately remove from site/ or brought to the site as and when required (xii) Transport material, waste etc., during low traffic periods (eg, before 8 AM) (xiii) Minimize access disruptions to adjacent properties; vehicle access may be controlled however, pedestrian access should always be available; if necessary provide temporary pedestrian access (eg, over the trench) using wooden planks/metal sheets (xiv) Plan transportation (for material and waste) routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; (xv) Schedule transport and hauling activities during non-peak hours; (xvi) Locate entry and exit points in areas where there is low potential for traffic congestion; (xvii) Keep the site free from all unnecessary obstructions; (xviii) Drive vehicles in a considerate manner;		

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(xix) Coordinate with Traffic Police for temporary road diversions, where necessary, and for provision of traffic aids if transportation activities cannot be avoided during peak hours (xx) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. Provide information to the public through media – newspapers and local cable television (TV) services (xxi) At work site, public information/caution boards shall be provided including contact for public complaints (xxii) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored.		
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations; (ii) Do not block any access; leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches (iii) Adopt trenchless technology to avoid any blockage of access (iv) Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around (v) Control dust generation (vi) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. This will also avoid any business loss due to dust and access inconvenience of construction work. (vii) Employee best construction practices, including trenchless technology, speed up construction work with better equipment, increase workforce, etc in the areas with predominantly commercial, and with sensitive features like hospitals, and schools; (viii) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and (ix) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Socio-Economic - Employment	Generation of temporary employment and increase in local revenue	(i) Employ local labour force, or to the maximum extent possible to increase local employment opportunities temporarily	Construction Contractor	-
Occupational Health and Safety	Occupational hazards which can arise during work	(i) Comply with all national, state and local labour laws (see Appendix 6) (ii) Develop and implement site-specific occupational health and safety (OH&S) Plan which will include measures such as: (a) identification of potential hazards and safety issues (b) ensuring all workers are provided with and use personal protective equipment; (c) OH&S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents (iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the site (iv) Secure all installations from unauthorized intrusion and accident risks (v) Provide supplies of potable drinking water (Appendix 7 provided drinking water standards) (vi) Provide clean eating areas where workers are not exposed to hazardous or noxious substances (vii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers (viii) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions may be present. Ensure also that visitor/s do not enter hazard areas unescorted (ix) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas (x) Ensure moving equipment is outfitted with audible back-up alarms (xi) 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; and (xii) Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.	Construction Contractor	Part of civil works costs
Asbestos Cement (AC) Materials	Health risks associated with AC pipes	(i) leave AC pipes in-situ untouched	Construction Contractor	-
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during	(i) Restrict construction vehicle movements to defined access roads and demarcated working areas (unless in the event of an emergency)	Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	material and waste transportation	(ii) Enforce strict speed limit (20-30 kmph) for playing on unpaved roads, construction tracks (iii) Night-time driving will be by exception only, as approved by the PIU to minimize driving risk and disturbance to communities (iv) Adopt standard and safe practices for micro tunneling (v) Temporary traffic control (e.g. flagmen) and signs will be provided where necessary to improve safety and provide directions (vi) Temporary traffic control measures will be employed at road crossings and to reduce the risk of traffic accidents (vii) Where traffic is diverted around crossings, traffic control or careful selection of the exit from the working areas will be provided with the aim of ensuring that vehicles join the road in a safe manner. (viii) At sensitive locations where particularly where there are schools and markets close to the road, awareness of safety issues will be raised through neighborhood awareness meeting (ix) All drivers will undergo safety and training (x) Public access to all areas where construction works are on-going will be restricted through the use of barricading and security personnel (xi) Warning signs, blinkers will be attached to the barricading to caution the public about the hazards associated with the works, and presence of deep excavation (xii) The period of time when the pipeline trench are left open will be minimized through careful planning (xiii) Control dust pollution – implement dust control measures as suggested under air quality section (Para 104) (xiv) Ensure appropriate passage for pedestrians, provide a separate (xv) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. (xvi) Provide road signs and flag persons to warn of on-going trenching activities.		
Safety of sensitive groups (children, elders etc.) and others pedestrians in narrow streets	Trench excavation in in narrow streets will pose high risk to children and elders in the locality	(i) Provide prior information to the local people about the nature and duration of work (ii) Conduct awareness program in each neighborhood on safety during the construction work prior to the start of work (iii) Undertake the construction work stretch-wise; excavation, pipe laying and trench refilling should be completed on the same day as far as possible (iv) Provide safety barricades, and deploy security personnel to ensure safe movement of people and also to prevent unnecessary entry and to avoid accidental fall into open trenches	Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(v) Provide temporary planks over trenches where required to maintain the access		
Construction work camps	Temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants Unsanitary and poor living conditions for workers	(i) Select a camp site away from residential areas (at least 50 m buffer shall be maintained) or locate the camp site within the existing facilities of DJB (ii) Avoid tree cutting for setting up camp facilities (iii) Ensure that a proper compound wall is provided, and erect a wind/dust screen around the site as per the DPCC guidelines (i.e. 3 m or 1/10th of plot length whichever is higher) (iv) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas (v) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exits (vi) Provide proper temporary accommodation with proper materials, adequate lighting and ventilation, appropriate facilities for winters and summers; ensure conditions of liveability at work camps are maintained at the highest standards possible at all times (vii) Provide drinking water, water for other uses, and sanitation facilities for employees (viii) Provide cooking fuel (cooking gas) to workers (ix) Wastewater shall be disposed into sewer system with DJB prior permission if no sewer systems are available in the area, contractor should be provide a package sewage treatment plant for treatment and disposal of wastewater generated at the camp site (x) Train employees in the storage and handling of materials which can potentially cause soil contamination; (xi) Recover used oil and lubricants and reuse or remove from the site; (xii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (xiii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and (xiv) Environmentally restore the work sites to at least pre-project conditions; PIU to approve in writing that site is restored	Construction Contractor	Part of civil works costs
Submission of EMP implementation report	Unsatisfactory compliance to EMP	(i) Mobilization of EHS Supervisor to ensure EMP implementation (ii) Timely submission of monitoring reports including pictures	Construction Contractor	Part of civil works costs
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	(i) Remove all spoils wreckage, rubbish, or temporary structures (such as buildings, shelters, and latrines) which are no longer required (ii) All excavated roads shall be reinstated to original condition. (iii) All disrupted utilities restored	Construction Contractor	Part of civil works costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(iv) All affected structures rehabilitated/ compensated (v) 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. (vi) All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and regrassed (vii) The contractor must arrange the cancellation of all temporary services. (viii) Restore the work sites to pre-project conditions; PIU to approve in writing that site is restored (ix) Ensure that newly laid pipes are properly cleaned and disinfected prior to supplying water to consumers		

Table 13: Operation Stage Environmental Management Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Contamination of water supplies	Treated water pollution and impacts on public health	• Ensure that newly laid pipes are properly cleaned and disinfected prior to supplying water to consumers • Conduct regular water quality monitoring tests	DJB	-
Check for blockage and leakage problems reducing the water losses	Loss of water, increased demand and inconvenience to consumers & general public Water contamination	• Effective leak detection and water auditing to reduce the water losses	DJB	Operating costs
Increased in sewage generation	Water pollution, and impacts on public health and environment	• Sanitation facilities needs to be improved at community level and at the town level to meet the increased sewage demand	DJB	To be identified DJB
Occupational health and safety	Health, social and economic impacts on the workers	• Provide appropriate PPE to workers & training on its proper use • Use fall protection equipment when working at heights. • Maintain work areas to minimize slipping and tripping hazards. • Implement a training program for operators who work with chlorine regarding safe handling practices and emergency response procedures..	DJB	Operating costs
Public inconvenience & safety during repair and maintenance works	Traffic disruption, dust, safety risk etc	• As the work will be similar to laying of pipes, the issues will be similar, but confined to very small area where the repair work is being implemented	DJB	Operating costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		• Implement the measures as suggested in the construction stage EMP		

Table 14: Construction Stage Environmental Monitoring Plan

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost & Source of Funds
Construction disturbances, nuisances, public & worker safety,	All work sites	Implementation of dust control, noise control, traffic management, & safety measures.	Regularly as required during construction; checklist to be filled monthly once	Supervising staff and safeguards specialists	Part of TOR of PIU, PMC and PMU
Ambient air quality	4 locations (to be identified prior to start of work)	• PM10, PM2.5 NO2, SO2, CO, HC	Once before start of construction Monthly during construction (2 year construction period considered)	Construction Contractor	Contractor cost (part of BOQ items) 100 samples x 5000 per sample = INR 500,000
Ambient noise	4 locations (to be identified prior to start of work)	• Day time and night time noise levels (24 hours)	Once before start of construction Monthly during construction (2 year construction period considered)	Construction Contractor	Contractor cost (part of BOQ items) 100 samples x 1500 per sample = INR 150,000
Surface water quality	2 locations (locations to be selected prior to start of construction)	• pH, Oil & grease, Cl, F, NO3, TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalnity	Once before start of construction & Quarterly once during construction (24)	Construction Contractor	Contractor cost (part of BOQ items) 18 samples x 4000 per sample = INR 72,000

Table 15: Operation Stage Environmental Monitoring Plan

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost & Source of Funds
Monitoring of quality of water supplied to consumers	Consumer end-random sampling	Color, odor, taste, pH, Nitrite, Nitrate, Turbidity Total Alkalnity, Total coliform and Feacal coliform	Quarterly once	DJB	O&M costs

C. EMP Compliance Responsibilities

149. **PMU/PIU Responsibilities**. Safeguard Officer will be supported by PMC, which will be staffed with an Environmental Specialist. Key tasks and responsibilities of the PO (Environment) include the following:

Bidding stage:

(i) Prior to invitation of bids for civil works contract, ensure that
   a. Permission from ASI is obtained for laying of pipelines in the regulated areas of protected monuments if the pipelines are aligned within 300 m

(ii) Ensure that EMP is included in bidding documents and civil works contracts
(iii) Ensure that the bid/contract documents include specific provisions requiring contractors to comply with all applicable labor laws and core labor standards including:
   a. Labour welfare measures and provision of amenities
   b. prohibition of child labor as defined in national legislation for construction and maintenance activities;
   c. equal pay for equal work of equal value regardless of gender, ethnicity, or caste;
   d. elimination of forced labor;
   e. the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites.

(iv) Ensure that staff required for implementation of EMP (EHS officer) is included in the bid requirements
(v) Ensure that EMP cost is included in the project cost
(vi) In the pre-bid meeting, provide insight into the EMP requirements to the bidders

Construction stage:

(i) Facilitate and ensure that all necessary environmental clearances/permissions, including that of contractor's are in place prior to start of construction
(ii) Organize an induction course for the training of contractors, preparing them on EMP implementation, environmental monitoring, and on taking immediate action to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation.
(iii) Review and approve updated EMP, SEP prepared by contractor
(iv) Review and approve method statement, including TMP, CWMP & OHSP, prepared by contractor. Ensure that they are is revised and updated as required for each section.
(v) Guide contractor in finalizing sections for use of trenchless technology considering technical, environmental and social safeguard aspects
(vi) During the works, ensure that all the construction procedures adopted by Contractor are as per the method statement.
(vii) Oversee day-to-day implementation of EMPs by contractors, including compliance with all government rules and regulations, take necessary action for obtaining rights of way
(viii) Oversee environmental monitoring by contractors

(ix) Take corrective actions when necessary to ensure no environmental impacts
(x) Conduct continuous public consultation and awareness
(xi) Address any grievances brought about through the grievance redress mechanism in a timely manner as per the EMP
(xii) Consolidate monthly environmental monitoring reports of contractor and submit semi-annual monitoring reports to ADB
(xiii) Oversee site closures to ensure that all work / facility sites are restored properly prior to issuing work completion certificate to the contractor
(xiv) Ensure that the newly laid pipelines are properly cleaned and disinfected prior to supply of water to consumers

Contractor's responsibilities.

Bidding stage:

(i) Understand the EMP requirements and allocate necessary resources (budget, staff, etc.,)
(ii) Understand the regulatory compliance requirements related to labour welfare, safety, environment etc.,

Construction stage:

(i) Ensure that all regulatory clearances (both project related and contractor related) are in place before start of the construction work.
(ii) Mobilize EHS supervisor prior to start of work
(iii) Confirm with PIU availability of rights of way at all project sites prior to start of work.
(iv) Update EMP and prepare SEP
(v) Prepare Method Statement and get it approved prior to start of work
(vi) Prepare the following duly incorporating EMP measures, and submit to the PIU :
    a. Construction waste management (CWM) plan
    b. Traffic management (TM) plan
    c. Occupational Health & Safety (OHS) Plan
(vii) Implement the mitigation measures as per the EMP including CWM & TM Plans
(viii) Finalize sections for use of trenchless technology considering technical, environmental and social safeguard aspects with the coordination of PIU and PMC
(ix) Follow the EMP measures/guidelines for establishment of temporary construction camps, construction waste disposal sites, and material borrow areas, etc.,
(x) Implement EMP and ensure compliance with all the mitigation and enhancement measures
(xi) Conduct environmental monitoring (air, noise, water etc.,) as per the EMP
(xii) Undertake immediate action as suggested by PIU / PMU / PMC to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation
(xiii) Submit monthly Environmental Monitoring Reports on EMP implementation
(xiv) Act promptly on public complaints and grievances related to construction work and redress in a timely manner in coordination with PIU
(xv) Comply with applicable government rules and regulations
(xvi) Site clean-up and restoration including clean up and disinfection of pipelines prior to supply

D. Training Activities on EMP Implementation

150. The following Table presents the outline of capacity building program to ensure EMP implementation. The detailed cost and specific modules will be customized for the available skill set after assessing the capabilities of the target participants and the requirements of the project by the Environmental Specialist of the PMC.

Table 16: Outline Capacity Building Program on EMP Implementation

Description	Contents	Schedule	Participants
Pre-construction stage			
Orientation program .	- DWSIIP Environmental safeguard requirements - Implementation arrangement -monitoring & reporting -Corrective actions	½ day orientation workshop - at the start of the program	DJB, PMU, and PIU – all senior and mid-level officials and engineers involved in DWSSIP
Training program on EMP implementation & monitoring	Module 1 – Orientation - ADB SPS; - Government of India Environmental Laws and Regulations. Module 2 – Environmental Assessment Process. - Environmental process, identification of impacts and mitigation measures, formulation of an EMP, implementation, and monitoring requirements; - Review & approval of environmental assessment reports Module 3: EMP Implementation, monitoring & reporting - Incorporation of safeguard clauses and EMP in bid and contract documents -Pollution prevention and abatement (IFC EHS Guidelines) -.Monitoring & evaluation - Formulation of corrective action plans (CAP) -Reporting Module 4: Consultation & disclosure - Grievance redress mechanism	2 day training program - .prior to invitation of any bids for civil works under the Program	PMU & PIU staff
Construction stage			
Orientation program	- Contractual requirements -Legal & regulatory requirements -EHS requirements -Site Environment Plan (SEP) preparation, EMP implementation and reporting -roles and responsibilities	½ day orientation course to during mobilization	Contractors and PIU, PMC supervising staff
Training program/ workshop for contractors and supervisory staff.	- Environmental issues during construction; - Site specific SEP - EMP Implementation - Day to day monitoring	1 day workshop immediately after mobilization	Contractors and PIU, PMC supervising staff

Description	Contents	Schedule	Participants
	- Periodic ambient monitoring - Reporting -Consultation & grievance redress		
Periodic refresher training workshop	Same as above	½ day workshop thrice a year	Contractors and PIU, PMC supervising staff
Stakeholder workshop Experience and best practices sharing.	- Experience of EMP implementation – issues and challenges; - Best practices followed.	½ day workshop Once in a year during implementation	PMU, PIU, and stakeholder agencies (DPCC, PWD, Municipal Corporation, Delhi Police etc.,)

E. Monitoring and Reporting

151. Prior to commencement of the works, the contractor will submit a compliance report to PIU that all identified pre-construction mitigation measures as detailed in the EMP are undertaken. Contractor should confirm that the EHS supervisor is mobilized. PIU with the assistance of the PMC will review the report and permit commencement of works.

152. During construction, results from internal monitoring by the contractor will be reflected in their monthly EMP implementation reports to the PIU. PIU will review and advise contractors for corrective actions if necessary. A Semi-annual Environmental Monitoring Report summarizing compliance and corrective measures taken, will be prepared by PMC and submitted to PIU. PMU will submit to ADB the semi-annual (6-monthly) EMR. Once concurrence from the ADB is received the report will be disclosed on the DJB website.

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

F. EMP Implementation Cost

154. Most of the mitigation measures require the contractors to adopt good site practice, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. The costs which are specific to EMP implementation and are not covered elsewhere in the projects are given below. The total costs are estimated at INR 5.6 million, which are to be covered by contractor costs.

Table 17: Cost Estimates to Implement the EMP

	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
A.	**Implementation staff**						
1	EHS Supervisor	Construction	per month	24	75,000	1,800,000	Contractor
	Subtotal (A)					**1,800,000**	
B.	**Mitigation Measures**						
2	Provision for tree cutting & compensatory plantation measures	Construction	Lump sum			500,000	PIU
3	Traffic management at work sites (Pavement Markings, Channelizing Devices,	Construction	Lump sum	-	-	500,000	Contractor

	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
	Arrow Panels and Warning Lights)						
4	Barricading + dust screens	Construction	Per m	2000	400	800,000	Contractor
5	Plain cement concrete (PCC) layer on the trench immediately after the backfilling (1m wide & 0.1 m depth) – 50% length considered open trenching & 50% open cut	Construction	m3	5000	2500	1,250,000	Contractor
	Subtotal (B)					**3,050,000**	
C.	**Monitoring**						
1	Air quality	Construction	/ sample	100	5,000	500,000	Contractor
2	Noise levels	Construction	/ sample	100	1,500	150,000	Contractor
3	Surface water	Construction	/ sample	18	4,000	72,000	Contractor
	Subtotal (C)					**722,000**	
	Total (A+B+C)				**INR**	**5,572,000**	

IX. CONCLUSION AND RECOMMENDATIONS

155. The process described in this document has assessed the environmental impacts of all elements of the proposed Transmission Mains Improvement subproject for 11 UGR command areas located in the northern part of NCT Delhi. All potential impacts were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant.

156. Subproject include improvement of transmission mains and pumping systems, mainly focusing on increasing capacity, providing connectivity to reorganized Wazirabad WTP command area, and enhancing overall efficiency and coverage of the system. Subproject do not include any supply side measures (like water source augmentation, treatment etc.,) and therefore there are no impacts during operation envisaged. In the IEE the discussion focused mainly on construction phase activities, as water pipelines are not generally associated with any significant impacts during operation.

157. The subproject activities are mainly located in an urban area congested with traffic, pedestrians and activities. Moreover, many of the roads are high traffic roads and are abutted with busy with commercial establishments frequented by people. Measure to align the pipeline to minimize the impacts are suggested. Subproject area is located outside the historic Delhi Triangle, therefore the archeological potential of the area is low. There are two nationally protected monuments in the subproject area, one of which is located close to the proposed transmission main alignment. No impact envisaged on the monument, however, necessary precautions and prior approval of the competent authority included in the EMP.

158. During the construction phase, impacts mainly arise from the construction dust and noise; from the disturbance of residents, businesses, traffic and important buildings by the construction work, and from the need to dispose of large quantities of waste soil and import of construction material. The social impacts (access disruptions) due to construction activities are unavoidable, as the residential and commercial establishments exist along the roads where pipes will be laid. The baseline ambient air quality of Delhi is poor with high particulate matter and therefore the

generation of construction dust will further deteriorate the situation, though temporarily. Appropriate measures are suggested, including the use of documented procedures for construction and immediate restoration of road after the work. Furthermore, adoption of trenchless method will also be considered and at least 50% of the pipelines will be laid by this method. This method will greatly minimize the construction impacts like dust and associated impacts on health, socio economic activities, traffic disruptions, etc.

159. Anticipated impacts of water supply during operation and maintenance will be related to detection and repair of leaks, pipe bursts. These are, however, likely to be minimal, as proper design and selection of good quality pipe material shall mean that leaks are minimal. Leak repair work will be similar to the pipe-laying work.

160. The public participation processes undertaken during project design ensured 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.

161. The project's grievance redress mechanism will provide the citizens with a platform to redress of their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance.

162. The EMP will assist the PIU, PMC and the construction contractor in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project.

163. A copy of the EMP/approved SEP shall be kept on-site during the construction period at all times. The EMP shall be made binding on all contractors operating on the site, and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

164. The project will benefit the general public by contributing to the long-term improvement of water supply systems and community livability in the subproject area.

165. Therefore, as per ADB SPS, the project is classified as environmental category B and does not require further environmental impact assessment. However, to conform to government guidelines, the project requires prior permission of National Monument Authority for laying og pipelines near the protected monument. This permission shall be obtained prior to inviting bids for civil works.

166. This IEE shall be updated during the detailed design stage by the PMC to reflect final alignment, amendments and will be reviewed and approved by ADB.

Site Photographs

Shah Alam Tomb adjacent to the road

APPENDIX 1: RAPID ENVIRONMENTAL ASSESSMENT 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: Delhi Water Supply Improvement Investment Program – Subproject 2

Sector Division: SAUW

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the project area…			
▪ Densely populated?	√		Subproject area is located in Delhi, the Capital City of India. Subproject area is densely populated. There are no major negative impacts envisaged, because pipelines will be located in unused government lands alongside the existing roads , and implementation of best construction practices and measures will avoid the impacts
▪ Heavy with development activities?		√	
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site	√		Sheesh Mahal and Shah Alam Tomb, protected monuments, are is situated within the study area. Proposed pipeline is located close to the Shah Alam Tomb and located within 300 m from the boundary of the monument. These works will be taken up after due permission from the competent authority. No impacts however on the protected monument is envisaged.
• Protected Area		√	
• Wetland		√	
• Mangrove		√	
• Estuarine		√	
• Buffer zone of protected area		√	

SCREENING QUESTIONS	Yes	No	REMARKS
• 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?		√	Subproject deals with improvement of water transmission system. No source augmentation / rehabilitation components are part of the subproject. Water will continues to be supplied from an existing WTP, and the treated water quality meets the drinking water standards
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	-
▪ hazard of land subsidence caused by excessive ground water pumping?		√	-
▪ social conflicts arising from displacement of communities ?		√	No displacement of communities envisaged in the project
▪ conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		√	-
▪ unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		√	Water is treated prior to supply
▪ delivery of unsafe water to distribution system?		√	Monitoring of treated of water supplies at consumer end will be proposed
▪ inadequate protection of intake works or wells, leading to pollution of water supply?		√	-
▪ over pumping of ground water, leading to salinization and ground subsidence?		√	-
▪ excessive algal growth in storage reservoir?		√	-
▪ increase in production of sewage beyond capabilities of community facilities?	√		Sewerage system needs to be improved to cater to the increased demand
▪ inadequate disposal of sludge from water treatment plants?		√	Subproject scope is limited to improvement of distribution system
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	Pumping stations are located within the existing WTP compound of DJB. Site has adequate buffer and protected by compound wall
▪ impairments associated with transmission lines and access roads?		√	Subproject scope is limited to improvement of water transmission system
▪ health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		√	Subproject scope is limited to improvement of transmission system
▪ health and safety hazards to workers from the management of chlorine used for disinfection and other contaminants?		√	Subproject scope is limited to improvement of transmission system
▪ dislocation or involuntary resettlement of people		√	No dislocation or involuntary resettlement envisaged
▪ social conflicts between construction workers from other areas and community workers?	√		Maximizing the use of local labour, and appropriate location of labour camps will avoid the conflicts

SCREENING QUESTIONS	Yes	No	REMARKS
▪ noise and dust from construction activities?	√		Dust and noise control measures will be implemented
▪ increased road traffic due to interference of construction activities?	√		Traffic management plan will be prepared and implemented
▪ continuing soil erosion/silt runoff from construction operations?	√		Erosion control measures will be implemented
▪ delivery of unsafe water due to poor O&M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?		√	-
▪ delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		√	-
▪ accidental leakage of chlorine gas?		√	-
▪ excessive abstraction of water affecting downstream water users?		√	-
▪ competing uses of water?		√	-
▪ increased sewage flow due to increased water supply	√		Sewerage system needs to be improved to cater to the increased demand
▪ increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant	√		Sewerage system needs to be improved to cater to the increased demand

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?	√		Falls in high risk seismic zone; design takes into consideration the seismic zoning
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)?		√	Subproject includes only distribution network system
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)?		√	No
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)?		√	No

APPENDIX 2: NATIONAL AMBIENT AIR QUALITY STANDARDS

SL NO:	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas	
1	Sulphur Dioxide (SO_2) $\mu g/m^3$	Annual 24 hours	50 80	20 80	Improved West and Geake-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2) $\mu g/m^3$	Annual 24 hours	40 80	30 80	Modified Jacob &Hochheiser (Na-Arsenite) Chemiluminescence
3	Particulate Matter (Size less than 10 µm) or PM10 $\mu g/m^3$	Annual 24 hours	60 100	60 100	Gravimetric -TOEM -Beta attenuation
4	Particulate Matter (Size less than 2.5 µm) or PM2.5 $\mu g/m^3$	Annual 24 hours	40 60	40 60	Gravimetric -TOEM -Beta attenuation
5	Carbon Monoxide (CO) mg/m^3	8 hours 1 hours	02 04	02 04	Non Dispersive Infra Red (NDIR) Spectroscopy

APPENDIX 3: VEHICLE EXHAUST EMISSION NORMS

1. Passenger Cars

Norms	CO(g/km)	HC+ NOx(g/km)
1991Norms	14.3-27.1	2.0(Only HC)
1996 Norms	8.68-12.40	3.00-4.36
1998Norms	4.34-6.20	1.50-2.18
India stage 2000 norms	2.72	0.97
Bharat stage-II	2.2	0.5
Bharat Stage-III	2.3	0.35 (combined)
Bharat Stage-IV	1.0	0.18 (combined)

2. Heavy Diesel Vehicles

Norms	CO(g/kmhr)	HC (g/kmhr)	NOx (g/kmhr)	PM(g/kmhr)
1991Norms	14	3.5	18	-
1996 Norms	11.2	2.4	14.4	-
India stage 2000 norms	4.5	1.1	8.0	0.36
Bharat stage-II	4.0	1.1	7.0	0.15
Bharat Stage-III	2.1	1.6	5.0	0.10
Bharat Stage-IV	1.5	0.96	3.5	0.02

Source: Central Pollution Control Board

CO = Carbon Monixide; g/kmhr = grams per kilometer-hour; HC = Hydrocarbons; NOx = oxides of nitrogen; PM = Particulates Matter

APPENDIX 4: NATIONAL AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE

Area code	Category of area/zone	Limit in dB (A)	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

APPENDIX 5: EXTRACT FROM CONSTRUCTION & DEMOLITION MANAGEMENT RULES, 2016

[Published In the Gazette of India, Part-II, Section-3, Sub-section (ii)]
Ministry of Environment, Forest and Climate Change

NOTIFICATION

New Delhi, the 29th March, 2016

G.S.R. 317(E).-Whereas the Municipal Solid Wastes (Management and Handling) Rules, 2000 published vide notification number S.O. 908(E), dated the 25th September, 2000 by the Government of India in the erstwhile Ministry of Environment and Forests, provided a regulatory frame work for management of Municipal Solid Waste generated in the urban area of the country;

And whereas, to make these rules more effective and to improve the collection, segregation, recycling, treatment and disposal of solid waste in an environmentally sound manner, the Central Government reviewed the existing rules and it was considered necessary to revise the existing rules with a emphasis on the roles and accountability of waste generators and various stakeholders, give thrust to segregation, recovery, reuse, recycle at source, address in detail the management of construction and demolition waste.

And whereas, the draft rules, namely, the Solid Waste Management Rules, 2015 with a separate chapter on construction and demolition waste were published by the Central Government in the Ministry of Environment, Forest and Climate Change vide G.S.R. 451 (E), datedthe 3rd June, 2015 inviting objections or suggestions from the public within sixty days from the date of publication of the said notification;

And Whereas, the objections or suggestions received within the stipulated period were duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sections 6, 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Municipal Solid Wastes (Management and Handling) Rules, 2000, except as respect things done or omitted to be done before such supersession, the Central Government hereby notifies the following rules for Management of Construction and Demolition Waste –

1. Short title and commencement.-(1) These rules shall be called the Construction and Demolition Waste Management Rules, 2016.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Application.-The rules shall apply to every waste resulting from construction, re-modeling, repair and demolition of any civil structure of individual or organisation or authority who generates construction and demolition waste such as building materials, debris, rubble.

3. Definitions –(1) In these rules, unless the context otherwise requires,-

(a) " ACT' means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "**construction**" means the process of erecting of building or built facility or other structure, or

building of infrastructure including alteration in these entities,;

(c) "**construction and demolition waste**" means the waste comprising of building materials, debris and rubble resulting from construction, re-modeling, repair and demolition of any civil structure;

(d) **"de-construction"** means a planned selective demolition in which salvage, re-use and recycling of the demolished structure is maximized;

(e) **"demolition"** means breaking down or tearing down buildings and other structures either manually or using mechanical force (by various equipment) or by implosion using explosives.

(f) **"form" means a Form annexed to these rules;**

(g) **"local authority"** means an urban local authority with different nomenclature such as municipal corporation, municipality, nagarpalika, nagarnigam, nagarpanchayat, municipal council including notified area committee and not limited to or any other local authority constituted under the relevant statutes such as gram panchayat, where the management of construction and demolition waste is entrusted to such agency;

(h) **" schedule"** means a schedule annexed to these rules;

(i) **"service provider'** means authorities who provide services like water, sewerage, electricity, telephone, roads, drainage etc. often generate construction and demolition waste during their activities, which includes excavation, demolition and civil work;

(j) **"waste generator" means any person or association of persons** or institution, residential and commercial establishments including Indian Railways, Airport, Port and Harbour and Defence establishments who undertakes construction of or demolition of any civil structure which generate construction and demolition waste.

(2) Words and expressions used but not defined herein shall have the same meaning defined in the ACT.

(4) Duties of the waste generator -

(1) Every waste generator shall prima-facie be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed or notified by the concerned local authority in consonance with these rules.

(2) The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed separately.

(3) Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work and keep the concerned

authorities informed regarding the relevant activities from the planning stage to the implementation stage and this should be on project to project basis.

(4) Every waste generator shall keep the construction and demolition waste within the premise or get the waste deposited at collection centre so made by the local body or handover it to the authorised processing facilities of construction and demolition waste; and ensure that there is no littering or deposition of construction and demolition waste so as to prevent obstruction to the traffic or the public or drains.

(5) Every waste generator shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities; Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall have to pay for the processing and disposal of construction and demolition waste generated by them, apart from the payment for storage, collection and transportation. The rate shall be fixed by the concerned local authority or any other authority designated by the State Government.

(5) Duties of service provider and their contractors -

(1) The service providers shall prepare within six months from the date of notification of these rules, a comprehensive waste management plan covering segregation, storage, collection, reuse, recycling, transportation and disposal of construction and demolition waste generated within their jurisdiction.

(2) The service providers shall remove all construction and demolition waste and clean the area every day, if possible, or depending upon the duration of the work, the quantity and type of waste generated, appropriate storage and collection, a reasonable timeframe shall be worked out in consultation with the concerned local authority.

(3) In case of the service providers have no logistics support to carry out the work specified in sub-rules (1) and (2) , they shall tie up with the authorised agencies for removal of construction and demolition waste and pay the relevant charges as notified by the local authority.

(6) Duties of local authority-The local authority shall,-

(1) issue detailed directions with regard to proper management of construction and demolition waste within its jurisdiction in accordance with the provisions of these rules and the local authority shall seek detailed plan or undertaking as applicable, from generator of construction and demolition waste;

(2) chalk out stages, methodology and equipment, material involved in the overall activity and final clean up after completion of the construction and demolition ;

(3c) seek assistance from concerned authorities for safe disposal of construction and demolition waste contaminated with industrial hazardous or toxic material or nuclear waste if any;

(4) shall make arrangements and place appropriate containers for collection of waste and shall remove at regular intervals or when they are filled, either through own resources or by appointing private operators;

(5) shall get the collected waste transported to appropriate sites for processing and disposal either through own resources or by appointing private operators;

(6) shall give appropriate incentives to generator for salvaging, processing and or recycling preferably in-situ;

(7) shall examine and sanction the waste management plan of the generators within a period of one month or from the date of approval of building plan, whichever is earlier from the date of its submission;

(8) shall keep track of the generation of construction and demolition waste within its jurisdiction and establish a data base and update once in a year;

(9) shall device appropriate measures in consultation with expert institutions for management of construction and demolition waste generated including processing facility and for using the recycled products in the best possible manner;

(10) shall create a sustained system of information, education and communication for construction and demolition waste through collaboration with expert institutions and civil societies and also disseminate through their own website;

(11) shall make provision for giving incentives for use of material made out of construction and demolition waste in the construction activity including in non-structural concrete, paving blocks, lower layers of road pavements, colony and rural roads.

(7) Criteria for storage, processing or recycling facilities for construction and demolition waste and application of construction and demolition waste and its products-

(1) The site for storage and processing or recycling facilities for construction and demolition waste shall be selected as per the criteria given in **Schedule I**;

(2) The operator of the facility as specified in sub- rules (1) shall apply in **Form I** for authorization from State Pollution Control Board or Pollution Control Committee.

(3) The operator of the facility shall submit the annual report to the State Pollution Control Board in **Form II.**

(3) Application of materials made from construction and demolition waste in operation of sanitary landfill shall be as per the criteria given in **Schedule II.**

(8) Duties of State Pollution Control Board or Pollution Control Committee-

(1) State Pollution Control Board or Pollution Control Committee shall monitor the implementation of these rules by the concerned local bodies and the competent authorities and the annual report shall be sent to the Central Pollution Control Board and the State Government or Union Territory or any other State level nodal agency identified by the State Government or Union Territory administration for generating State level comprehensive data. Such reports shall also contain the comments and suggestions of the State Pollution Control Board or Pollution Control Committee with respect to any comments or changes required;

(2) State Pollution Control Board or Pollution Control Committee shall grant authorization to construction and demolition waste processing facility in **Form-III** as specified under these rules after examining the application received in **Form I**;

(3) State Pollution Control Board or Pollution Control Committee shall prepare annual report in **Form IV** with special emphasis on the implementation status of compliance of these rules and forward report to Central Pollution Control Board before the 31st July for each financial year.

(9) Duties of State Government or Union Territory Administration-

(1) The Secretary in-charge of development in the State Government or Union territory administration shall prepare their policy document with respect to management of construction and demolition of waste in accordance with the provisions of these rules within one year from date of final notification of these rules.

(2) The concerned department in the State Government dealing with land shall be responsible for providing suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition waste.

(3) The Town and Country planning Department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long term basis.

(4) Procurement of materials made from construction and demolition waste shall be made mandatory to a certain percentage (say 10-20%) in municipal and Government contracts subject to strict quality control.

(10) Duties of the Central Pollution Control Board - (1) The Central Pollution Control Board shall,-

(a) prepare operational guidelines related to environmental management of construction and demolition waste management;

(b) analyze and collate the data received from the State Pollution Control Boards or Pollution Control Committee to review these rules from time to time;

(c) coordinate with all the State Pollution Control Board and Pollution Control Committees for any matter related to development of environmental standards;

(d) forward annual compliance report to Central Government before the 30th August for each financial year based on reports given by State Pollution Control Boards of Pollution Control Committees.

(11) Duties of Bureau of Indian Standards and Indian Roads Congress -The Bureau of Indian Standards and Indian Roads Congress shall be responsible for preparation of code of practices and standards for use of recycled materials and products of construction and demolition waste in respect of construction activities and the role of Indian Road Congress shall be specific to the standards and practices pertaining to construction of roads.

Schedule III
Timeframe for Planning and Implementation
[See Rule 13]

Sl. No.	Compliance Criteria	Cities with population of 01 million and above	Cities with population of 0.5-01 million	Cities with population of less than 0.5 million
1	Formulation of policy by State Government	12 months	12 months	12 months
2	Identification of sites for collection and processing facility	18 months	18 months	18 months
3	Commissioning and implementation of the facility	18 months	24 months	36 months
4	Monitoring by SPCBs	3 times a year – once in 4 months	2 times a year – once in 6 months	2 times a year – once in 6 months

The time Schedule is effective from the date of notification of these rules.

FORM – I
See [Rule 7 (2)]
Application for obtaining authorisation

To,
The Member Secretary

_____Name of the local authority or Name of the agency : appointed by the municipal authority

Correspondence address Telephone No. Fax No.	
Nodal Officer and designation (Officer authorized by the competent authority or agency responsible for operation of processing or recycling or disposal facility)	
Authorisation applied for (Please tick mark)	Setting up of processing or recycling facility of construction and demolition waste
Detailed proposal of construction and demolition waste processing or recycling facility to include the following Location of site approved and allotted by the Competent Authority. Average quantity (in tons per day) and composition of construction and demolition waste to be handled	

APPENDIX 6: SALIENT FEATURES OF MAJOR LABOR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN CONSTRUCTION OF CIVIL WORKS

(this list is indicative only, contractor should check all applicable laws that are in force during contractor period)

(i) Workmen Compensation Act, 1923 - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

(ii) Payment of Gratuity Act, 1972 - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

(iii) Employees' PF and Miscellaneous Provisions Act, 1952 - The Act provides for monthly contributions by the employer plus workers @10 % or 8.33 %. The benefits payable under the Act are: (a) Pension or family pension on retirement or death as the case may be; (b) deposit linked insurance on the death in harness of the worker; (c) payment of PF accumulation on retirement/death etc.

(iv) Maternity Benefit Act, 1951 - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

(v) Contract Labour (Regulation and Abolition) Act, 1970 - The Act provides for certain welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same are required to be provided by the Principal Employer by Law. The principal employer is required to take Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act is applicable to the establishments or Contractor of principal employer if they employ 20 or more contract labor.

(vi) Minimum Wages Act, 1948 - The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employment.

(vii) Payment of Wages Act, 1936 - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

(viii) Equal Remuneration Act, 1979 - The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees in the matters of transfers, training and promotions etc.

(ix) Payment of Bonus Act, 1965 - The Act is applicable to all establishments employing 20 or more workmen. The Act provides for payments of annual bonus subject to a minimum of 8.33 % of wages and maximum of 20 % of wages to employees drawing Rs. 3,500/- per month or less. The bonus to be paid to employees getting Rs. 2,500/- per month or above up to Rs.3,500/- per month shall be worked out by taking wages as Rs.2,500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of the Act.

(x) Industrial Disputes Act, 1947 - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(xi) Industrial Employment (Standing Orders) Act, 1946 - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.

(xii) Trade Unions Act, 1926 - The Act lays down the procedure for registration of trade unions of workmen and employees. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities.

(xiii) Child Labor (Prohibition and Regulation) Act, 1986 - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labor is prohibited in Building and Construction Industry.

(xiv) Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 - The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The inter-state migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc

(xv) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996 - All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay Cess at rate not exceeding 2% of the cost of construction as may be notified by the Government. The employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for workers near the workplace etc. The employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

APPENDIX 7: DRINKING WATER STANDARDS

No.	Substance or characteristic	Indian Standards				WHO Guideline
		Requirement Desirable limit	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate Source	Remarks	
	Essential Characteristics					
1.	Color Hazen Units, Max	5	Above 5, consumer acceptance decreases	25	Extended to 25 only if toxic Substance are not suspect in absence of alternate sources	
2.	Odour	Unobjectionable	-	-	a) test cold and when heated b) test are several dilutions	
3.	Taste	Agreeable	-	-	Test to be conducted only after safety has been established	
4.	Turbidity (NTU) Max	5	Above 5, consumer acceptance decreases	10	-	1 NTU
5.	pH value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and/or water supply system	No relaxation	-	6.5 – 8.5
6.	Total Hardness (mg/L) CaCO3	300	Encrustation in water supply structure and adverse effects on domestic use	600	-	200 mg/l
7.	Iron (mg/L, Fe) Max	0.3	Beyond this limit taste/appearance are affected; has adverse effects on domestic uses and water supply structure and promotes iron bacteria	1.0	-	0.3 mg/l
8.	Chlorides 250 (mg/L, Cl) Max	250	Beyond this limit taste, corrosion and palatability are affected.	1000	-	
9.	Residual free Chlorine (mg/L), Max	0.2	-	-	To be applicable only when water is chlorinated. Tested at customer end. When protection	0.2 mg/l

No.	Substance or characteristic	Indian Standards				WHO Guideline
		Requirement Desirable limit	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate Source	Remarks	
					against viral infection is required, it should be min. 0.5 mg/L.	
	Desirable Characteristics					
10.	Dissolved solids mg/L. Max	500	Beyond this, palatability decreases and may cause gastrointestinal irritation.	2000	-	
11.	Calcium (mg/L, Ca) Max.	75	Encrustation in water supply structure and adverse effects on domestic use.	200	-	
12.	Magnesium (mg/L, Mg) Max	30	Encrustation in water supply structure and adverse effects on domestic use.	100	-	
13.	Copper (mg/L, Cu) Max	0.05	Astringent taste dis coloration and corrosion of pipes fittings and utensils will be caused beyond this.	1.5	-	
14.	Manganese (mg/L, Mn) Max	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic use and water supply structure	0.3	-	0.1 mg/l
15.	Sulphate (mg/L, SO4) Max.	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400	May be extended up to 400 provided magnesium (as Mg) does not exceed 30	250 mg/l
16.	Nitrate (mg/L, NO3) Max.	45	Beyond this methaemo globinemia takes place.	100	-	50 mg/l
17.	Fluoride (mg/L, F) Max.	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis.	1.5	-	1.5 mg/l
18.	Phenolic Compounds (mg/L C6H5OH) Max.	0.001	Beyond this, it may cause objectionable taste and odour	0.002	-	

No.	Substance or characteristic	Indian Standards				WHO Guideline
		Requirement Desirable limit	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate Source	Remarks	
19.	Mercury (mg/L Hg) Max	0.001	Beyond this the water becomes toxic	No Relaxation.	To be tested when pollution is suspected	0.006 mg/l
20	Cadmium (mg/L, Cd) Max	0.003	Beyond this the water becomes toxic	No Relaxation.	To be tested when pollution is suspected	0.003 mg/l
21.	Selenium (mg/L, Se) Max	0.01	Beyond this the water becomes toxic.	No Relaxation.	To be tested when pollution is suspected	0.04 mg/l
22.	Arsenic (mg/L, As) Max.	0.01	Beyond this the water becomes toxic	No Relaxation	To be tested when pollution is suspected	0.01 mg/l
23.	Cyanide	0.05	Beyond this the water becomes toxic	No Relaxation	To be tested when pollution is suspected	
24.	Lead (mg/L Pb) Max.	0.01	Beyond this the water becomes toxic	No Relaxation	To be tested when pollution is suspected	0.01 mg/l
25.	Zinc (mg/L, Zn) Max.	5	Beyond this limit it can cause astringent taste and an opalescence in water	15	To be tested when pollution is suspected	4 mg/l
26.	Anionic detergents (mg/L, MBAS) Max	0.2	Beyond this limit it can cause a light froth in water	1.0	To be tested when pollution is suspected	
27.	Chromium (mg/L, Cr6+	0.05	May be carcinogenic above this limit	-	-	0.05 mg/l
28.	Polynuclear Aromatic Hydrocarbons (mg/l, PAH) Max	-	May be carcinogenic	-	-	
29.	Mineral oil (mg/L)	0.01	Beyond this limit, undesirable taste and odour after chlorination takes place	0.03	To be tested when pollution is suspected	
30.	Pesticides (mg/L) max	Absent	Toxic	0.001	-	
	Radioactive materials					
31.	Alpha emitters Bq/L Max	-	-	0.1	-	
32.	Beta emitters Pci/L Max	-	-	1.0	-	
33.	Alkalinity (mg/L,) Max	200	Beyond this limit, taste becomes unpleasant	600	-	
34.	Aluminum (mg/L, Al) Max	0.03	Cumulative effect is reported to cause dementia	0.2		
35.	Boron (mg/L) Max	1.0	-	5.0	-	2.4 mg/l

APPENDIX 8: SAMPLE OUTLINE SPOILS (CONSTRUCTION WASTE) MANAGEMENT PLAN

1. The Spoil Management Plan should be site specific and be part of the monthly Construction Management Plan.
2. The contractor, in consultation with the PIU, has to find out appropriate location/s for the disposal of the excess soil generated. The spoils should be deposited only at these sites.
3. Further precautions need to be taken in case of the contaminated spoils
4. The vehicle carrying the spoil should be covered properly.
5. The spoils generating from each site should be removed on the same day or immediately after the work is complete. The site / road should be restored to the original condition.

I. Spoils information

The spoil information contains the details like a) The type / material, b) Potential contamination by that type, c) Expected volume (site / component specific), d) Spoil Classification etc.

II. Spoils management

The Spoil Management section gives the details of a) Transportation of spoil b) disposal site details c) Precautions taken d) Volume of contaminated spoil, if present, d) Suggested reuse of disposal of the spoil

III. Documentation

The volume of spoil generated (site specific, date wise), site disposed, reuse / disposal details should be documented properly.

APPENDIX 9: SAMPLE OUTLINE TRAFFIC MANAGEMENT PLAN

A. Principles for TMP around the Water Pipes Construction Sites

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

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

B. Operating Policies for TMP

2. The following principles will help promote safe and efficient movement for all road users (motorists, bicyclists, and pedestrians, including persons with disabilities) through and around work zones while reasonably protecting workers and equipment.

(i) Make traffic safety and temporary traffic control an integral and high-priority element of project from planning through design, construction, and maintenance.
(ii) Inhibit traffic movement as little as possible.
(iii) Provide clear and positive guidance to drivers, bicyclists, and pedestrians as they approach and travel through the temporary traffic control zone.
(iv) Inspect traffic control elements routinely, both day and night, and make modifications when necessary.
(v) Pay increased attention to roadside safety in the vicinity of temporary traffic control zones.
(vi) Train all persons that select, place, and maintain temporary traffic control devices.
(vii) Keep the public well informed.
(viii) Make appropriate accommodation for abutting property owners, residents, businesses, emergency services, railroads, commercial vehicles, and transit operations.

3. **Figure A9.2 to Figure A9.6** illustrates the operating policy for TMP for the construction of water pipes and the sewers along various types of roads.

C. Analyze the impact due to street closure

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

(i) approval from the ULB/Public Works Department (PWD) to use the local streets as detours;
(ii) consultation with businesses, community members, traffic police, PWD, etc, regarding the mitigation measures necessary at the detours where the road is diverted during the construction;
(iii) determining of the maximum number of days allowed for road closure, and incorporation of such provisions into the contract documents;
(iv) determining if additional traffic control or temporary improvements are needed along the detour route;
(v) considering how access will be provided to the worksite;

(vi) contacting emergency service, school officials, and transit authorities to determine if there are impacts to their operations; and

(vii) developing a notification program to the public so that the closure is not a surprise. As part of this program, the public should be advised of alternate routes that commuters can take or will have to take as result of the traffic diversion.

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

Figure A9.1: Policy Steps for the TMP

D. Public awareness and notifications

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

7. The awareness campaign and the prior notification for the public will be a continuous activity which the project will carry out to compensate for the above delays and minimize public claims as result of these problems. These activities will take place sufficiently in advance of the time when the roadblocks or traffic diversions take place at the particular streets. The reason for

this is to allow sufficient time for the public and residents to understand the changes to their travel plans. The project will notify the public about the roadblocks and traffic diversion through public notices, ward level meetings and city level meeting with the elected representatives.

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

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

9. It may be necessary to conduct the awareness programs/campaigns on road safety during construction.

10. The campaign will cater to all types of target groups i.e. children, adults, and drivers. Therefore, these campaigns will be conducted in schools and community centres. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the area and will also be available at the PIU, and the contractor's site office. The text of the brochure should be concise to be effective, with a lot of graphics. It will serve the following purpose:

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

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

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

(i) Signs
(ii) Pavement Markings
(iii) Channelizing Devices
(iv) Arrow Panels
(v) Warning Lights

12. Procedures for installing traffic control devices at any work zone vary, depending on road configuration, location of the work, construction activity, duration, traffic speed and volume, and pedestrian traffic. Work will take place along major roads, and the minor internal roads. As such, the traffic volume and road geometry vary. The main roads carry considerable traffic; internal roads in the new city areas are wide but in old city roads very narrow and carry considerable traffic. However, regardless of where the construction takes place, all the work zones should be cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary “STOP” and “GO”).

13. Figure A10.2 to Figure A10.6 illustrates a typical set-up for installing traffic control devices at the work zone of the area, depending on the location of work on the road way, and road geometrics:

(i) Work on shoulder or parking lane
(ii) Shoulder or parking lane closed on divided road
(iii) Work in Travel lane
(iv) Lane closure on road with low volume
(v) Street closure with detour

14. The work zone should take into consideration the space required for a buffer zone between the workers and the traffic (lateral and longitudinal) and the transition space required for delineation, as applicable. For the works, a 30 cm clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 cm is necessary to install the temporary traffic signs and cones.

15. Traffic police should regulate traffic away from the work zone and enforce the traffic diversion result from full street closure in certain areas during construction. Flagggers/ personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type) for regulating the traffic during night time.

16. In addition to the delineation devices, all the construction workers should wear fluorescent safety vests and helmets in order to be visible to the motorists at all times. There should be provision for lighting beacons and illumination for night constructions.

Figure A9.2 & A9.3: Work on shoulder or parking lane & Shoulder or parking lane closed on divided road

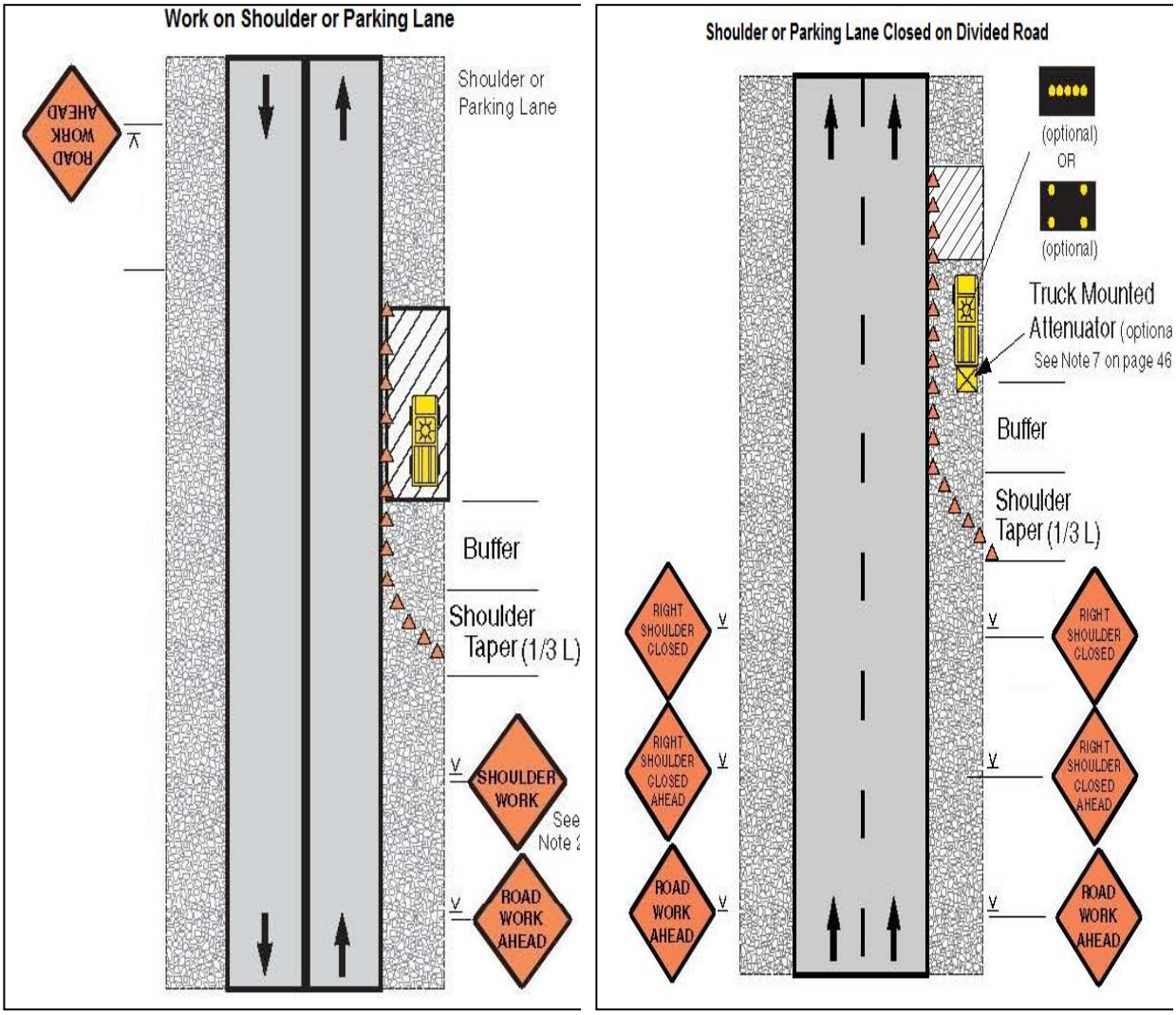


Figure A9.4 & A9.5: Work in Travel lane & Lane closure on road with low volume

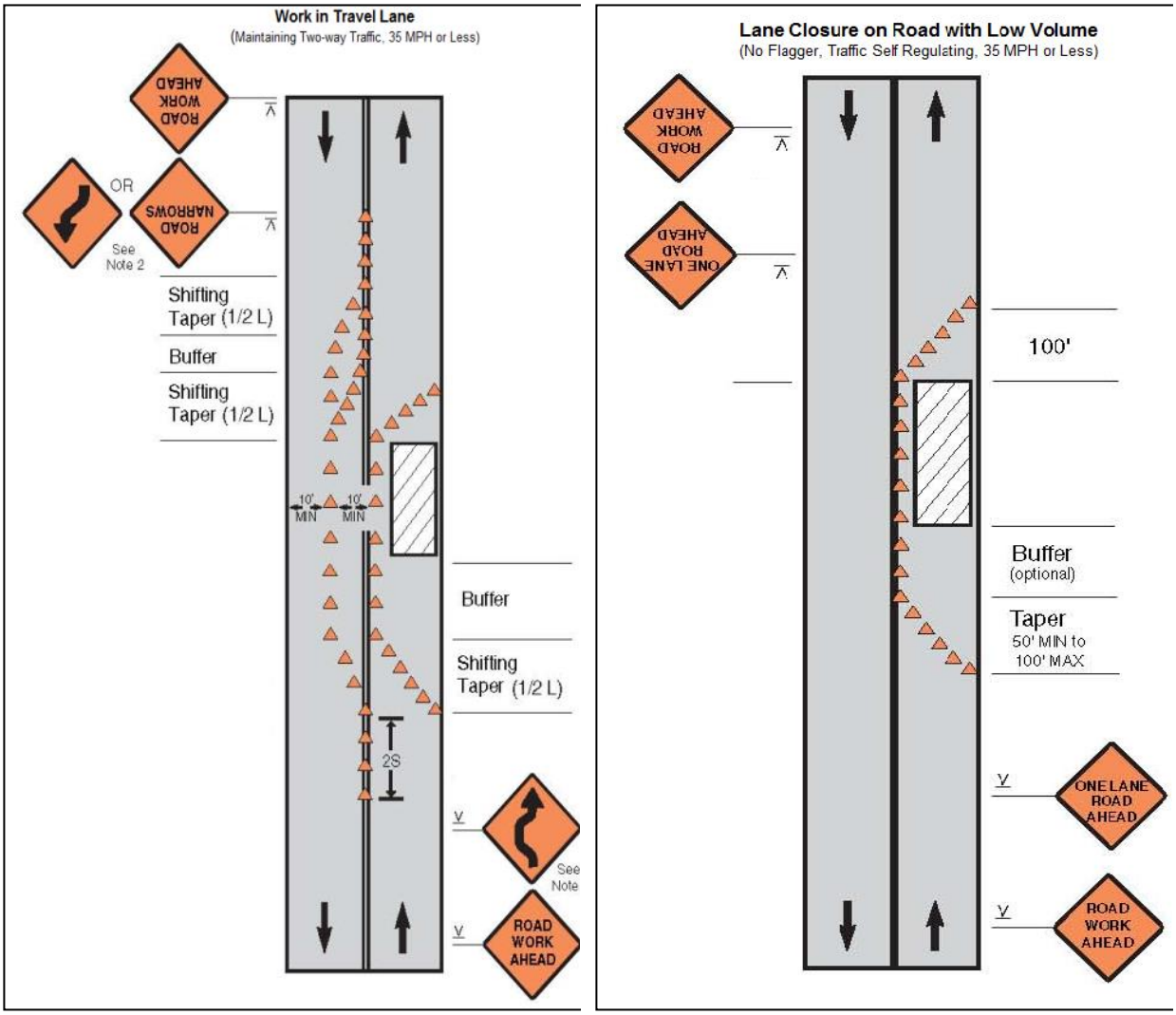


Figure A9.6: Street closure with detour